KARPAGAM ACADEMY OF HIGHER EDUCATION

Deemed to be University

(Established Under Section 3 of UGC Act 1956)

Eachanari Post,Pollachi Main Road,Coimbatore -641021

COURSE OF STUDY AND SCHEME OF EXAMINATION

M.Phil. & Ph.D. COURSE IN ASTROLOGY

2019-2020

PART-I COURSE WORK SYLLABUS FOR M.Phil. & Ph.D COURSE IN ASTROLOGY - (2019-2020)

SI.NO	TITLE OF THE COURSE	NO.OF THE SUBJECT	CREDIT	EXAM HOURS	MARKS
1.	PAPER I	01	4	3	100
2	PAPER II	01	4	3	100
3	PAPER III	01	4	3	100
	TOTAL	03	12	9	300

PART-I COURSE WORK SYLLABUS FOR Ph.D COURSE IN ASTROLOGY (2019-2020)

SUB.CODE	TITLE OF THE COURSE	NO.OF THE SUBJECT	CREDIT	EXAM HOURS	MARKS
PAPER-I (COMPULSORY)					
19RAS101	RESEARCH METHODOLOGY	01	4	3	100
PAPER –II (COMPULSORY)					
19RAS201	PREDICTION ASTROLOGY	01	4	3	100
PAPER-III (ANY ONE)					
19RAS301	HISTORY OF ASTROLOGY	01	4	3	100
19RAS302	ASTROLOGY PREDICTIONS IN K.P METHOD	01	4	3	100
19RAS303	WESTERN ASTROLOGY	01	4	3	100
19RAS304	MARRIAGE MATCHING	01	4	3	100
19RAS305	CASE STUDIES IN HOROSCOPE	01	4	3	100

KARPAGAM ACADEMY OF HIGHER EDUCATION
M.Phil/Ph.D. ASTROLOGY
Paper – I RESEARCH METHODOLOGY
EFFECTIVE FROM ACADEMIC YEAR 2019-2020

நோக்கங்கள்

1. ஆய்வேட்டின் கட்டமைப்பை புரிந்துக் கொள்வது.
2. ஆய்வாளனுக்குரிய தகுதியை புரிந்துக் கொள்வது.
3. ஆய்வு சிக்கலை புரிந்துக் கொள்வது.
4. கள ஆய்வை பற்றி தெரிந்துக் கொள்வது.
5. ஆய்வின் வகைகளை தெரிந்துக் கொள்வது.
6. ஆய்வின் நெறிமுறைகளை புரிந்துக் கொள்வது.

பயன்கள்

1. ஆய்வேட்டினை உருவாக்க உறுதுணையாக விளங்கும்.
2. ஆய்வேட்டை உருவாக்க பல்வகை நிலைகளை புரிந்துக் கொள்ள பயன்படும்.
3. நேர்காணல், வினாநிரல் ஆகியவற்றை செய்வதற்கு பயன்படும்.
4. கற்றலில் உள்ள படிநிலைகள், கற்பித்தலில் உள்ள படி நிலைகள்ஆகியவற்றை புரிந்துக் கொள்ள பயன்படும்.
5. கல்வித்துறையில் நுட்பங்கள் பற்றிய அறிவு கிடைக்கும்.
6. பல்வேறு வகையான கருத்தரங்குகளில் கலந்துக் கொள்ள பயன்படும்

அலகு : 1

ஆய்வு என்பதன் விளக்கம் - ஆய்வாளனுக்குரிய தகுதிகளும் உளப்பாங்கும் - ஆய்வுக்குரிய களம் - ஆய்வு நோக்கினைச் சுட்டல் - ஆய்வுச் சிக்கல் - ஆராயும் பொருள் பற்றி தெளிதல் - ஆய்வுப் பொருள் பற்றி அதுவரை செய்யப்பட்ட ஆய்வுகள் பற்றிய தொகுப்புரையும் மதிப்பிடும்.

அலகு : 2

முதன்மைக் கூறுகள் (Primary Sources) துணை நிலைக் கூறுகள் (Secondary Sources) இவற்றைத் தொகுத்தலும் பகுத்தலும் - பல்வேறு தொகுப்பு முறைகள் - நேர்காணல் - வினாத்தொகுதி (Questionaire) மாதிரிகள் (Samples) முதலியவை பற்றிய விளக்கம் கன ஆய்வு வகைகள் - கள ஆய்வுக்குத் தேவையான பொருட்கள் - கள ஆய்வில் ஈடுபடுவோர் தகுதிகள் - நேர்காணல். வினாநிரல் ஆகியவற்றின் விளக்கம் - எழுத்து பட ஆதாரம் - புகைப்படம், திரைப்படம், நாடா ஒலிப்பதிவு, ஓவியம், அரும் பொருள்கள் ஆகியவற்றைப் பயன்படுத்தும் முறைகள்.

அலகு : 3

ஆய்வு நெறிமுறைகள் வகைகள் - ஆய்வேட்டை உருவாக்கும் பல்வகை நிலைகள் மாதிரி வரைவு – பொறியாளர் அறிஞர்களின் கருத்தறிதல் - கலந்துரையாடல், மாதிரி வரைவை மறுபார்வை செய்தல் - திருத்தல் - செம்மையாக்கல்- ஆய்வேட்டின் அமைப்பு – பகுதிகள் - இயல் பிரிப்பு – சுருக்கக் குறியீடு, அடிக்குறிப்புகள், அட்டவணை, விளக்கப்படங்கள், பின்னிணைப்பு முதலியன- ஆய்வேட்டின் கட்டமைப்பும் புறத்தோற்றமும்.

அலகு : 4

உயர்கல்வி நோக்கம் - கற்றலில் உள்ள படிநிலைகள் - கற்பித்தல் படிநிலைகள் - கற்றலைத் தூண்டுதல் - கற்பித்தல் தொழில் நுட்பங்களைத் திட்டமிடுதல் - கருத்தாக்கம் - கற்பித்தல் தொழில்நுட்பத்தில் உள்ள வாய்ப்பு – அடிப்படைத் திட்டங்கள்.

அலகு : 5

குழுவாகக் கற்பித்தல் - பல்வேறுவகைக் கருத்தரங்குகள் - ஆய்வுத்திட்ட முயற்சிகள் - பயிலரங்குகள் - ஒரு சிக்கல் குறித்து விவாதமும் - கருத்துக்கணிப்பும் - குரு – தனித்திட்டப் பகுப்புகளை மேற்கொள்ளுதல் - கணினி வழிப் பயனறிதல் - கல்வித்துறையில் நுட்பங்கள் பற்றி அறிதல்.

பார்வை நூல்கள்:

1. ஆய்வியல் அறிமுகம் - டாக்டர் தமிழண்ணல், டாக்டர் எம்.எஸ்.இலக்குமணன்
2. ஆய்வு கட்டுரை எழுதும் முறை – டாக்டர் முத்துச் சண்முகம், டாக்டர் சு. வேங்கட்ராமன்
3. நாட்டார் வழக்காற்றியல் ஆய்வு – டாக்டர் தே. லூர்து
4. கள ஆய்வியல் சில அனுபவங்கள் - டாக்டர் சரசுவதி வேணுகோபால்
5. ஆராய்ச்சி நெறிமுறைகள் - டாக்டர் ச. வே. சுப்பிரமணியம்
6. ஆய்வு நெறிமுறைகள் - டாக்டர் ஈ.சு.விசுவநாதன்
7. திறனாய்வுக்கலை – தி.சு. நடராஜன்

KARPAGAM ACADEMY OF HIGHER EDUCATION
M.Phil/Ph.D ASTROLOGY
PAPER –II PREDICTION ASTROLOGY
EFFECTIVE FROM ACADEMIC YEAR – 2019- 2020

நோக்கங்கள்

1. பிறப்பு ஜாதகத்தில் லக்னத்தை கொண்டு பலன் கூறுதல்.
2. பன்னிரு பாவக அதிபதிகள் மற்ற பாவகங்களில் மாறியிருப்பதால் ஏற்பட கூடிய நன்மை, தீமை அறிதல்.
3. பாதகாதிபதி கொண்டு பலன்கள் நிர்ணயித்தல் .
4. கோள்களின் சேர்க்கையை கொண்டு பலன் நிர்ணயம் செய்தல்.
5. கோள்கள் பன்னிரு பாவகங்களில் நின்று ஏற்படுத்தும் பலன்களை நிர்ணயித்தல்.
6. 6/8/12- ல் நிற்கும் பாவாதிபதிகளில் நிலையறிந்து பலன்களை நிர்ணயித்தல்.

பயன்கள்

1. சார, ஆதிபத்ய முறைகளில் பலன்கள் நிர்ணயம் செய்ய பயன்படும்.
2. யோக பலன்களை நிர்ணயம் செய்ய முடியும்.
3. கோள்களின் பார்வை பலன்களை நிர்ணயம் செய்ய முடியும்.
4. திதி சூண்யம் அடைந்த பாவகம், பாவகாதிபதி கொண்டு பலன்களை கூற முடியும்.
5. கோள்கள் ஆட்சி, உச்சம், நீச்சம் அடைவதால் ஏற்படும் பலன்களை நிர்ணயிக்க முடியும்.
6. கேந்திர, திரிகோணங்களில் கோள்கள் நிற்பதால் ஏற்படும் பலன்களை நிர்ணயிக்க முடியும்.

அலகு -1

பன்னிரு இலக்ன சாதகங்களில் இலக்னாதிபதியின் நிலை கொண்டு மற்ற பாவகங்களின் தன்மை, கோள்கள், பன்னிரு பாவகத்தில் இருப்பதால் ஏற்படும் பலன்கள். பன்னிரு இலக்னங்களில் பிறந்தவர்களின் பலன்களை சாரம், ஆதிபத்ய முறையில் பலன்களை எழுதுதல். பிறப்பு லக்னத்தில் உள்ள நட்சத்திர அடிப்படையிலான பலன்கள். லக்னத்தில் ஆட்சி, உச்சம், நீச்சம் பெறும் கோள்களினால் ஏற்படும் பலன்கள்.

அலகு -2

பன்னிரு பாவக அதிபதிகளும் மற்ற பாவகங்களில் மாறியிருப்பதால் ஏற்படக் கூடிய நன்மை, தீமைப் பலன்கள். பாதகாதிபதி, மாரகாதிபதி, யோகத்தை கொடுக்கும் பாவாதிபதிகள், யோக பலனை தடுக்கும் பாவதிபதிகள். பாவாதிகள் ஆட்சி, உச்ச, நீச்ச பகை ராசிகளில் நிற்பதால் ஏற்படும் பலன்கள்.

அலகு -3

கோள்கள் தங்களுக்குள் இணைந்திருக்கும் பலன்கள், பாவக அடிப்படையில் கோள்கள் இணைந்திருக்கும் பலன்கள். கேந்திரங்களின் இணையும் கோள்கள் -திரிகோணங்களின் சேரும் கோள்களின் பலன்கள் யோகத்தை தரும் கோள்கள், அவயோகத்தை தரும் கோள்கள்.

அலகு -4

தீய பாவாதிபதிகள், நல்ல பாவகத்தில் இருப்பதினால் ஏற்படும் பலன்கள், நல்ல பாவக அதிபதிகள் தீய பாவகத்தில் இருப்பதால் ஏற்படும் பலன்கள். திதி சூன்ய பாவகத்தினால் ஒவ்வொரு திதியிலும் பிறந்தவர்களின் பலன்கள். ராகு,கேது கோள்கள் பாவாதிபதிகளுடன் இணைவால் ஏற்படும் பலன்கள்.

அலகு – 5

தீய பாவாதிபதிகளின் திசையில் ஏற்படும் பலன்கள், நற்பாவாதிபதிகளின் திசைகளில் ஏற்படும் பலன்கள். ராசியில் 6/8/12-இல் நிற்கும் கிரகங்களின் திசா புத்தி காலங்களில் ஏற்படும் பலன்கள் வர்க்க சக்கரங்களில் 3/6/8/12-ல் நின்று தசை அல்லது புத்தி நடத்தும் கிரகங்களால் ஏற்படும் நன்மை, தீமைகள்.

Reference Nooks:

Jataka Bharanam(1998) - Girish chand Sharma
சாராவளி (1939) - குமாரசுவாமி ஆசாரி
விமேசுவர உள்ளமுடையான் (1935) - மார்க்கலிங்க சோதிடர்
பூர்வபாராசர்யம் (1998) - S. சுவாமிநா சாஸ்திரி
விரிவுரைக் குறிப்புகள் - T. விமலன்
கிரகங்களும் நோய்களும் - கௌரி சங்கர்
கிரகங்களின் பலம் அறியும் வழிகள் - சுப. சுப்பிரமணிய்ன
அனுபவ ஜோதிட பலன்கள் - கிரிடாதி ஆனந்தா

KARPAGAM ACADEMY OF HIGHER EDUCATION
M. Phil/ Ph. D ASTROLOGY
PAPER III : SPECIAL PAPER I
HISTORY OF ASTROLOGY
EFFECTIVE FROM ACADEMIC YEAR 2019 -2020

நோக்கங்கள்

1. மேற்கத்திய நாடுகளில் ஜோதிடவியலின் தோற்றம் வளர்ச்சியை அறிந்துக் கொள்வது.
2. சீனா, அரேபியா, இசுலாம் நாடுகளில் ஜோதிட வளர்ச்சியை அறிந்துக் கொள்வது.
3. இந்திய ஜோதிடவியலின் தோற்றம், வளர்ச்சியை அறிந்துக் கொள்வது.
4. வராகமிகிரர், கல்யாணவர்மா ஆகிய இந்திய ஜோதிட மேதைகளின் நூற்களை படிப்பது.
5. தமிழ் இலக்கிய ஜோதிட வரலாற்றை புரிந்துக் கொள்வது.
6. தற்கால ஜோதிட வளர்ச்சியை புரிந்துக் கொள்வது.

பயன்கள்

1. ஜோதிடவியலில் ஆய்வேட்டை உருவாக்க வரலாற்று பகுதியை எழுதுவதற்கு உதவும்.
2. மேற்கத்திய ஜோதிட முறைக்கும், இந்திய ஜோதிட முறைக்கும் உள்ள வேறுபாட்டை புரிந்துக் கொள்ள உதவும்.
3. எண்கணிதம், கைரேகை, வாஸ்து போன்ற ஜோதிடம் சார்ந்த துறைகளில் அறிவை பெற முடியும்.
4. தற்கால ஜோதிடவியலின் நிலையை புரிந்து பலன்கள் சொல்ல முடியும்.
5. பழங்கால ஜோதிடவியல் நூற்களின் பெருமைகளை புரிந்துக் கொள்ள முடியும்.
6. தமிழ் ஜோதிட நூற்களின் பெருமை புரியும்.

அலகு : 1

மேற்கத்திய நாடுகளில் சோதிடவியல் தோற்றம் சுமேரியர், மெசபடோமியர், ஆசீதியர், பாபிலோனியர், சால்தியர், எகிப்து, சீனா, அரேபியா, இசுலாம் நாடுகள் சோதிட வளர்ச்சி.

அலகு : 2

இந்திய சோதிட வரலாறு வேத சோதிடம் (வான சாத்திரம்) ஆர்யபட்டர், வால்மீகி இராமாயணம், வராகமிகிரர், பட்டோத்பலர், ப்ருதுயஜஸ், கல்யாணவர்மர், ஸ்ரீபதி பத்ததி, துண்டிராஜ் போன்றோரின் சோதிட நூல்களில் காணப்படும் சோதிட வளர்ச்சி.

அலகு : 3

தமிழ் இலக்கிய சோதிட வரலாறு பண்டைய தமிழ் இலக்கிய நூல்களில் காணப்படும் வானசாத்ர சோதிட செய்திகள், கம்பராமாயணம், தொல்காப்பியம், சிலப்பிகாரம், பரிபாடல்.

அலகு : 4

பிற்கால தமிழ் சோதிட நூல்களின் வரலாறு, கீரனூர் நடராசர், முத்துக்குமாரசுவாமி ஆசாரியார், தில்லை சேகரம், நடேசய்யர், முருகையா சோதிடர், கே.வி. வெங்கட்ராம அய்யர், இரகுநாத அய்யர், சி.வி. ராஜன், இரத்தினநாயக்கர் & சன்ஸ், கூடலிங்கம்பிள்ளை, அரங்கசாமி பிள்ளை போன்றோரின் நூற்கள்.

அலகு : 5

தற்கால சோதிட வளர்ச்சி, மேற்கத்திய சோதிடமுறை, கே.பி. கிருஷ்ணமூர்த்தி சோதிட முறை, எண் கணிதம், கைரேகை, ஆருடம், நட்சத்திர பலன், பஞ்சாங்க விளக்கம், மனைவிதி விளக்கம்.

பார்வை நூல்கள்:

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2. இலக்கியத்தில் சோதிடவியல் டாக்டர். தி.மகாலட்சுமி
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4. Astrology History (MA.,Paper 2003) – Pottisree Ramulu University Hyderabad
5. Indian Astronomers,(1991) R. Krishnmurthi
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KARPAGAM ACADEMY OF HIGHER EDUCATION
M.Phil/Ph.D ASTROLOGY
Paper –III – Special Paper II
ASTROLOGY PREDICTIONS IN K.P.METHOD
EFFECTIVE FROM ACADEMIC YEAR 2019- 2020

நோக்கங்கள்

1. கே.பி முறைக்கும், இந்திய ஜோதிட முறைக்கும் உள்ள வேறுபாட்டை புரிந்துக் கொள்வது.
2. உபநட்சத்திராதிபதிகளின் மூலம் பலன்கள் நிர்ணயம் செய்வது.
3. ஆருட முறையில் கேள்வியாளர்களின் கேள்விகளுக்கு பதில் கூறுதல்.
4. 249 உபநட்சத்திராதிபதிகளின் தொழில்களை அறிவது.
5. கே.பி முறையில் பல்வேறு கேள்விகளுக்கு பதில் கூறுவது.
6. ஆளும் கிரகங்களை கொண்டு கால நிர்ணயம் செய்தல்.

பயன்கள்

1. பலன்களை துல்லியமாக நிர்ணயம் செய்ய பயன்படும்.
2. பலன்கள் நடக்கும் காலங்களை துல்லியமாக கணிக்க பயன்படும்.
3. பிரசன்ன கேள்விகளுக்கு உரிய பதிலையும், காலத்தையும் கூறப்பயன்படும்.
4. கே.பி முறையில் கோள்களின் பார்வையை கொண்டு பலன்கள் கூறமுடியும்.
5. நட்சத்திர அதிபதிகளை கொண்டு பலன்கள் நிர்ணயம் செய்ய பயன்படும்.
6. குறிகாட்டிகளைக் கொண்டு பலன்கள் நிர்ணயம் செய்ய பயன்படும்.

அலகு: 1

இலக்ன உபநட்சத்திரப் பலன்கள், மேசம், ரிசபம், மிதுனம், கடகம், சிம்மம், கன்னி, துலாம், விருச்சிகம், தனுசு, மகரம், கும்பம், மீனம் ஆகிய இராசிகளில் இலக்ன உபநட்சத்திரம் இருந்தால் ஏற்படும் பலன்கள்,

அலகு: 2

வினாக்களுக்குப் பலன்கள் பன்னிரு பாவகத் தொடர்பினால் ஏற்படும் வினாக்களுக்குப் பலன் கூறும் முறைகள். பன்னிரு பாவாதிபதிகள் மற்ற பாவகங்களில் மாறி நிற்பதால் ஏற்படும் பலன்கள். பாவதிபதிகள் தனது சொந்த நட்சத்திரத்தில் நிற்பது.

அலகு: 3

மேச இராசி முதல் மீனம் வரை உள்ள 249 உபநட்சத்திரங்களுக்குரிய தொழில்கள், இருப்பிடங்கள் பிரிக்கப்படும் தன்மைகள். 249 உபநட்சத்திரங்கள் பிரிக்கும் முறைகள்- அதன் சிறப்பு அம்சங்கள் - அதனுடைய பயன்களை துல்லியமாக கணக்கிடும் முறைகள்.

அலகு: 4

கே.பி முறையில் தயாரிக்கப்பட்ட பல்வேறு சாதகங்களுக்கு பன்னிரு பாவகத் தன்மையில் ஏற்படும் வினாக்களுக்கு பதில் அளிக்கும் முறைகள். ஆயுள் - ஆரோக்யம் - தனம் - திருமணம். குழந்தை பிறப்பு – வேலை – சொந்த தொழில். பொருட்கள் காணாமல் போதல் பற்றிய வினாகளுக்கு பதில் அளிக்கும் முறைகள்.

அலகு: 5

பிரசன்ன கேள்விகள், கேள்வி நேர்த்தின் கோள்கள், பாவகங்களின் தன்மைகள், கிருஷ்ணமூர்த்தி முறை பிரசன்ன விதிகள், பிரசன்ன ஜாதகம் தயாரித்தல், கேள்விகளுக்கு பாவகங்களின் தொடர்பு விம்சோத்தரி தசாவில் செயல் நடைபெறும் பன்னிரு பாவகத்தின் குணத்தைக் கொண்டு கேட்கப்படும் கேள்விகளும் அதற்குரிய பதில்களும்.

Reference Books:

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3. பிரசன்ன சோதிடம்
4. சோதிடம் விஞ்ஞானமே
5. சாதக பலன் சொல்வது எப்படி (3 பாகங்கள்)
6. கிருஷ்ணமூர்த்தி பத்ததி ஓர் வழிகாட்டி (6 பாகங்கள்)
7. கிருஷ்ணமூர்த்தி பத்ததி முறைப்படி சாதகம் கணிப்பது எப்படி?
8. பாவ ஆரம்ப முனை கிரகம் மற்ற பாவங்களிலிருந்தால் என்ன?

கிருஷ்ணமூர்த்தி பள்ளிகேசன்ஸ். ஏப். 21-பு, முதல் தளம், ஸ்பென்சர் பிளாசா, பேஸ்-1,769 அண்ணாசாலை, சென்னை -2

கே.பி. சோதிட கணிதம்
கே.பி. சோதிட இரகசியங்கள் பகுதி 1-4
ஆளும் கிரகங்களும் அற்புதங்களும்
சோதிட பொக்கிசம் 1-6
கே.பி.உயர்தர நட்சத்திர சோதிடம் 1-3
கிருஷ்மன் அன்.கோ.நெ.804 அண்ணாசாலை, எல்.ஐ.சி. எதிரில், சென்னை -2

KARPAGAM ACADEMY OF HIGHER EDUCATIOM
M.Phil /Ph.D ASTROLOGY
Paper –III – Special Paper III
WESTERN ASTROLOGY
EFFECTIVE FROM ACADEMIC YEAR 2019 -2020

நோக்கங்கள்

1. மேற்கத்திய ஜோதிட முறைகளின் அடிப்படை விதிகளை புரிந்துக் கொள்வது.

2. யுரேனஸ், நெப்ட்யூன், புளூட்டோ ஆகிய கோள்களின் குணங்களை புரிந்துக் கொள்வது.

3. ராசிகள் சுட்டிகாட்டும் ஊர்கள், நாடுகள், நகரங்கள் ஆகியவற்றை தெரிந்துக் கொள்வது.

4. சூரியன் நிற்கும் ராசியை லக்னமாக கொண்டு பலன்கள் கூறுவது.

5. பன்னிரு ராசிகளின் பொதுவான குணங்களையும், தொழில்களையும் புரிந்துக் கொள்ளுதல்.

6. கோள்களின் பார்வை பலன்களை நிர்ணயித்தல்.

பயன்கள்

1. இயற்கைச் சீற்றங்கள் – நில அதிர்வு – பேரலைகள் – தொற்று நோய்கள் ஆகியவற்றினால் மக்களுக்கு ஏற்படும் பாதிப்பை அறிவதற்கு பயன்படும்.

2. கோள்களின் சேர்க்கையால் பார்வையால் ஏற்படும் பலன்கள் நிர்ணயம் செய்ய பயன்படும்.

3. இகலோக ஜோதிடவியலுக்கான பலவிதிகளை எடுத்து பயன்படுத்த உதவும்.

4. தொழில் நிர்ணயம் செய்ய பயன்படும்.

5. சூரியரின் முக்கியத்துவம் நன்கு புலப்படும்.

6. வாழ்நாள் பலன்களை நிர்ணயம் செய்ய முடியும்.

அலகு : 1

மேற்கத்திய சோதிட முறை அடிப்படை விதிகள், சாயன முறை, சூரியனின் முக்கியத்துவம், சூரியன், சந்திரன், செவ்வாய், புதன், குரு, சுக்கிரன், சனி, யுரேனஸ், நெப்ட்யூன், புளூட்டோ கோள்களின் குணங்கள். ராசிகள், சுட்டிகாட்டும் ஊர்கள், நாடுகள், நகரங்கள். மனிதன் பயன்படுத்தும் பொருட்கள்.

அலகு : 2

இராசிகளின் குணங்கள், சூரியமுறையில் பன்னிரு ஆகிய இராசிகளின் பொது, ஆண், பெண், குழந்தை, முதலாளி, தொழிலாளியின் குணங்கள். இராசிகள் குறிப்பிடும் விலங்குகள், பறவைகள் பாவகங்களில் கோள்களின் இணைவால் ஏற்படும் பலன்கள். பன்னிரு இலக்னங்களில் படிப்பதால் ஏற்படும் பயன்கள் - சூரியனின் முக்கியத்துவம்.

அலகு : 3

பார்வைப் பலன்கள் - சூரியன், சந்திரன், புதன், சுக்கிரன், செவ்வாய், குரு, சனி, யுரேனஸ், நெப்டியூன், புளூட்டோ ஆகிய கோள்கள் ஒன்றுடன் ஒன்று இணைந்த பாகையில் ஏற்படுத்தும் பலன்கள். ஒவ்வொரு கோளின் பலம் பலஹீனம் நிர்ணயிக்கும் முறைகள். கோள்கள் சுட்டிகாட்டும் பொருட்கள் - நிகழ்வுகள் - நிலஅதிர்வு - இயற்கை சீற்றங்களால் ஏற்படும் ஆபத்துகள்.

அலகு : 4

பார்வைப் பலன்கள் - சூரியன், சந்திரன், புதன், சுக்கிரன், செவ்வாய், குரு, சனி, யுரேனஸ், நெப்டியூன், புளுட்போ ஆகிய கோள்கள் ஒன்றுடன் ஒன்று கேந்திரம், திரிகோணம் பார்வைகளில் ஏற்படுத்தும் பலன்கள். கோள்களின் வலிமையான பார்வை, தீமையைத் தரும் பார்வைகள். மேற்கத்திய கோள்களின் பார்வைக்கான பெயர்களும் விளக்கங்களும்.

அலகு : 5

மேற்கத்திய பார்வை முறையில் இயற்கைச் சீற்றங்கள் ஏற்பட்ட காலங்களில் உள்ள கோள்களின் நிலைகள் அவற்றின் பலன்கள். நில அதிர்வு ஏற்படுவதற்கான விதிகள். பேரலைகள் ஏற்படுவதற்கான விதிகள் - பெரும் தொற்று நோயினால் ஏற்படும் உயிர் இழப்புகளை சுட்டும் விதிகள்.

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  மணிமேகலை பிரசுரம், சென்னை

KARPAGAM ACADEMY OF HIGHER EDUCATION
M.Phil/Ph.D ASTROLOGY
Paper-III – Special Paper V
MARRIAGE MATCHING
EFFECTIVE FROM ACADEMIC YEAR 2019-2020

நோக்கங்கள்

1. நட்சத்திர பொருத்தம் பார்க்கும் முறையை தெரிந்துக் கொள்வது.
2. கணவன் மனைவியின் அன்னோன்யத்தை புரிந்துக் கொள்வது.
3. கோள்களினால் ஏற்படும் தோஷங்களை புரிந்துக் கொள்வது.
4. தம்பதியர்களின் யோகம், அவயோகம் ஆகியவற்றை புரிந்துக் கொள்வது.
5. தம்பதியர்களின் மன பொருத்தம், மக்கட் செல்வம், நோய்கள் ஆகியவற்றை கணிப்பது.
6. விவாகரத்து, திருமண வாழ்க்கையில் ஏற்படும் நன்மை தீமைகளை ஆராய்வது.

பயன்கள்

1. பொருத்தமான கணவன், மனைவியை தேர்ந்தெடுப்பது.
2. திருமண வாழ்க்கையில் ஏற்படும் சாதக, பாதகங்களை கூறி பரிகாரங்களின் மூலம் தோஷத்தை நீக்குவது.
3. திருமணத்திற்கு பிறகு வளர்ச்சி அல்லது சிக்கல்களை முன்கூட்டியே அறிவது.
4. திருமண தடை, தாமதம், இவைகளை கண்டறிந்து வழிகாட்டுதல்.
5. வரன் தேடும் முறை, வரன் அமையும் முறையை எடுத்து கூறுவதற்கு பயன்படும்.
6. நவாம்சத்தின் மூலம் வாழ்க்கை துணையின் நிலையை அறிதல்.

அலகு : 1

திருமணப் பொருத்தம் பார்க்கும் விதிகள், சாதக பொருத்தம் பார்க்கும் அமைப்பு, கணவன் - மனைவி சாதக பலன்கள். திணைப் பொருத்தம் - கணப் பொருத்தம் - மகேந்திர பொருத்தம் -ஸ்திரி பொருத்தம் - யோனிப் பொருத்தம் - ராசி பொருத்தம் - ராசி அதிபதி பொருத்தம். வசிய பொருத்தம் - ரச்சுப் பொருத்தம் - வேதைப் பொருத்தம் - ஏக நட்சத்திரப் பொருத்தம் - ஸ்திரி பூர்வம்.

அலகு : 2

கணவன் - மனைவி சாதகத்தில் பொருளாதாரம், மக்கட் செல்வம், தெய்வீக ஈடுபாடு, இல்லற வாழ்வு, வெற்றி பெற்ற வாழ்வு. ஆயுள் - ஆரோக்கியம் - இருவருக்கும் அன்னோன்யம் கணவனால் மனைவிக்கு யோகம் - மனைவியால் கணவனுக்கு யோகம் - தாம்பத்ய சுகத்தில் ஏற்படும் மனநிறைவு. தம்பதியர்களின் குணாதிசயங்கள்.

அலகு :3

தம்பதியர் சாதகத்தில் திருமணத்திற்குப் பின் ஏற்படும் மனைவியின் முன்னேற்ற நிலை, பின் தங்கிய நிலை, கணவரின் முன்னேற்ற நிலை, பின்னேற்ற நிலை. நவாம்ச லக்னம் - நவாம்ச லக்னாதிபதியின் பலம் பலஹீனம்- நவாம்சத்தில் அவயோகங்கள் சுக்கிரன் பலம் நவாம்சத்தில் சுக்கிரன் 6/8/12 – ல் மறைவு பெருதல்.

அலகு : 4

மக்கட் செல்வம் இல்லாமை, முன்னேற்றமற்ற பொருளாதாரம், உறவினர் பகை, கடன் தொல்லைகள், நோய் தொல்லைகள், வழக்குகள், விபத்துக்கள், எதிர்பாராதத் துன்பங்கள். வர்க்க சக்கரங்களாகிய D2,D3,D4, D6,D7,D9,D10,D11 மூலம் முக்கிய பலன்களாகிய தனம் -வீர்யம் - சொத்து – நோய்கள் - புத்ர பாக்கியம் - திருமண வாழ்க்கை – வேலை – சொந்த தொழில் ஆகியவைகளின் தரம் நிர்ணயித்தல்.

அலகு : 5

கணவன் - மனைவி பிரிவுடன் கூடிய வாழ்வு, விவாகரத்து, விதவை, விதவன், ஒற்றுமையின்மை, கணவனை விட்டு மனைவி வேறு திருமணம், மனைவியை விட்டு கணவன் வேறு திருமணம், அடிமை வாழ்வுகள், சிக்கல்கள், பெரும் தொந்தரவுகள். இரண்டு திருமணம் - கணவன், மனைவி வரும் திசை, படிப்பு, குணங்கள், வேலையின் அமைப்பு- ஆகியவற்றை முடிவு செய்தல்.

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கோச்சார கிரகங்கள் தரும் பலன்கள்	எஸ்.பி. சுப்பிரமணியன்
கோசார பலன்கள் நிர்ணயம்	மு. மாதேஸ்வரன்
கோசார தீபிகை	சி.ஜீ. ராஜன்
சனிபகவான் வழிபாடும் பரிகாரமும்	காழியூர் நாராயணன்
சனிபகவானும் பரிகாரமும்	முருகு இராசேந்திரன்
சகல காரிய சித்தி தரும் சித்தர் எண்யந்திரங்கள்	பாலஷண்முகானந்தா
சாதக ஜாலங்கள்	குடந்தை நாதன்
சாதக அமைப்பும் இல்லற வாழ்க்கையும்	புலியூர் பாலு
சாதகப்படி ஆரோக்கிய நிலை	ரிஷபானந்தர்
சாதகப் பொருத்தம் பார்க்கும் கணிதம	எஸ்.பி. சுப்பிரமணியன்
சாதகப் பலா பலன்கள் கூறுவது எப்படி	ஏ. பிரகஸ்பதி
சாதகப்படி ஆயுள் பாவம்	ரிஷபானந்தர்

KARPAGAM ACADEMY OF HIGHER EDUCATION
M.Phil/Ph.D ASTROLOGY
Paper –III – Special Paper IV
CASE STUDY IN HOROSCOPES
EFFECTIVE FROM ACADEMIC YEAR 2019-2020

நோக்கங்கள்

1. பல்வேறு முறையில் தொழில் நிர்ணயம் செய்தல்.

2. இலக்னத்தை கொண்டு தொழில் நிர்ணயம் செய்தல்.

3. தொழில் முனைவோர் ஜாதகங்களை ஆய்வு செய்யும் முறை.

4. தொழிலில் ஏற்படும் முன்னேற்றங்கள், பின்னடைவுகளை அறிதல்.

5. குடும்ப வாழ்க்கை, திருமண வாழ்க்கை ஆகியவற்றை மாதிரி ஜாதகங்களை கொண்டு ஆய்வு செய்தல்.

6. பொறியாளர்கள், வக்கில், மருத்துவர்களின் ஜாதகங்களை ஆய்வு செய்தல்.

பயன்கள்

1. ஜாதகர்களின் தொழிலை முடிவு செய்ய பயன்படும்.

2. வியாபாரிகளின் ஜாதகங்களை ஆய்வு செய்து சொந்த தொழில் செய்ய கூடிய அமைப்பை கூறுதல்.

3. திருமண வாழ்க்கையில் ஏற்படும் நன்மை தீமைகளை விளக்க முடியும்.

4. ஜாதகர்களின் பொருளாதார நிலைகளை நிர்ணயம் செய்ய பயன்படும்.

5. படித்த படிப்புக்கு ஏற்ற வேலை கிடைக்குமா என்பதை கூறமுடியும்.

6. தலைப்புக்கு ஏற்ற ஜாதக மாதிரிகளை ஆய்வு செய்யும் முறைகளை தெரிந்துக் கொள்வது.

அலகு -1

நெருப்பு இலக்ன சாதகர்கள் தங்களுக்குரிய தொழில்களில் ஏற்பட்ட முன்னேற்றங்களும், பின்னடைவுகளும், 1,10 பாவகங்களுக்கு தொடர்பில்லாத தொழில்களை செய்வதால் ஏற்படும் பலன்கள். வேலை, சொந்த தொழிலை நிர்ணயிக்கும் முறைகள் - ப்ருகு நந்தி நாடி முறை – பராசரர் முறை -ஜெயமினி முறை – தசாம்சம் - ஏகாதசாம் கொண்டு முடிவு செய்தல் - கே.பி.முறை.

அலகு -2

நிலம் இலக்ன சாதகர்கள் தங்களுக்குரிய தொழில்களில் ஏற்பட்ட முன்னேற்றங்களும், பின்னடைவுகளும். 1,10 பாவகங்களுக்கு தொடர்பில்லாத தொழில்களை செய்வதால்

ஏற்படும் பலன்கள். ஜாதகன் படித்த படிப்பிற்கும் செய்யும் வேலை அல்லது தொழிலுக்கும் சம்பந்தம் உண்டா? இல்லையா? என்பதை முடிவு செய்தல்.

அலகு -3

காற்று இலக்ன சாதகர்கள் தங்களுக்குரிய தொழில்களில் ஏற்பட்ட முன்னேற்றங்களும், பின்னடைவுகளும். 1,10 பாவகங்களுக்கு தொடர்பில்லாத தொழில்களை செய்வதால் ஏற்படும் பலன்கள். ஜாதகனுக்கு ஏற்படும் கடன் -நோய் - கஷ்டங்கள் - கண்டங்கள் பற்றிய விதிகள். மருத்துவ ஜோதிட கருத்துக்கள் பிரச்சினை- நோய்களுக்கான பரிகாரங்கள்.

அலகு – 4

நீர் இலக்ன சாதகர்கள் தங்களுக்குரிய தொழில்களில் ஏற்பட்ட முன்னேற்றங்களும், பின்னடைவுகளும் 1,10 பாவகங்களுக்கு தொடர்பில்லாத தொழில்களை செய்வதால் ஏற்படும் பலன்கள். ஜாதகனின் படிப்பு, குடும்ப வாழ்க்கை திருமணத்தினால் ஏற்படும் கணவன், மனைவி அன்னோன்யம் - பிரிவினை – குழந்தைகளால் இன்பமா? துன்பமா?

அலகு -5

பிரபலமடைந்த சாதகங்களில் உள்ள கோள்களின் நிலையும், அவற்றினால் ஏற்படும் பலன்களின் மாற்றங்களும். தொழில் முனைவோர் - அரசாங்க வேலையில் உள்ளவர்களின் ஜாதகங்கள் -மருத்துவர்கள் - பொறியாளர் ஜாதகங்கள். வக்கில் - கணக்கர் - உணவு பொருள் வியாபாரம் ஜவுளி வியாபாரம் செய்யும் ஜாதகங்களின் அமைப்பு.

Reference Books

கோட்சாரப் பலனை ஜாதகப் பலனுடன் இணைத்துப் பார்ப்பது எப்படி	ஏ. பிரகஸ்பதி
கோசார கிரகங்கள் தரும் பலன்கள்	எஸ்.பி.சுப்பிரமணியன்
கோசார பலன்கள் நிர்ணயம்	மு. மாதேஸ்வரன்
கோசார தீபிகை	சி.ஜி.ராஜன்
சனிபகவான் வழிபாடும் பரிகாரமும்	காழியூர் நாராயணன்
சனிபகவானும் பரிகாரமும்	முருகு இராசேந்திரன்
சகல காரிய சித்தி தரும் சித்தர் எண்யந்திரங்கள	பாலஷண்முகானந்தா
சாதக ஜாலங்கள்	குடந்தை நாதன்
சாதக அமைப்பும் இல்லற வாழ்க்கையும்	புலியூர் பாலு
சாதகப்படி ஆரோக்கிய நிலை	ரிஷபானந்தர்
சாதகப் பொருத்தம் பார்க்கும் கணிதம்	எஸ்.பி. சுப்பிரமணியன்
சாதகப் பலன்கள் கூறுவது எப்படி	எ. பிரகஸ்பதி
சாதகப்படி ஆயுள் பாவம்	ரிஷபானந்தர்

DEPARTMENT OF BIOCHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
KARPAGAM ACADEMY OF HIGHER EDUCATION
(*Deemed to be University,Established Under Section 3 of UGC Act 1956*)
Eachanari PO, Coimbatore – 641 021, India.

M.Phil / Ph.D– BIOCHEMISTRY
(Effective from the academic year 2019 - 2020 and onwards)

PREAMBLE

- The degree of Master of Philosophy [M.Phil] /Doctor of Philosophy (Ph.D) is awarded to a candidate who has submitted a thesis on the basis of original and independent research in any biochemistry field of research.
- This makes a contribution to the advancement of knowledge, which can be useful to the society.

DEPARTMENT OF BIOCHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
RESEARCH PROGRAM – M.Phil / PhD in Biochemistry
(2019–2020 and onwards)

Course code	Name of the course	Instruction hours / week	credits	Maximum Marks (100)
19RBC101	Research Methodology and Pedagogy	4	4	100
19RBC201	Advanced paper in Biochemistry	4	4	100
19RBC301A	Enzyme and Enzyme technology	4	4	100
19RBC301B	Cancer Biology and immunology			
19RBC301C	Medicinal Plants and Plant therapeutics			
19RBC301D	Clinical Biochemistry and Toxicology			
19RBC301E	Plant Molecular Biotechnology			
19RBC301F	Animal Tissue Culture			
19RBC301G	Fish nutrition and tissue culture			
Program Total		12	12	300

19RBC101 RESEARCH METHODOLOGY&PEDAGOGY 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjective:

Equip the students with:

- The availability of tools for literature search
- Usage of tools and documentation of available research
- Identification of lacunae in the literature
- Processing of data and evaluating statistical significance
- Nuances of scientific writing
- Dissemination of research data

CourseOutcome:

After successful completion, the students will understand

1. Scopus, Cochrane, Pubmed databases
2. Collation of available research and exportation to appropriate format
3. Methods involved in the identification of lacunae in the literature
4. How to Process data and evaluate statistical significance
5. Nuances of scientific writing
6. Dissemination of research data

UNIT I: Research Problem

Definition - Identification - Review of Literature – Lacunae identification-Research process - Research design –Experimental and non experimental designs- Exploratory – Diagnostic.

UNIT II: Sampling methods

Sampling - Population –Census - Sample – Types – Probability – Non Probability sampling – Sampling size – Sampling process – Hypothesis and its formulation. Sampling distribution – Students t test. Experimental design – CRD, RBD. Analysis of experimental results – ANOVA and its interpretation. Duncan's Multiple Range Test. Interpretation.

UNIT III: Data Processing

Data Collection Tools -Case studies - Interview – Questionnaire -Schedule - observation- Scaling techniques – Scale Construction – Rating scales. Hypothesis testing – Parametric and non parametric tests - Coding – Editing – Tabulation –Analysis – Correlation & regression.

UNIT IV: Scientific writing and presentation

Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided. Microsoft Windows: Macintosh versions, Microsoft Word- Characteristics - Document statistics - Typical usage, Microsoft Excel - Basic operation – Charts - Using other Microsoft applications - Using external data, Microsoft Power Point –power point viewer – versions – uses, Microsoft Access –Uses – Features.

UNIT- V: Pedagogical methods in higher education
Objectives and role of higher education- Important characteristics of an effective lecture- Quality teaching and learning- lecture preparation- characteristics of instructional design- Methods of teaching and learning: Large group- Technique – lecture, seminar, symposium, team teaching, project, small group technique- simulation, role playing demonstration, Brain storing, Case discussion, and assignment, methods of evaluation- self evaluation, student evaluation, diagnostic testing and remedial teaching- question banking- electronic media in education:- ‘e’ learning researches- web based learning.

SUGGESTED READING

1. B. Somekh& C. Lewin, (2005), Research methods in the social sciences, Vistaar Publications, New Delhi

2. Crotty, M. (1998), The Foundation of Social Research: Meaning and Perspective in the Research Process, Sage Publications, London

3. Blaikie, N. (2000), Beginning Social Research, Polity Press, Cambridge

4. V. Desai & R. B. Potter, (2006), Doing Development Research, Sage Publications, New Delhi.

M.Phil/Ph.D Biochemistry		**2019-2020**
19RBC201	**ADVANCED PAPER IN BIOCHEMISTRY**	**4H-4C**

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjective:

Equip the students with:

- Applications and limitations of antibody based assays
- Applications and limitations of fluorescence based assays
- Applications and limitations of microscopic assays
- Applications and limitations of nucleic acid analysis
- Analysis of protein using wet lab and computational methods
- Basic methodology of animal and plant tissue culture methods

Course outcomes:

After successful completion, the students will understand

1. Appropriate antibody based assays for a specific research question
2. Appropriate f fluorescence based assays for a specific research question
3. Specific microscopic assays for a research question
4. Appropriate nucleic acid analysis for a specific research question
5. Usage of wet lab and computational methods for a specific research question
6. General methodology of animal and plant tissue culture methods

UNIT I: Biochemical Techniques

Fluorescent Antibody assay – Histochemical localization, ELISA techniques – Principles & Applications. Immuno radiometric assay – Principles & Applications
Natural Products – Detection of bioactive molecules by gas chromatography, HPLC and HPTLC, Mass spectrometry, NMR. Emission Spectroscopy – Fluorescence, Phosphorescence and Chemiluminescence. X-Ray diffraction and Flow injection analysis.

UNIT II: Microscopy and PCRTechniques

Electron microscopy- transmission and scanning, Freeze fracture technique, specific staining of biological material. Flow Cytometry – Principles, Abnormal chromosome analysis, Karyotyping, Comet assay. DNA Fragmentation analysis – Microfabrication techniques and uses in biological applications. PCR methodology – Design of primers – RTPCR. PCR in genomic analysis and diagnostic applications. PFGE – Principles, techniques and applications.

UNIT III: Bioinformatics Tools

Biological database- DNA sequence database, protein sequence database SRS – Similarity searching, BLAST, FASTA Local and Global alignment, Multiple sequence alignment –

Phylogeny. Structure database – Secondary structure prediction. Predicting 3D folds (Threading) Visualisation tool.

UNIT IV: Genomics and Proteomics Human Genome project

History, techniques and applications: Anatomy of prokaryotic and human genome: genetic mapping and genetic markers-RFLP, Mini and micro satellite, STS and EST, SSCP, RAPD, AFLP, SNPs, Analysing gene expression- DNA micro array.Proteome analysis- 2D gel electrophoresis: protein-protein interactions- yeast two-hybrid system and protein micro arrays.

UNIT V: Culture Techniques

Plant Tissue Culture: Tissue culture media, composition and preparation, primary culture, callus and suspension cultures, somoclonal variation, micro propagation, organogenesis, Somatic embryogenesis, artificial seeds, Transfer and establishment of whole plants in soil, Haploidy: Protoplast fusion and somatic hybridization.

Animal Tissue Culture: Media - Natural media, balanced salt solution and simple media, serum and protein free chemically defined media. Primary cell culture,(chick, mouse and human biopsy)and methods of desegregations of tissues; continuous or established cell culture, tissue culture, organ culture; three dimensional culture, feeder layer, cell separation; cell synchronization; cryopreservation and revival.

SUGGESTED READING

1. Adrian Slater, Neigel Scott and Maark Fowler (2008), Plant Biotechnology – Genetic manipulation of plants, 2nd edition, Oxford University Press, New York.

2. Akay M. (2007) Genomics and Proteomics Engineering in Medicine and Biology Wiley-Interscience John Wiley & sons, Inc. Publication, USA.

3. Deepak Bhariog (2006), Fundamentals of Information Technology, 3rd Edition Excel Books India.

4. Hall, Christopher; Tews, Carey (Retrieved 7 November 2010). "Mac Office matches Windows — almost". InfoWorld. p. 117.

5. Freshney, R. I., &Freshney, M. G. (2010), Animal cell culture: a practical approach, 2nd ed. IRL Press at Oxford University Press.

6. Karp G. (2012), Cell and Molecular Biology: Concept and Experiments. John Willy, New York, USA.

7. Lodish et.al. (2013) Molecular Cell Biology, 7th edition, W.H.Freeman and Company, New York.USA.

8. Watson, J. D., Baker, T. A. & Bell, S. P. (2007). Molecular Biology of the Gene. 6th Ed. BenjaminCummings.USA.

M.Phil/Ph.DBiochemistry **2019-2020**

19RBC301A **ENZYMES AND ENZYME TECHNOLOGY** **4H-4C**

Instruction hours/week: L: 4 T: 0 P: 0 **Marks:100**

End Semester Exam: 3 Hours

CourseObjective:

Equip the students with:

- Techniques involved in the analysis of protein structure and function
- The applications and limitations of methods involved in isolation of enzymes
- The applications and limitations of methods involved in purification of enzymes
- Physical, Chemical and Biological methods of enzyme immobilization
- Clinical significance of enzyme analysis
- Biotechnological applications of enzymes

CourseOutcomes:

After successful completion, the students will understand

1. X-Ray crystallographic, Spectrophotometric analysis of enzymes
2. How to estimate the fold purity during isolation of an enzyme
3. Enzyme purification techniques
4. Physical, Chemical and Biological methods of enzyme immobilization
5. The clinical significance of enzyme analysis in analyzing the vital organ functions
6. Applications of enzymes in the area of medical and industrial biotechnology

UNIT I: Protein and enzymes

Protein structure, functions, compositions and conformation of proteins. Enzyme catalysis-Acid base catalysis, covalent catalysis, an example, serine proteases. Enzyme kinetics – Michaelis menton equation, Line weaver Burk plot, Hills equation, Hans plot.

UNIT II: Isolation and purification of enzymes

Sources of enzymes for industry, extraction of enzymes for scientific and industrial purposes. Downstream processing of enzymes, uses of soluble enzymes. Study of enzymes in aqueous biphasic systems. Factors affecting the enzyme activity -Substrate concentration, Enzyme concentration, pH, temperature etc.,

UNIT III: Enzyme immobilization and their applications

Techniques employed for immobilizing enzymes, kinetics of immobilized enzymes. Advantages and disadvantages in the utilization of soluble enzymes, Immobilized enzymes and immobilized cells. Different types of reactors of immobilized enzymes and their applications.

UNITIV: Clinical analysis of enzymes

Application of ELISA and EMIT in clinical analysis. Different types of Biosensors-potentiometric, amperometric, piezo - electric and immuno biosensors. Electro analytical applications of enzymes, Methods of coenzyme regeneration. Biochips and Biocomputers.

UNIT V: Enzymes in Biotechnology

Enzyme catalysis in organic solvents, Restriction endonucleases, DNA ligases, DNA polymerase and their uses in Biotechnology. Site directed mutagenesis, artificial enzymes, ribozymes and Abzymes and their uses.

SUGGESTED READING

1. Bommarius A.S., B.R. Riebel. 2004. Biocatalysis – Fundamentals and Applications, Wiley-VCH, Weinheim, Germany.
2. Buchholz K., V. Kasche, U.T. Bornscheuer. 2005. Biocatalysts and Enzyme Technology, Wiley-VCH, Weinheim, Germany.
3. Cook P. F., W.W. Cleland. 2007. Enzyme Kinetics and Mechanism, Garland Science Publishing, London, England and New York, USA.
4. Irwin Segel. 2004. Biochemical Calculations, John Wiley and Sons, California, USA.
5. Marangoni A.G. 2003, Enzyme Kinetics-A Modern Approach.

19RBC302B CANCER BIOLOGY AND IMMUNOLOGY 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with:

- Etiology of cancer
- Steps involved in the progression of cancer
- Changes in the cell division during oncogenesis
- Programmed cells death
- Immune surveillance strategy
- Techniques involved in the assessment of cancer development and progression

CourseOutcomes:

After successful completion, the students will understand:

1. The reasons for the development of cancer
2. Factors involved in the advancement of cancer
3. Targeting the cell division for the treatment of cancer
4. Targeting apoptosis for the treatment of cancer
5. Methods of enhancing immune surveillance for cancer treatment
6. Usage of appropriate techniques for assessment of cancer stages

UNIT I: Biology of cancer

Biology of cancer-Phenotype of a cancer cell causes of cancer-DNA tumor viruses, RNA tumor viruses, cell cycle and its control-role of protein kinases, checkpoints, kinase inhibitor and cellular response.

UNIT II: Apoptosis

Programmed cell death (Apoptosis)-Intracellular proteolytic cascade, cascade of caspase proteins, adapter proteins, Bcl-2, IAP family proteins, extra cellular control of cell division, tumor necrosis factor and related death signals.

UNIT III: Genetic basis of cancer

Genetic basis of cancer-oncogenes, tumor suppressor genes, aberrations in signaling pathways. oncogenic mutations in growth promoting proteins, Mutations causing loss of growth –inhibiting and cell cycle control, Role of carcinogens and DNA repair in cancer.

UNIT IV: Immunology of cancer

Immunity- Active, passive, humoral and cell mediated immunity. Therapeutic uses of cytokines and cytokine receptors. Test for lymophocyte function. B cell and T cell immuno deficiency disorder. Clinical laboratory methods for the detection of antigens and antibodies test for histocompatability antigens, neoplasm of the immune system.

UNIT V: Cancer Techniques

Techniques-FISH techniques, Real time PCR, Western blotting, ELISA assay, immunocytochemistry, immunohistochemistry, flow cytometry, fluorescent microscopy and confocal microscopy.

SUGGESTED READING

1. Alberts, B. et al. (2008). Molecular Biology of the Cell. 5th Ed. Garland Publishing House. USA.
2. Benjamin Lewin (2007) Genes VIII, Prentice Hall. USA.
3. Brown T.A. (2010), Gene Cloning & DNA Analysis, 6nd Edition, Wiley-Blackwell, New York.
4. Karp G. (2012), Cell and Molecular Biology: Concept and Experiments. John Willy, New York.
5. Klug, W.S., Cummings, M.R, Spencer C.A and Palladino, M.A. (2012), Concept of Genetics, 10^{th} Edition, Pearson Education, Singapore.
6. Lodish H., Berk A., Kaiser CA., KrigerM .,Scott M.P.,Bretscher A., Ploegh H., Matsudaira P.2008. Molecular Cell Biology, 6^{th} edition, W.H. Freeman and Company, New York.
7. Janeway et al., 2012.Immunobiology, 8th Edition, Current Biology publications, USA.
8. Watson J.D. 2009, A Passion for DNA: Genes, Genomes & Society, Cold Spring Harbor Laboratory press (CSHL).

19RBC303C MEDICINAL PLANTS AND PLANT THERAPEUTICS **4H-4C**

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives

Equip the students with:

- Methods to identify plants/herbs with a specific biological activity
- Evaluating the presence/absence of flavonoids, terpenoids, glycosides and steroids
- Analysis of the crude extract in vitro to evaluate its free radical scavenging activity
- Fractionation methods to isolate a specific compound and its evaluation
- Enhancing the production of secondary metabolite using plant tissue culture
- Assessment of the efficacy of a specific plant metabolite using animal cell culture

CourseOutcomes:

After successful completion, the students will understand:

1. The availability of traditional knowledge search resources
2. Identify flavonoids, terpenoids, glycosides and steroids
3. Analyze the crude extract in vitro for its free radical scavenging activity
4. Column chromatography, TLC
5. How to enhance the production of secondary metabolite using plant tissue culture
6. Animal cell culture

UNIT I: Medicinal plants

Medicinal plants-bioactive principles in medicinal plants methods of extraction, isolation, separation and screening, pharmacologically active plants-CNS, CVD, Hypoglycemic, Hepatoprotective, anti allergic, anticancer, immunoactive plants, plants protecting against oxidative stress, chemotherapeutic products.

UNIT II: Free radicals

Free radicals –types, sources, importance, production, free radicals induced damages, lipid peroxidation, measurement of free radicals, disease caused by radicals, reactive oxygen species, antioxidant defence system, enzymic and nom-enzymic antioxidants, role of antioxidants in prevention of diseases, phytochemicals as antioxidants.

UNIT III: Metabolites of Plant

Alkaloids, flavonoids, terpenoids, phenols-Occurrence ,distribution& functions, Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques, elicitation, biotransformation- production of pharmaceutical compounds.

UNIT IV: Plant cell culture

Principles-callus, meristem and organ culture, culture methods, culture media &preparations ,plant regeneration, protoplast technology, micropropogation in plants, somatic embryogenesis, somoclonal selection.

UNIT V: Therapeutic studies of medicinal plants using animal cell culture

Animal cell culture: Culture media, Serum and protein free defined media and their application. Functions of different constituents of culture medium. Role of carbon dioxide, growth factors, glutamine in cell culture. Cell lines, primary culture and culture maintenance.

Experimental animals and Animal handling - Sacrification, collection of sample. Ethical issues for animal handling.

In vivo and *in vitro* assays for therapeutic studies.

SUGGESTED READING

1. Dubey R.C. (2009).Text book of Biotechnology, S. Chand & Company Ltd. New Delhi.
2. Freshney, R. I., &Freshney, M. G. (2010). In Freshney, R. I. (ed.), Animal cell culture: a practical approach, 2nd ed. IRL Press at Oxford University Press.USA.
3. Jain V. K. (2010). Fundamentals of plant physiology, C. Chand and Company Ltd, New Delhi.
4. Purohit. S.S. (2005). Agricultural Biotechnology, Dr.Updesh Purohit Publishers, Jodhpur.India
5. Singh. M.P and Panda. H (2005). Medicinal Herbs with their formulations, Daya Publishing House, New Delhi.

19RBC304D CLINICAL BIOCHEMISTRY AND TOXICOLOGY **4H-4C**

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with:

- The collection of blood, serum and plasma
- Analyzing the inflammatory markers
- Clinical significance of enzyme assays
- Role of oxidative stress in physiological and pathological state
- Enzymatic and non enzymatic antioxidants
- Toxicological studies

CourseOutcome:

After successful completion, the students will understand:

1. The different anti-coagulants used for the isolation of plasma and its significance
2. Assessment of inflammation
3. Role of enzymes to predict vital organ functioning
4. Regulation of oxidative stress
5. Significance of endogenous antioxidant system
6. Principles and applications of histo-chemical analysis

UNIT I: Serology

Blood collection, processing and transfusion process. Normal blood profile. C- reactive protein test, immunological test for pregnancy. Rheumatoid arthritis (RA) test, ESR. Coagulation test, prothrombin test. Haemoglobin Normal and abnormal Hb, separation of haemoglobin, Thalassemia, Hemoglobinopathies. Disorder of erythrocyte metabolic pathways, erythrocyte enzyme disorders. Porphyrins and disorder: porphyrias.

AIDS- Clinical diagnosis. Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis, Hemachromatosis, thalassemias, sickle cell diseases).

UNIT II: Clinical Enzymology

Clinical significance of Phosphatases, transmainases, 5'nulceotidase, Gamma –glutamyl transferase, Lactate Dehydrogenase, Creatine Phospho kinase.

Diagnostic enzymes in hepatobiliary disease, Atherosclerosis, Myocardial infarction, renal dysfunction. Cancer markers for oral, prostate, colorectal breast and GI tract cancer, oncofetal cancer markers.

UNIT III: Free radicals

Formation of free radicals, autoxidation initiated by oxygen radicals, Influence of free radicals in metal toxicity. Free radicals and cancer .Oxidative process in tissue injury. Detection of free radicals and radical ions. Role of free radicals in diseases.

UNIT IV: Antioxidants

Enzymic antioxidants- Chemistry, mechanism, antioxidant effect of SOD, catalase, Glulathione Peroxidase.

Non Enzymic antioxidants- source, chemistry, toxicity, biochemical functions, bioavailability, bioassays, Antioxidant effects of Vit A, Vit C, Vit E, glutathione and selenium.

Trace elements - Introduction, sources, biochemical functions of zinc, copper and magnesium and iron.

UNIT V: Toxicity

Effects of physiochemical and biological factors on heavy metal toxicity, toxic mechanism-Carcinogenesis, teratogenesis and immunotoxicity. Bioassays for heavy metal toxicity, pathological, histopathological examinations for heavy metal toxicity.

SUGGESTED READING

1. Chatterjee M.N. and Rana Sinde, (2006) Text Book of Medical Biochemistry, 6th Edition, Jaypee Brothers, Medical Publishers, New Delhi.
2. Harper's Illustrated Biochemistry (2009) 28th Edition McGraw Hill, Mumbai.
3. Nelson and Cox (2005). Principles of Biochemistry by, 4th Edition, Mumbai.
4. Devlin (2006). Biochemistry with Clinical Correlation, 6th Edition, John Wiley & Sons, USA.
5. RamnikSood (2009). Medical Laboratory Technology,; Jaypee Brothers Medical Publishers, New Delhi
6. Tietz. Fundamentals of Clinical Chemistry (2008). 6th Edition, Elsevier, USA.
7. VoetD.andVoet J (2008) .Biochemistry, 3rd Edition, J. Wiley & Sons, USA.

19RBC305E PLANT MOLECULAR BIOTECHNOLOGY 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with

- The organization of plant genome
- Molecular markers of plant tissues
- Growth regulators of plant
- Cloning strategies
- Transformation methods
- Manipulation of plant nucleic acids

CourseOutcomes:

After successful completion, the students will understand:

1. Organization of plant genome
2. Molecular markers of plant tissues
3. Growth regulators of plant
4. Cloning strategies
5. Transformation methods
6. Manipulation of plant nucleic acids

UNIT I: Plant genome

Plant genome organization, structural features of a representative plant gene. Organization of chloroplast genome and mitochondrial genome. Molecular markers (AFLP, ISSR and RAPD). Plant tissue culture media, plant hormones and growth regulators in tissue culture, preparation of suitable explants. Micropropagation of plants - somatic embryogenesis, protoplast culture, somatic hybridization and synthetic seeds.

UNIT II: Cloning strategies

Tools for cutting and joining of DNA; gene transfer techniques;Methods of selection and screening of recombinant DNA. Construction of genomic libraries and cDNA libraries - probe construction and labelling (radio and non-radio).Molecular mechanism of anti-sense technology - inhibition of splicing , disruption of RNA structure & capping - application of anti-sensing technology.

UNIT III: Gene regulation

Inducible enzymes, regulatory mutations, repressor, operon, promotor, catabolic repression, repressible enzyme systems, control by attenuation, positive control, gene regulation in eukaryotes, transcriptional regulation, post transcriptional regulation, hormones & gene expression; viruses & gene expression, genetic control of pattern formation in plant development.

UNIT IV: Plant transformation technology

Symbiotic nitrogen fixation in legumes by rhizobia - biochemistry and molecular biology. Binary vectors, Use of 35s & other promoters genetic markers methods of nuclear transformation viral vectors & their applications, Use of reporter gene, Particle bombardment, Electroporation, Microinjection, Chloroplast transformation, Transformation of monocots, Transgene stability & gene silencing in Plant transformation.

UNIT V: Plant manipulation and its applications

Transgenic plants - for– biotic (weeds, insects, viruses, fungi and bacteria) and abiotic (drought, salt, temperature, poor soil quality and oxidative) stress tolerance.Production of secondary metabolites production. Molecular farming (improvement in protein, lipids, carbohydrates. Plant antibodies, vaccines, therapeutic proteins and active principles. Biofortication of important crops (rice and banana).

SUGGESTED READING

1. Altman A, Hasegawa P M. 2012 "Plant Biotechnology and agriculture. Prospect for the 21st century" Academic Press, USA.
2. Brown T. A. 2010. Gene Cloning and DNA Analysis: an introduction, 6th edition, Wiley-Blackwell Publisher, UK.
3. Chawla H.C. 2009 Introduction to Plant Biotechnology 3rd Edition, Oxford & IBH publication Pvt .Ltd, New Delhi.
4. Davies K. 2004. Plant Pigments and their Manipulation – Annual plant reviews, vol 14 Blackwell Publication, UK.
5. Glick and Paster mark, 2002. Molecular Biotechnology - Principles and Applications in Recombinant DNA. Panima Publishing Co-operation, Banglore.
6. Primrose S.B and R.M. Twyman. 2003. Principles of Genome Analysis.Blackwell Publishing, Oxford.
7. Slater A, Scott NW, Fowler MR. 2008 Plant Biotechnology: the genetic manipulation of plants, Oxford Press, UK.
8. Winnacker E. 2003. From Gene to Clones; Introduction to gene technology, 4th edition, Panima Publisher, India.

19RBC306F ANIMAL TISSUE CULTURE 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with:

- Applications and limitations of cell based studies
- Aseptic methods to perform animal cell culture
- Types of cell culture techniques
- Assessment of cell proliferation
- Assessment of cell differentiation
- Scale up technologies

CourseOutcomes:

After successful completion, the students will understand:

1. The need and circumstances for the cell based studies
2. Sterile working culture
3. Suspension and adherent cell culture
4. Thymidine incorporation, WST-1 Assays
5. Galactosidase staining, von-kossa, and alizarin red staining
6. Organ culture

Tissue engineering

UNIT I: Introduction to animal cell culture

Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture, advantages and limitations medical/pharmaceutical products of animal cell culture-genetic engineering of animal cells and their applications. Risks in a tissue culture laboratory and safety - biohazards.

UNIT II: types of cell culture

Different types of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application. Facilities for animal cell culture-infrastructure, equipment, culture vessels. Biology and characterization of cultured cells-cell adhesion, proliferation, differentiation, morphology of cells and identification.

UNIT III: Types of Techniques

Primary cell culture techniques - mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells. Mass culture of cells - manipulation of cell line selection - types of cell lines -maintenance of cell lines - immobilization of cells and its application - synchronization of cell cultures and cell division - production of secondary metabolites - biotransformation - Induction of cell line mutants and mutations - cryopreservation – germplasm conservation and establishment of gene banks.

UNIT IV: Animal cell culture scale up

Animal cell culture scale up: Scale up in suspension - stirrer culture, continuous flow culture, air-lift fermentor culture; Scale up in monolayer - Roller bottle culture, multi surface culture, multi array disks, spirals and tubes - monitoring of cell growth. Organ culture - whole embryo culture - specialized culture techniques - measurement of cell death.

UNIT V: Tissue engineering

Tissue engineering: Design and engineering of tissues - tissue modeling. Embryonic stem cell engineering - ES cell culture to produce differential cells - Human embryonic stem cell research. Transgenic animals-transgenic animals in xenotransplantation.

SUGGESTED READING

1. Butler. M. 2004. Animal Cell Culture and Technology, BIOS Scientific Publishers, Taylor and Francis Group. U. K.
2. Freshney, R. I., &Freshney, M. G. 2010. In Freshney, R. I. (ed.), Animal cell culture: a practical approach, 2nd ed. IRL Press at Oxford University Press.
3. Gupta P.K. (2010), Biotechnology & Genomics, 5th Reprint, Rastogi Publications Meerut.
4. Ranga M.M., Animal Biotechnology, (2007) Agrobios, India.
5. Satyanarayana, U., 2006. Biotechnology Books and Allied (P) Ltd. India.

19RBC301G FISH NUTRITION AND TISSUE CULTURE 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 **Marks:100**

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with:

- Fish nutritional value
- Larval nutritional requirements
- Formulation of fish feeds
- Handling of fish
- Breeding methods for fish
- Fish as a model system for the assessment of diseases

CourseOutcomes:

After successful completion, the students will understand:

1. The nutritional value of fish
2. Nutritional requirements for fish larval culture
3. Composition and role of fish feeds components
4. How to handle the fish
5. Methods for the breeding of fish
6. Usage of fish model to determine the efficacy of therapeutic drugs

UNIT – I: Fish Nutrition

Fish nutrition: Principles of fish nutrition and terminologies, Role of nutrients: amino acids, fatty acids, proteins, lipids, carbohydrates, vitamins and minerals. Essential aminoacids, vitamins and minerals and their role in fish and shellfish nutrition.

Unit – II: Energy nutrition

Energy nutrition: Definition, energetics, expression of energy value of feed (gross energy, digestible energy, metabolizable energy, net energy), partitioning of energy and energy budget, protein energy ratio.

UNIT- IV: Larval nutrition

Larval nutrition: Nutritional requirements of fish and shellfish larvae, quality requirements of larval feeds (particle size, digestibility), natural food and its importance in aquaculture, nutritional quality of commonly used fish food organisms (bacterioplankton, phytoplankton and zooplankton) and their roles in larval nutrition.

Unit -IV: Feed Formulations

Feed Formulations and Feed Technology: Classification of feed ingredients. Antinutrients in fish feed ingredients. General principle of feed formulation, Methods of feed formulation: Pearson's method, quadratic equation linear programming, limitations. Types of feed.Hydro-stability of feed and their storage and prevention of spoilage from rancidity. Feed additives: - Classification, function, and specific use for economic and quality fish and shellfish production. Feed evaluation through the study of growth performance, FCR and PER analysis.

Unit V: Fish breeding and Tissue culture

Fish breeding and TissueCulture: Collection, selection and Nutritional management of brooderfishes.Methods of natural and artificial fertilization of fish reproduction. Induced breeding by synthetic hormones and its analogues. Genetic improvement of inheritance, inbreeding and cross breeding.General principles of cell and tissue culture.Culture of primary cell and secondary cell (sub-culture), Cryopreservation of cells, Cell viability and Karyotyping. Fish cell culture and development of fish cell lines and their application.

SUGGESTED READING

1. Cyrino. J. E. P., Bureau, D. and Kapoor B. G. (2008) Feeding and Digestive Functions in Fishes. Edited by. xiii 575 pp. Published by Science Publishers, Enfield, New Hampshire. ISBN 978-1-57808-575-6.

2. Guillame J, Kaushik S, Bergot P &Metallier R. 2001. Nutrition and Feeding of Fish and Crustaceans. Springer Praxis Publication.

3. Heil, N. (2009). Nutritional Wild Fish Health Survey – Laboratory Procedures Manual 5th Edition. U.S. Fish and wildlife services, Warm Springs, GA, Washington, DC.

4. Goswami, M. and Lakra, W.S. (2012). Fish Cell and Tissue Culture: A Text Book. Published by Narendra Publishing House, Delhi. ISBN 10: 9380428642 / ISBN 13: 9789380428642.

5. Westerfield, M. Leonard Zon, H. and Detrich,W. (2009) Essential Zebrafish Methods: Cell and Developmental Biology. 1st Edition, Academic Press.

DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
RESEARCH PROGRAM – M. Phil / PhD in Biotechnology
(2019–2020 Batch and onwards)

Code	Course	Objectives and Outcomes		Ins*	Marks	Exam Hrs	Credit
		PEO´s	PO´s & PSO´s	hours / week	Total		
19RBT101	**Paper – I:** Research Methodology and Pedagogy	I, II, III	a, c, e	4	100	3	4
19RBT201	**Paper – II:** Recent Trends in Biotechnology	I,II	b, d	4	100	3	4
Paper – III *				4	100	3	4
19RBT301	Paper – III: Animal Biotechnology	II, III	d, f, g				
19RBT302	Paper – III: Biotechnology for crop improvement	II, III	d, f, g				
19RBT303	Paper – III: Environmental Biotechnology	II, III	d, f, g				
19RBT304	Paper – III: Immunology	II, III	d, f, g				
19RBT305	Paper – III: Medicinal Plant Biotechnology	II, III	d, f, g				
19RBT306	Paper – III: Plant Tissue Culture	III, IV	f, g, h, i				
19RBT307	Paper – III: Food Technology	III, IV	f, g, h, i				
19RBT308	Paper – III: Structural Biology	III, IV	f, g, h, i				
	G. total			**12**	**300**	**9**	**12**

Blue – Employability **Green – Entrepreneurship** **Red- Skill Development**

PROGRAMME OUTCOMES (POs)

a) Research Graduates will be able to spread over the basic knowledge of applied theories in practical research.

b) Providing necessary broad analytical knowledge to make the scholar for appearing in competitive examinations

c) Ability to design and conduct experiments as well as to interpret the results.

d) A skilled to work on biotechnological concepts and allied fields (immuno, medical, microbial, Food, agricultural, environmental, plant and animal) with recent tools and techniques towards academic, industrial and research application.

e) Scholars will be able to visualize and work on multidisciplinary laboratory problems with standard operating methodologies.

f) With professional, societal and ethical responsibilities, the research scholars with be able to identify, formulate and solve to deliver process/product.

g) Research Graduates will be able to update the current knowledge of interdisciplinary subjects of biotechnology

PROGRAMME SPECIFIC OUTCOMEs (PSOs)

To enable the scholar to emerge as:

h) Professional Biotechnologist with lifelong learning with recognized the societal need.

i) Proficient entrepreneurial and leadership qualities with life-long learning**.**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO I: The research graduates of Biotechnology will able to acquire in-depth research knowledge in various fields of Biotechnology and become competent in competitive exams

PEO II: The research graduates of Biotechnology are able to design, analyze, conduct and interpret the experimental data for process/product development in all sub areas of biotechnology

PEO III: The research graduates of Biotechnology will able to use the concept of theories, research practical skills and recent technological tools in solving any technological and professional issues independently in a global and societal context

PEO IV: The research graduates of Biotechnology will continue learning to update and to become an entrepreneur in a competitive world of technology and contribute to all forms of life

MAPPING OF PEOs AND POs

PEOs			Programme Outcome (s)						
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
PEO I	×	×		`					
PEO II			×	×					
PEO III					×	×			
PEO IV							×	×	×

19RBT101 **Paper – I: Research Methodology and Pedagogy** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives
The main objectives of the course are

- To impart the knowledge on Identification of research requirements
- To apply the state of art knowledge for dissertation writing
- To become familiarize with Experiment design
- To understand the methods of data collection and analysis
- To grasp knowledge on Objective and roll of higher education
- The students will learn overall the basic concept in Characteristics of instructional design

Course Outcomes
On completion of the course, students are able

1. To understand principles of formulation of objectives and hypothesis
2. To explain Guidelines for review of literature
3. To get insight to Use of software for graphics
4. To production of therapeutic proteins in transgenic animals
5. To explain the Ethical issues in animal biotechnology
6. To explain the methods of teaching and learning

Unit I Analysis and Identification of research requirements:
Prioritization of research area. Review of work done in identified area - time scheduling - laboratory facilities, Research duration –choice of research topic – formulation of objectives- formulation of hypothesis– Methodology – Procedure, experiment design.

Unit II Dissertation writing:
Guidelines for review of literature - Materials and methods, results and discussion. Interpretation of results, presentation of results, summary, presentation of references and appendix.

Unit III Experiment design:
Regarding observation. Types of observation. Laboratory setting sample; Data collection – Presentation of and analysis of collected data. Preparation of result reports and Publication of research findings in prier reviewed journals, impact factor.

Unit IV Methods of data collection and analysis:
classification and tabulation. Frequency distribution. Measures of central tendency – Mean, median and mode; Measures of dispersion – Standard deviation, standard error, and variance. Correlation and regression – simple correlation, correlation co-efficient, simple and linear regression analysis. Test of significance (F, t test), chi-square test, ANOVA, DMRT, SPSS. Introduction to computer, MS office. Data handling – Use of software for graphics, slide making, scanning gels, photography X-ray photography and autoradiogram perspective.

Unit V Objective and roll of higher education:
Important characteristics of an effective Lecture - Quality teaching and learning – Lecture Preparation - Characteristics of instructional design – Methods of teaching and learning: Large group – Technique – Lecture, Seminar, Symposium, Team teaching, Project, Small Group Technique – Simulation, role playing Demonstration, Brain storing, case Discussion, and assignment, Methods of evaluation – Self evaluation, Student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education : 'e' learning researches – web based learning.

SUGGESTED READINGS

1. Sandhu,T. (1990). Research Techniques in Biological Sciences. Anmol Publishers, New Delhi.
2. Palanivelu, P. (1999). Analytical Biochemistry and Separation Technique. 3rd Ed, 21st Century Publications, Madurai.
3. Sundar Rao, P.S.S and Richard, J. (2006). Introduction to Biostatistics and Research Methods. PHI Publications, New Delhi.
4. Kothari, C. R. (2004). Research Methodology – Methods and Techniques. 2nd Ed. New Age International Pvt. Ltd, New Delhi.
5. Attwood, T. K. and Parry Smith, D. J. (2002). Introduction to Bioinformatics. Pearson Education Ltd, Singapore.

19RBT201 **Paper – II: Recent Trends in Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To impart the knowledge on UPGMA based analysis
- To apply the state of art knowledge for Molecular cloning
- To become familiarize with Protein engineering
- To understand the methods of Pharmaceutical and Nano Biotechnology
- To grasp knowledge on Upstream and downstream processes
- The students will learn overall Stem cells research

Course Outcomes

On completion of the course, students are able

1. To understand principles of cloning in microorganisms and higher organisms
2. To explain Metabolic engineering
3. To get insight to Use the Transgenic plants
4. To production of therapeutic proteins in transgenic animals
5. To explain the organic synthesis in drug discovery
6. To explain Stem cell therapy

Unit I Biotechnological tools:

UPGMA based analysis –RFLP, RAPD, AFLP, STS, ISSR. Protein and Nucleic acid sequencing and Micro-array. New generation sequencing approaches, Basic Principles and applications. Bioinstrumentation: Microscopy, Electrophoresis, Centrifugation, ELISA, RIA, FISH. Separation techniques: HPLC, GC, HPTLC, LC-MS and application. Spectrophotometry – UV-VIS, FT-IR, Flame photometry, Fluorimetry, Flow cytometry and AAS.

Unit II Molecular cloning:

Vectors in gene cloning: Types of plasmids, vectors; modifying enzymes, polymerase chain reaction, DNA/Protein sequencing, Genomic/cDNA library construction and screening, cloning in microorganisms and higher organisms: Direct and indirect gene delivery systems.

Unit III Applications of Genetic Engineering:

Protein engineering – Site Directed Mutagenesis; Recombinant protein; *De novo* designs; computational design and rational design. Metabolic engineering – Metabolic Flux Analysis, production of secondary metabolites; Molecular breeding of plants – Production of interferon – rDNA vaccines. Transgenic plants – disease- and virus resistance. Transgenic animals- Production, application.

Unit IV Pharmaceutical and Nano Biotechnology:

Biotechnology as a new frontier in health; drug design and discovery; drug development; random screen up, target identification and validation; organic synthesis in drug discovery. Drug delivery; Protein targets for drug design. Molecular modeling using computers. Nucleic acid, Protein - based Nano structure; Lab-on-a-chip; Micro contact printing.

Unit V Advances in Biotechnology:

Fermentation - Types of fermenters- Upstream and downstream processes. Gene targeting; Gene splicing; Gene pool; Genome mapping; Human genome project; Stem cells research- Fundamentals of stem cells- Stem cell therapy.

SUGGESTED READINGS

1. Bernald R Glick, and Jack J Paternack (1996) Molecular Biotechnology, Panima Publication, New Delhi.
2. Brown TA (2000) "Gene cloning - An introduction, 3rd Edition, Stanley thrones Publishers Ltd, New York.
3. Brown TA (1999). "Genomes", John Wiley and Sons Asia Pvt Ltd, New York.
4. Daan J A Crommelin and Robert D Sindelar (2002). Pharmaceutical Biotechnology, 2nd Edition, Routledge Taylor and Francis Inc, New York
5. James D Watson, Michael Gilman, Jan Witkowski. (2000). Recombinant DNA, 2nd edition, Freeman Publication, New York.
6. Palanivelu P. (2004). Analytical Biochemistry and Separation Techniques, 21st Century Publications, Madurai, India.
7. Primrose SB, Twyman, R. M. and Old, R. W. (2001). Principles of gene manipulation, 6th Edition, Blackwell Science Publishing Company, Germany.
8. Ratner and Daniel Ratner (2005). Nanotechnology a Gentle Introduction to the Next Big idea by Mark, Pearson Education, Inc.
9. Stanbury P F., A Whitaker and S J Hall, (1997). Principles of Fermentation Technology, Adithya Book Pvt Ltd, Chennai.

19RBT301 **Paper – III: Animal Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To impart the knowledge on basic animal tissue culture techniques
- To apply the state of art knowledge of subject for the production of tissues, introducing modern drug delivery or vaccination methods.
- To become familiarize with the ethical practices in animal biotechnology
- To understand the laboratory design and requirements for animal tissue culture
- To grasp knowledge on molecular techniques in animal cell culture
- The students will learn overall the basic concept in embryology

Course Outcomes

On completion of the course, students are able to

1. To understand principles of animal culture, media preparation
2. To explain Invitro fertilization and embryo transfer technology
3. To get insight in applications or recombinant DNA technology
4. To production of therapeutic proteins in transgenic animals
5. To explain the Ethical issues in animal biotechnology
6. To handle and maintain the animal models in animal houses

Unit I Laboratory design and requirements for animal tissue culture

Animal tissue culture media, Physical, chemical and metabolic functions of different constituents of culture medium serum free defined media and their applications. Types of tissue culture; disaggregation of tissue and primary cell culture, established culture, suspension culture, organ culture, three-dimensional culture

Unit II Cell separation

Cell counting Cell synchronization. cryopreservation. Cell lines - cell banks. Tissue engineering. Biology and characterization of cultured cells, tissue typing; cell – cell interaction; measuring parameters of growth; measurement of cell death – apoptosis and its determination; cytotoxicity assays.

Unit III Characterization

Need for characterization, Morphology, Chromosome analysis, DNA Content, RNA, Protein, Enzyme and Antigenic Markers. Lymphocyte preparation, Somatic cell fusion.

Unit IV Molecular cell techniques in cell culture

Cell transformation- physical, chemical and biological methods; manipulation of genes; cell cloning and micro manipulation; hybridoma technology and its applications; gene targeting. Gene Therapy. Green fluorescent protein and its application, Oncogenes and tumor suppressor genes and their regulation

Unit V Embryology

Collection and preservation of embryos; culturing of embryos; gametogenesis and fertilization in animals; types of cleavage pattern. *In vitro* fertilization and stem cell research. Transgenesis: Transgenic animals; production and application; transgenic animals as models for human diseases, transgenic in industry; Vaccine production. Ethical issues in animal biotechnology.

SUGGESTED READINGS

1. Ranga, M. M. (2003). Animal Biotechnology. 2nd Edition, Agrobios (India), Jodhpur.
2. Primrose, S. B., Twyman, R. M. and Old, R. W. (2001). 6th Ed, Principles of Gene Manipulation. Blackwell Science Publishing Company, Germany.
3. Freshney, R.I. (2000). Culture of Animal cell: A practical approach, 4th Edition, John Wiley Publications, New York.
4. Jennie, P. Mather and David Barnes. (2001). Methods in Cell Biology. Academic Press, New York.

19RBT302 **Paper – III: Biotechnology for Crop Improvement** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To learn about Molecular Markers
- To learn the strategies for gene transfer in plants and animals
- To acquire knowledge on genome mapping
- To familiarize the student with emerging field of biotechnology
- To acquaint the students to techniques employed in Molecular breeding
- To learn the history and recent developments in Molecular genetics

Course Outcomes

On completion of the course, students are able to

1. Outline the fundamental steps in a genetic engineering procedure
2. Describe the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production
3. Explain the usefulness of Molecular breeding in crop development
4. Discuss about the Molecular genetics
5. Conceptualize C-DNA clones, gene libraries, cloning of DNA sequencing.
6. Summarize various applications of cloning of DNA sequencing.

Unit I Molecular Markers:
Morphological, Biochemical and DNA based markers (RAPD, RFLP, AFLP, SSLP, SSR, VNTRS, and SNP). Development of maps, mapping populations, (F2'S Back crosses, RILs, NILs, and DHs) marker assisted selection, bioinformatics tools in mapping and comparative mapping.

Unit II Genetic Engineering:
Tools of genetic engineering, transformation techniques, gene transfer systems: - *Agrobacterium*-mediated gene transfer, vector mediated gene transfer, micro injuction, Electroporation, direct DNA - uptake, gene gun technique, selectable markers and reporter system., evaluation of transgenics, stabilization and release, biosafety and regulatory issues, intellectual property rights, bioinformatics and bioinfirmation tools.

Unit III Genetic engineering and biotechnology:
Introduction to plant genetic engineering and biotechnology, gene identification, gene isolation, synthesis of gene and gene cloning, restriction enzymes and vectors, regeneration in crop plants, application of plant genetic engineering and biotechnology, transgenic crops, application of rDNA technology - current status and future prospects, regulation mechanism for genetically modified crops, biosafety issues of transgenic crops

Unit IV Molecular breeding:
Molecular mapping and tagging of agronomically-important traits, QTL analysis in crop plants, marker assisted selection for qualitative and quantitative traits, gene pyramiding, genetic engineering, Application in crop improvement.

Unit V Molecular genetics:
Recombination in bacteria and viruses, molecular mechanism of recombination and repair, episomic and transposable elements, genomes in prokaryotes and eukaryotes, genome organization - euchromatin and heterochromatin, DNA

content variation. Types of DNA sequences - unique and repetitive sequences, C-DNA clones, gene libraries, cloning of DNA sequencing.

SUGGESTED READINGS

1. Bernald R Glick, and Jack J Paternack (1996). Molecular Biotechnolog" Panima Publication, New Delhi.
2. Brown TA. (1999). Genome John Wiley and Sons Asia Pvt. Ltd, New York.
3. Brown TA. (2000). Gene Cloning-An Introduction 3rd Edition, Stanley thrones Publishers Ltd, New York.
4. James D Watson, Michael Gilman, Jan Witkowski. (2000). Recombinant DNA" 2nd edition, Freeman Publication, New York.
5. Joshi P. (2007). Genetic Engineering and it's Application 2nd Edition, Agro Bios, India.
6. Primrose SB, Twyman, R.M. and Old R.W. (2001). Principles of gene Manipulation 6th Edition, Blackwell Science Publishing Company, Germany.
7. Purohit S.S. (2008). Biotechnology, Fundamentals and Applications 4th Edition, Agro Bios, India.
8. Varma P.S and Agarwal V.K. (2006). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand Publications.

19RBT303 **Paper – III: Environmental Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain basic concepts of biotechnology to solve the environmental pollution problems
- To ascertain the knowledge about solid waste management and wastewater treatment.
- To gain information about Environmental nanotechnology.
- To gain knowledge about the biological and biotechnological measures for restoring environment.
- To involve in the present scenarios and find valuable solutions for remedy
- To update about the management strategies followed up by the industries and government.

Course Outcomes

On completion of the course, students are able to apply their knowledge on

1. Water Pollution Monitoring
2. Pollution and pollution control
3. Environmental significance of genetically modified microbes, plants and animals
4. Solid waste management systems
5. Treatment of municipal waste and Industrial effluents
6. Biotechnologically important intracellular products

Unit I Environmental Pollution:

Concept of Environmental Pollution; Origin of pollution; Classification and nature of Environmental Pollutants; Major sources; Environmental Pollution at local regional and global level. Environmental Quality Assessment and Monitoring, Deterioration of environmental quality with reference to anthropogenic impact; Environmental Impact Assessment (EIA)

Unit II Water Pollution Monitoring:

Pollutant analysis in water – Physiochemical parameters, Microbiological examination, APDC and MIBK analyses. Methods of monitoring; Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Strategies for controlling pathogen transfer; Chemical methods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Biosensors to monitor pollution.

Unit III Effluent treatment and Solid waste management systems:

Sewage and waste water treatments systems; Primary, secondary and tertiary treatments- Pycoremediation; Measurement of treatment efficiencies; Biological treatments - aerobic versus anaerobic treatments; Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Bioreactors for waste water treatments; Reactors types and design; Solid waste management – types of solid waste; Disposal methods – Sanitary, incineration, land-fill, composting, vermicomposting; recovery of energy from solid waste.

Unit IV Environmental Nanotechnology:

Techniques for synthesis of nanomaterials and nanocomposite; mobility of nanomaterials in aqueous environments, surface chemistry of mineral oxide and carbon nanoparticles, development of nanostructured membranes, mechanisms of nanoparticle bio- degradation, development of nanostructured ceramic bodies for environmental separations and catalysis, nanomaterial-based adsorbents for water treatment, possible mutagenic properties of nanoparticles, nanoparticle bioaccumulation.

Unit V Environmental Microbiology:
Microbes in the environment, measurement of bacterial growth, collection and processing of environmental samples. Media Formulation; Sterilization; Thermal death kinetics Primary and secondary metabolites; Extracellular enzymes; biotechnologically important intracellular products; exopolymers; biopolymer production.

Suggested Readings:

1. Agarval, S. K (2002). Environmental Biotechnology. APH Publishing Corporation, New Delhi.
2. Mark J Hammer (2000). Water and Waste Water Technology. 4th Edition, Prentice Hall of India Pvt Ltd, New Delhi.
3. Yadav, P. R. and Shubhrata R Mishra. (2004). Environmental Biodiversity. Discovery Publishing House, New Delhi.
4. Singh, M. P., Soma Dey and Bijay S Singh. (2004). Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
5. Bailey J E and D F Ollis (1986). Biochemical Engineering fundamentals. 2nd Ed. Chapters 13 & 14, McGraw – Hill.
6. Charles P Poole Jr., Frank J Owens. (2007). Introduction to Nanotechnology. John Wiley & sons Asia Pvt. Ltd. New Delhi.
7. Alans Scragg (2005). *Environmental Biotechnology*. Oxford University Press. Inc. New York.

19RBT304 **Paper – III: Immunology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic concepts of immunology
- To expose students to use these principles of immune system to combats infections
- To gain the information about the auto immune diseases
- To identify the cellular and molecular basis of immune responsiveness
- To describe the roles of the immune system in both maintaining health and contributing to disease
- To demonstrate a capacity for problem-solving about immune responsiveness

Course Outcomes

On successful completion of the course the students will be able to

1. Gain about the various cells and organs involved in the immune system
2. Understand the molecular mechanisms of antigen-antibody interactions
3. And also, the molecular mechanisms behind the immune response evoked after infection by various pathogens
4. Learn the theoretical basis for the various immunological techniques
5. Apply immunological laboratory techniques to understand principles of antigen-antibody reaction
6. Use different immunological test to study the immune effector function and immune development

Unit I Immune System:

Origin and formation of blood cells. Structure, Classification of blood cells. Primary and secondary immune response. Lymphoid organs**:** Primary and secondary lymphoid organs. antigen- antibody interactions. Humoral and cell mediated immunity**.**

Unit II Cellular Defenses:

Blood Coagulation, Phagocytosis, Nodule formation, Encapsulation, Cytotoxicity reactions. Lysins, Hemagglutinins, Lymphokine-like substances, Antimicrobial Factors.

Unit III Hybridoma technology:

Hybridoma technology and monoclonal antibodies, immuno-diagnosis and application of monoclonal antibodies in biomedical research, human monoclonal antibodies and catalytic antibodies, Xeno transplantation from various species.

Unit IV Vaccine technology:

DNA vaccines, identification of B and T epitopes for vaccine development. Immunodiagnosis of infectious diseases, immuno screening of recombinant library. recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents.

Unit V Introduction to immunodiagnostics:

Passive & active immunization– RIA, ELISA and their types, Haemagglutination assay, Double immunodiffusion test. Rocket immunoelectrophorosis.

SUGGESTED READINGS

1. Rockstein, M. (Ed). (1974). The Physiology of Insecta, Vol 5. Academic Press, New York.
2. Gupta, A.P. (Ed). (1979). Insect Hemocytes. Cambridge University Press, Cambridge.
3. Ratcliffe, N.A. and A.F. Rowley. (1981). Invertebrate Blood Cells, Vol. I & II. Academic Press.
4. Kerkut, G.A. and L.I. Gilbert (Eds). (1985). Comprehensive Insect Physiology, Biochemistry and Pharmacology, Vol 3. Pergamon Press, Oxford.
5. Cohen, W.D. (Ed). (1985). Blood Cells of Marine Invertebrates: Experimental Systems in Cell Biology & Comparative Physiology.
6. Brehèlin, M. (Ed). (1986). Immunity in Invertebrates. Springer-Verlag, Berlin.
7. Brey, P.T. and D. Hultmark (Eds). (1998). Molecular Mechanisms of Immune Responses in Insects. Chapman & Hall, London.

19RBT305 **Paper – III: Medicinal Plant Biotechnology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0 External**: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic concepts of phytochemistry
- To expose students to use these principles of general extraction and isolation techniques
- To gain the information about production of secondary metabolites
- To identify the bioactive molecules in the plants
- To describe the roles of plant products and herbal formulations.
- To demonstrate the organic cultivation of medicinal plants

Course Outcomes

On successful completion of the course the students will be able to

1. Gain knowledge about the major secondary metabolites from plants
2. Understand the techniques involved in extraction of phytochemicals
3. Learn the theoretical basis for the Chemical fingerprinting
4. Apply Authentication of medicinal plants to understand the variation
5. Use the knowledge in DNA bar coding

Unit I Phytochemistry:

Screening of major secondary metabolites from plants. Biosynthesis of primary and secondary metabolites - alkaloids, terpenoids, Phenolic compounds and coumarins. Classification and sources of alkaloids. Major classes in phenolic compounds – carotenoids, flavonoids, tannins and phenolic acids. Classification of terpenoids.

Unit II General extraction and isolation techniques:

Alkaloids, sesquiterpenoids, flavonoids and other phenolic compounds from plants. Techniques involved in extraction of phytochemicals – Perculation, Soxhlet extraction, reflux and other methods. Isolation and purification techniques – Thin layer- and Column chromatography, HPLC and HPTLC.

Unit III Biotechnology of medicinal plants:

Production of secondary metabolites from cultured plant cells, elicitation, immobilization, biotransformation, continuous culture and product recovery. DNA bar coding. DNA fingerprinting of medicinal plants – DNA isolation and fingerprinting techniques. Chemical fingerprinting by HPTLC.

Unit IV Bioactive studies:

Anticancer, antidiabetic, anti-inflammatory, hepatoprotectives, antimicrobials from medicinal plants. Antioxidants of plant origin – Reactive Oxygen Species (ROS), antioxidant polyphenols. Toxicity studies on medicinal plants, plant products and herbal formulations.

Unit V Pharmacognosy:

Authentication of medicinal plants – Organoleptic and other pharmacognostic studies. Anatomical studies. Intellectual Property rights (IPR) - patents, copy rights, trade marks. Patenting of biological material. Organic cultivation of medicinal plants. Recent advancements.

SUGGESTED READINGS

1. Harborne, J.B. (1998). Phytochemical methods to modern techniques of plant analysis Chapman and Hall, London.
2. Trease GE, Evans, M.C. (1979). Textbook of Pharmacognosy 12th ed. Balliere-Tindal, London.
3. Irfan A. Khan and Atitya Khanum. (2004). Role of Biotechnology in medicinal and Aromatic plants, Vols. I-X. Ukaaz Publications, Hyderabad.

19RBT306 **Paper – III: Plant Tissue Culture** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To introduce biotechnological methods for Plant Tissue Culture
- To give knowledge about various methods of Shoot and Root induction.
- To cognize and get the knowledge on Suspension Culture in generating plants.
- To explain the basics of the Secondary Metabolites
- To use basic biotechnological techniques to explore general extraction and isolation techniques
- To understand the processes involved in Molecular docking

Course Outcomes

On completion of the course, students are able to

1. Understand the growth conditions required to culture the plants in *invitro* conditions.
2. Inculcate the deep understanding of generating plants in PTC labs
3. Acquire knowledge on Solvent Extraction Methods
4. Inculcate the deep knowledge the processes involved in Structure Prediction
5. Learn the structure and organization of plant genome
6. Learn the basic techniques for hybridization in producing plantlets

Unit I Introduction to Plant Tissue Culture:

Laboratory organization, Sterilization techniques. Plant cell culture media - Media preparation, Plant growth regulators, Role of hormones in plant morphogenesis. Choice of explants. Plant Genome Organization - Chloroplast, Mitochondria, and Nucleus.

Unit II Shoot and Root induction:

Callus culture- types, organ culture, Plant regeneration, Micropropagation, Embryogenesis, Organogenesis, Somatic hybridization and cybridization, haploid Production, Protoplast isolation, Protoplast fusion, Cryopreservation, Synthetic seeds, Somoclonal selection. Hardening of plants Biotransformation- Agrobacterium mediated gene transformation, Ti - plasmid, Ri -Plasmid, Transgenic plant, Resistant plants, Strategies in bioconversion. Production of pharmaceutical compounds.

Unit III Suspension Culture:

Cell suspension - Types of cell suspension- Uses of cell suspension culture - Culture methods- Mass cultivation of plant cells in small Laboratory Scale and Industrial. Secondary metabolite Production from Suspension Culture, Bioreactors - Photo bioreactor. Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques in secondary metabolites, uses of secondary metabolites elicitation.

Unit IV General extraction and isolation techniques:

Alkaloids, sesquiterpenoids, flavonoids and other phenolic compounds from plants. Techniques involved in extraction of phytochemicals -perculation, Soxhlet extraction, reflux and other methods. Secondary Metabolites Isolation and Purification - Solvent Extraction - TLC, GLC, HPLC, HPTLC, GC-MS Methods. Production of secondary metabolites from cultured plant cells, elicitation, immobilization and biotransformation. Structure Prediction - UV, IR, NMR, Mass Spectroscopy.

Unit V Bioactive studies:

Antiulcer, Anticancer, Antidiabetic, Anti-inflammatory, Hepatoprotectives, Antimicrobials from Medicinal Plants. Antioxidants of Medicinal Plant. plant products and herbal formulations. Clinical Application of Medicinal Plant. Organic cultivation of medicinal plants. Drug utilization, Nucleotide database, Molecular docking - Types of docking, Pubchem Compound.

SUGGESTED READINGS

1. Sam Brook, J., E.F Fritsch and T. Maniatis. (2000). Molecular Cloning: A Laboratory manual, Cold Spring Harbor Laboratory Press, New York.
2. Glick, B.R and J.J. Patemack. (1996). Molecular Biotechnology, Panima, New Delhi,
3. Brown, T.A. (1999). Genome, John Wiley and Sons Asia Pvt Ltd. New York.
4. Slater,A., N.W. Scott and M. R. Fowler (2008). Plant Biotechnology, Oxford University Press, Oxford.
5. Nigel Halford and N.G.Halford (2006). Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. Wiley, John & Sons, Incorporated, New Jersey.
6. Maliga, P. (1995). Methods in Plant Molecular Biology. A Laboratory Course, New Age Enterprises. New Delhi.
7. Martin J Chrispeels, David E. Sadava and David E. Sadava (2002). Plants, Genes, and Crop Biotechnology Jones & Bartlett Publishers, Inc., New Jersey.

19RBT307 **Paper – III: Food Technology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0**External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- Understand the concepts of food biotechnology related to food industry
- Attain strong knowledge on primary sources of microorganisms in food
- Explore the methods for development and preservation of fermented foods
- Recognize the nutritive values of fermented foods
- Understand the concepts of product performance testing
- Obtain strong knowledge on FASSI, Packaging and labelling

Course Outcomes

On successful completion of the course, students will be able to

1. Understand the beneficial role of microorganisms in fermented foods and in food processing
2. Understand the role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods
3. Know the baking technology
4. Recognize and describe the characteristics of planning therapeutic diets and dietary management
5. Learn various methods of Manufacturing strategies in food industries
6. Identify diet related diseases

UNIT I Fundamentals of Food Science & Technology:

Definition, scope and current trends in food science and technology. Definition and meaning of food, nutrition, nutrient, health, concept and characteristics of a balanced diet. Different types of food processing technology.

UNIT II Fish processing technology:

Pre-treatment of fish washing, gutting, filleting, beheading, peeling, deveining etc. Filleting of fish, treatments, glazing, packaging and freezing. Processing of prawns, lobster, squid, cuttle fish, crab etc. Canning process, steps involved, process flow, additives. FISH PROCESSING PLANTS: Plant design: Fundamentals of processing plant design: Site selection, design and preparation of layout of processing plants.

UNIT III Baking Technology:

Production of cakes and cookies/biscuits. Types of biscuit dough's –Developed dough, short dough's, semi-sweet, enzyme modified dough's and batters. Cake making: Ingredients and their function Structure builders. Tenderizers, moisteners and flavor enhancers. Production process for Wafers- type of flour, raising agents and maturing. Other miscellaneous products- puff pastry, chemically leavened. Problems of baking.

UNIT IV Therapeutic Nutrition:

Planning therapeutic diets and dietary management in case of fever, typhoid, influenza, rheumatic fever, nephritis, peptic ulcer, hypertension, atherosclerosis, liver cirrhosis and hepatitis. Diet in diseases (metabolic disorders, febrile conditions, surgical & other stress conditions) - causes, symptoms, physiological changes and dietary management.

UNIT V Employability Skills:
Manufacturing of indigenous frozen dessert- Ice-Cream and fat rich dairy products. (a) kulfi (b) malai ka burf (c) milk ices and lollies. (d) milk shake. Manufacturing of skim milk & whole milk powder. product performance testing; market positioning, FASSI, Packaging and labelling, costing; Marketing.

SUGGESTED READINGS

1. Rees, Andy (2006). Genetically Modifies Food: A Short Guide for the Confused. Pluto Press.
2. Davidson S.R, Passmore and J.F. Brock (1986). Human Nutrition and Dietetics. London Churchill, Livingstone.
3. Halford, Nigel G. (2003). Genetically Modified Crops. Imperial College Press.
4. Suri S and Malhotra A. (2014). Food Science, Nutrition and Safety, Pearson India Ltd.

19RBT308 **Paper – III: Structural Biology** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **0** External: **100** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- Understand fundamental principles of Stereochemical analysis of proteins
- Comprehend the optical activities of biological macromolecules.
- Recognize the concepts on Structural characterizations of proteins
- Obtain key knowledge on Molecular Modelling methods
- Understand key concepts on NMR structures of proteins – Calculations and validations.
- Attain strong knowledge on Computational Methods in Structural Biology

Course Outcomes

On successful completion of the course, students will be able to

1. Demonstrate an understanding the detection methods for enzyme kinetics
2. Identify, explain and judge safety issues related to biomedical instrumentation
3. Apply the principles in analyzing structural interactions and structural transitions
4. Define the principal concepts about Proteins in solution state
5. Recognize the definition of protein crystallography and related concepts
6. Apply the Phylogenetics in Structural Biology

Unit I Biomolecular Chemistry:

Electronic configurations – Quantum numbers – Chemical bondings – Isomerisms – Buffers in biological systems – Stereochemical analysis of proteins – Protein folding and biological significance – Thermodynamic estimation of protein stability – Biological functions - Allosteric effect - Detection methods for enzyme kinetics – DNA structures – Types – Helical transitions – *Syn/Anti* conformations - Sugar puckering – Optical activities of biological macromolecules.

Unit II Structural Characterizations of Biomolecules:

Analyzing structural interactions and structural transitions of biological macromolecules under thermodynamic and as well kinetic environments through advanced techniques – SF-Ultraviolet spectroscopy - SF-Fluorescence spectroscopy - SF-Circular Dichroism spectroscopy - QF-Nuclear Magnetic Resonance techniques in conjunction with Hydrogen-Deuterium exchange (EX1/EX2) methods.

Unit III NMR of Proteins:

Proteins in solution state - Basic principles of NMR - Chemical shift - Inductive effects - Anisotropic effects - Spin-spin splitting - Double resonance method - Structural characterizations of proteins by 1D NMR methods - 2D NMR experiments: COSY, TOCSY, NOESY - Assignment strategies - 3D NMR experiments (HNCA, HNCOCA, HNCACB, CBCACONH, CCH-TOCSY, HCCH-TOCSY) – NMR structures of proteins – Calculations and validations.

Unit IV Structures of Proteins in Solid and Gaseous states:
Mass spectrometry – Basic principles – EI-MS of small molecules - Structural characterizations and folding pathways of proteins by ESI-MS and MALDI-MS - Structures of proteins in gaseous state by IM-MS - Protein crystallography - Bragg's law - Space groups - Miller indices - Collecting X-ray data - Unit cell determination - Matthew's coefficient - Phase problem - Obtaining Model Structures.

Unit V Computational Methods in Structural Biology:
Local and global sequence alignment algorithms - Multiple-sequence alignment strategies – Phylogenetics – Molecular Modelling methods - Classification of proteins using CATH & SCOP - Process of drug discovery - Structure-based lead design – Ligand-based lead design – Molecular docking – HTVS - Small molecular libraries – Pharmacophores - QSAR methods - Lead optimisation – ADMET.

SUGGESTED READINGS

1. Morrison RT, Boyd RN and Bhattacharjee SK. (2011). Organic Chemistry (Pearson India).
2. Rodwell VW, Bender D, Botham KM, Kennelly PJ and Weil PA. (2015). Harper's Illustrated Biochemistry (McGraw-Hill Medical).
3. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R. (2013). Molecular Biology of the Gene (Benjamin Cummings).
4. Freeman WH (1999). Structure and mechanism in protein science.
5. Kurt W (1986). NMR of proteins and nucleic acids (Wiley, New York).
6. Keith W and John MW. (2010). Principles and Techniques of Biochemistry and Molecular Biology (Cambridge University Press).-
7. David W.M. (2005). Bioinformatics – Sequence and Genome Analysis. (CSHL Press).

KARPAGAM ACADEMY OF HIGHER EDUCATION

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(Established Under Section 3 of UGC Act 1956)

EachanariPost,Pollachi Main Road,

Coimbatore -641021

COURSE OF STUDY & SCHEME OF EXAMINATION

M.Phil. & Ph.D. COURSE IN CHEMISTRY

2019- 2020

Part-I Course Work Syllabus for M.Phil and Ph.D Chemistry

Subject Code	Title of the Course	Credit	Exam Hours	Marks
Paper-1(Compulsory)				
19RCH101	Research Methodology and Pedogogy	4	3	100
Paper-II(Compulsory)				
19RCH201	Physical Methods in Chemistry	4	3	100
Paper-III(Any One)				
19RCH301 A	Organic Chemistry	4	3	100
19RCH301B	Physical Organic chemistry	4	3	100
19RCH301C	Electro Chemistry	4	3	100
19RCH301D	Environmental Chemistry	4	3	100
19RCH301E	Chemistry of Crystalline solids	4	3	100
19RCH301F	Organometallic Chemistry of Transition metals	4	3	100
19RCH301G	Chemistry of Biomolecules	4	3	100
19RCH301H	Polymer Chemistry	4	3	100

Part I – M. Phil.,/ Ph.D.,

CHEMISTRY

Paper-I: Research Methodology and Pedagogy (Effective from the academic year 2019-2020 and onwards)

Course Objective:

- To learn and practice the literature survey aspects of projects and prepare the scope and goals for the proposed project.
- To learn, practice and improve the research presentation skill and with latest tools
- To learn and understand the research publication ethics
- To learn the tools like LaTeX
- To understand the error analysis
- To learn the emission spectrocopy

Course Outcome:

1. Enable the student potential to organize, coordinate and focus research aptitude with confidence

2. Improve the awareness on indexing, quality evaluation, author index of publications

3. Improve the presentation skills through seminars

4. Expertise in LaTeX tool for report preparation

5. Understood the error analysis

6. Learnt the emission spectroscopy

UNIT I

Research Methodology - Objectives of Research - Types of Research - Criteria for good Research . Defining the Research Problem - Research Design. Dissertation writing- Guidelines for review of literature - Materials and methods, results and discussion. Interpretation of results, presentation of results, summary, presentation of references and appendix.Use of Computers in Research – Data base Operations like creation – updating – indexing/sorting and searching of data, data entries and analysis, graphical applications.

UNIT II

Data Analysis: Errors in chemical analysis - classification of errors – determination of accuracy of methods - improving accuracy of analysis - significant figures - mean, standard deviation-comparison of results : "t'' test, "f" test, and "chi" square test – rejection of results-presentation of data.Sampling – introduction – definitions - theory of sampling-techniques of sampling - statistical criteria of good sampling and required size - stratified sampling vs random sampling – minimisation of variance in stratified sampling – transmission and storage of samples.

UNIT III

Definition of problem: Necessity of defining problem, Technique involved in defining a problem. Surveying the available literature. Building up of own literature collection, citation techniques.

Research Design: Subject of study; Place of study; Reason of such study; Type of data required; Method of data collection; Periods of study; Style of data presentation.

Developing a research plan: Research objective; Information's required for solving the problem; Different methods used to solve a problem.

Publication of Journal Articles: Concept, types of journals, components of a journal article, preparation of the manuscript, from manuscript to publication and online submission.

Submission of Research Proposals: Leading funding agencies in India, Submission of research project proposals with prescribed formats.

UNIT IV

Flame emission and atomic absorption spectroscopy and Fluorometric Analysis: Types of atomic spectroscopy – emission methods - absorption methods - fluorescence methods - applications of atomic emission spectroscopy – flames and flamespectra. Fluorescence and phosphorescence – applicationoffluorometricanalysis.

HPLC and Gas Chromatography:Theory of chromatography - detectors - Application of gas/mass analysis. Principles of high performance liquid chromatography - gradient elution, isocratic elution, sampling detectors for liquid chromatography - quantitative analysis by HPLC.

UNIT V

Pedagogical Methods in Higher Education Objectives and roll of higher education – Important characteristics of an effective Lecture – Quality teaching and learning – Lecture preparation – Characteristics of instructional design – Methods of teaching and learning : Large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing Demonstration, Brain storing, case discussion, and assignment, Methods of evaluation – Self evaluation, student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education: - ‘e’ learning researches – web based learning

References:

1. J. D. Dick,(1973). Analytical chemistry. McGraw Hill, N.Y. also available in International students edition McGraw Hill, Mogakusha.

2. J.Dyer, (1965), Applications of absorption spectroscopy of organic compounds. Prentice- Hall, Englewood Cliffs,N.J

3. S.M Khopkar,(1998), Basic concepts of analytical chemistry, New Age International, New Delhi

4. B. K. Sharma.(2000),Instrumental methods of chemical analysis, Krishna Prakashan Media,2000

5. Skoog.D.A and M. West.(2006), Principles of instrumental analysis, Brookes Cole Publishers,Calefornia

6. Willard.H, L. Merrit Jr and A. Dean.,Instrumental methods ofanalysis

7. Vedanayagam, E.G (1989) Teaching Technology for college teachers. NewDelhi: Sterling Publishers (P)Ltd.,

8. Rajasekar.S (2005) Computer Education and educational computing.Hyderabad: NeelkamalPublications.

9. Kumar K.L. (1997) Educational Technologies, New Delhi: New age International.

Part I – M. Phil.,/ Ph.D.,

CHEMISTRY

Paper-II: Physical Methods in Chemistry (Effective from the academic year 2019-2020 and onwards)

Course Objective:

- To develop fundamental understanding of spectroscopic techniques - their origin from the interaction of radiation with matter.
- Principles and instrumentation of major spectroscopic techniques.
- Application of each spectroscopic technique for chemical structure characterization.
- Develop an ability to rationally exploit a variety of spectroscopic techniques for future research or industrial assignments.
- It is expected that at the end of this course students will be able to decipher the structure of reasonably complex molecules using spectroscopic techniques.
- To discuss about electron spectroscopy and thermal analysis

Course Outcome:

- Develop fundamental understanding of spectroscopic techniques - their origin from the interaction of radiation with matter.
- Principles and instrumentation of major spectroscopic techniques.
- Application of each spectroscopic technique for chemical structure characterization.
- Develop an ability to rationally exploit a variety of spectroscopic techniques for future research or industrial assignments.
- It is expected that at the end of this course students will be able to decipher the structure of reasonably complex molecules using spectroscopic techniques.
- Discussed about electron spectroscopy and thermal analysis

UNIT I

U.V - Visible spectroscopy:

Electronic excitation – origin of different bands - intensity of bands – selection rules – laws of photometry – correlation of electronic absorption with molecular structure – chromophoric groups – conjugated systems – systems of extended conjugation – aromatic systems – empirical rules – experimental methods – photometric methods – photometric titrations.

I.R. spectroscopy: Molecular vibrations – selection rules – force constant – band assignments – applications –organic structures – finger printing – identification of common functional groups – applications.

UNIT II

1H and 13C NMR spectroscopy: Proton chemical shifts – aromatic ring systems – anisotropic effects – 13Carbon chemical shifts – mechanisms of spin - spin coupling – vicinal, geminal and long range proton – proton coupling.

Analysis of NMR spectra: Accumulation of spectra by the pulsed NMR technique – nuclear relaxation – Fourier transformation – the pulsed FT NMR spectrometer.

Double resonance technique and relaxation mechanisms: Homonuclear decoupling – heteronuclear decoupling – proton decoupling technique in 13C spectrum – INDOR and Nuclear overhausser effect (NOE) – 13C relaxation mechanisms – measurement of relaxation times – spin-lattice relaxation (T1)spin-spin relation (T2) measurements – assignment technique in 13C spectra – chemical shift correlation quantitative measurement in 13C – NMR – relaxation reagents – intensity standards.

UNIT III

ESR Spectroscopy: Theory – instrumentation –derivative curves 'g' values – 'g' shift – origin of hyperfine splitting – isotropic systems – anisotropic systems – anisotropic effect zero field splitting – Krammers degeneracy – applications to organic and inorganic systems – identification of free radicals.

X-ray PhotoelectronSpectroscopy: Introduction – Theory of XPS – Instrumentation – Applications of XPS to organic and inorganic systems.

UNIT IV

Mass Spectrometry: Theory – instrumentation – various types of mass spectrometers – magnetic focusing instruments – sample handling – production and reactions of gaseous ions – isotopic abundance – determination of molecular weights and formulae – metastable peaks – nitrogen rule – ion fragmentation mechanisms – rearrangements – use of mass spectrometry in the structural elucidation of organic compounds – mass spectra of compounds containing different functional groups.

UNIT V

Instrumental Methods Thermal Methods: Principle and applications of Differential Thermal analysis (DTA), Differential Scanning Calorimety (DSC), Differential Thermal Gravimetry (DTG) and Thermo Gravimetry (TG). Effects of experimental conditions on the course of thermo analytical curves. Diffraction Methods: Fundamentals of X-Ray Diffraction- Powder and

Rotating crystal methods- use of X-ray powder diffraction data in identifying crystalline solids-details for cubic systems- Comparison of X- ray, neutron and electron diffractions. Nanoscale Characterization: Principle and applications of SEM and TEM.

References:

1. Becker .K.,(2000). High Resolution NMR. AcademicPress.
2. Cullity. B.D (1975). Introduction to X-Ray Diffraction. Addison-WesleyPublishers
3. Drago,R.S.(1965) Physical methods in Inorganic Chemistry. Reinhold Publishing Corporation.
4. Hamming and Foster (1972). Interpretation of Mass Spectra of Organic Compounds. AcademicPress.
5. Mclafferty (1973). Interpretation of Mass Spectra. Published by BenjaminPress.
6. Raw.Johnstone (1975). Mass Spectrometry for Organic Chemistry. Published by The ChemicalSociety.
7. Scharz (1964).Physical methods in Organic Chemistry. Oliver & BoydPublishers.
8. Weilie Zhou., Zhong Lin Wang.(2006). Scanning Microscopy for Nanotechnology. SpringerPublishers.
9. West, A.R.(1985). Solid state Chemistry and its applications. Published by WileyDefault.

Part I – M. Phil.,/ Ph.D.,
CHEMISTRY
Paper III: Special Paper I – Organic Chemistry (Effective from the academic year 2019-2020 onwards)

Course Objectives
This course enables the students

- To understand theory of concerted reaction.
- To provide a versatile knowledge of different name reactions and their application in synthesis.
- To learn about familiar addition and elimination reactions.
- To gain knowledge about reaction intermediates.
- To understand the principles and reaction mechanisms involving various electrophilic and nucleophilic, addition and elimination reactions.
- To relate the different organic reaction mechanisms.

Course outcomes (CO's)
On the completion of this course, students should have to

1. Learned the concept theory of concerted reactions.
2. Familiarized the various types of electrophilic and nucleophilic substitution reactions and their Mechanism
3. Learned the familiar addition and elimination reactions
4. Learned the concept of reaction intermediates.
5. Understood about synthesize aromatic compounds using electrophilic and nucleophilic substitution, addition and elimination reactions.
6. Described the various organic reaction mechanisms.

UNIT I
Theory of Concerted Reactions: Definitions - molecular orbitals – frontier orbitals – frontier orbital approach – correlation diagrams – the aromatic transition state concept – general rule for pericyclicreactions.

Electrocyclic Reactions: Definition – thermal electrocyclic reactions – photochemical electrocyclic reactions – metal catalysed electrocyclic reactions.

Cycloadditions: Introduction – selection rules for thermal polyene cyclo additions – Diels – Alder reaction – The retro diels – alder reaction – 1,3 Dipolar cycloadditions – Retro 1,3 – dipolar additions.

UNIT II
Modern reagents in Organic synthesis: Sodium cyanoborohydride – osmium tetraoxide – lithium dimethyl copper – thallium trifluoro acetate – sodium hydrogen telluride – silver hexa fluorantimonate – Thiobenzoyl chloride – trichloro silane- vanadium oxytrifluro – phosphonitrile chloride – ruthenium tetraoxide – barium magnaganate – benzene selenic acid – benzene selenyl

bromide/chloride, aluminium chloride/phosphoryl chloride.

UNIT III

Stereochemistry, Conformational Analysis & Retrosynthetic analysis Stereoselective, stereospecific and regiospecific reactions – stereoselectivity in carbonyl addition- Cram's rule – configuration – conformation – torsional strain – Vander waals strain – gauche interaction – allylic strain – conformation analysis of acyclic molecules. Retrosynthetic Analysis of Simple Organic compounds: Retrosynthetic analysis of mono & difunctional open chain target molecules and monocyclic target molecules.

UNIT IV

Chromatography: Theory, Instrumentation & application in the chemical analysis of column, paper, thinlayer, ion-exchange, Gas chromatography (GC) and High Pressure Liquid Chromatography (HPLC).

Natural products: Extraction, Isolation and structural elucidation (using spectroscopic methods) of terpenes, steroids, alkaloids and phenolic compounds.

UNIT V

Problem solving: Solving the structure of simple organic molecules on the basis of UV, IR, NMR & Mass spectral data. (restricted to organic compound compounds having 12 carbon atoms).

References:

1. Agarwal O.P, (2004). Natural Product Chemistry, Vol. I, Goel Publishing House,Meerut
2. Agarwal O.P, (2004). Natural Product Chemistry, Vol. II, Goel Publishing House,Meerut
3. Mackie R.K. and D.M.Smith, 1982. " Guide book to Organic Synthesis",ELBS,

4. Reagents for Organic synthesis – Feiser & Feiser Vols. I –XII.
5. Silverstein and Webster, 1998. "Spectrometric Identification of Organic Compounds", 6th Ed., Wiley
6. Skoog D.A.and D.M.West, (2004).Fundamentals of Analytical Chemistry, 8th Edition, Thomson book store,Singapore
7. Usharani S., (2002). Analytical Chemistry, Mac Millan India Ltd.,Chennai

Part I – M. Phil.,/ Ph.D.,

CHEMISTRY

Paper III: Special Paper II – Physical Organic Chemistry (Effective from the academic year 2019-2020 onwards)

Course Objectives

On successful completion of the course the students should have

- To know about versatile knowledge of rearrangements
- To understand the different organic (radical and concerted) reactions and their applications in synthesis.
- To learn about unimolecular and bimolecular surface reactions and LFER
- To explain the concepts in organic photochemistry
- To describe the basic ideas about pericyclic reactions
- To implement this basic concept to design and produce the new organic molecules

Course outcomes (CO's)

1. Understood the versatile knowledge of rearrangements
2. Understood the different organic reactions (radical and concerted).
3. Learned about the unimolecular and bimolecular surface reactions and LFER
4. Explained about the molecular rearrangements, Pericyclic reactions and Cyclo addition and sigmatropic reactions
5. Described the basic ideas of pericyclic reactions.
6. Designed new form of organic compounds using these basic concepts.

UNIT-I

Theories of Reaction Rates:

Absolute reaction rate theory – thermodynamic treatment of ARRT – Significance of reaction co- ordinate – application of ARRT to simple unimolecular and bimolecular process –potential energy surfaces – partition functions and activated complexes. Eyring equation, estimation of free energy, enthalpy and entropy of activation and their significance – kinetic isotopic effect.

Homogeneouscatalysis

Acid – Base catalysis – Hammed acidity function, Bronsted relationship – enzyme catalysis – mechanism of single substrate reactions – Michaels – Mention law-influence of pH and temperature.

UNIT II

2.1 Reaction in solution

Introduction – Unimolecular & Bimolecular surface reaction (Langmuir & Freundlich adsorption isotherm only)- application of ARRT to solution kinetics – the influence of solvent- the ionization of neutral molecules - kinetics of ionization- primary and secondary salt effect.

2.2. Oxidation & Reduction

Oxidation with chromium and manganese compounds – Oxidation with per acids and other peroxides – oxidation with periodic, lead tetra acetate, mercuric acetate – selenium dioxide.

Catalytic hydrogenation and dehydrogenation metal hydride reductions and related reactions dissolving metal reductions and related reactions-reductions and the hydroactive and its derivatives.

UNIT III

Quantitative structure and Reactivity Relationships

The linear free energy principle – (LFER) linear relationship involving difference reaction - the cettler correlation. The Hammett equation – steric effects – resonance interaction – normal substitutent constants –σ - , σ + constants – inadequacy of dual hypothesis – regularities in through resonance effect – the Yukawa Tsuno equation – systematic deviation – steric inhabitation of resonance – Taft equation – correlation of aliphatic and aromatic relativities.

UNIT IV

Photo Organic chemistry: Light absorption – unimolecular photo physical processes – Jablonski diagrams –radioactive transitions – internal conversion – intersystem crossing – energy pooling – excimers and exciplexes.

Photochemical reactions: Introduction –cis – trans Isomerisation – Norrish type I reaction – Norrish type II reaction – Thermal generation of excited states. Zimmerman rearrangement,photochemical rearrangement of enones. photorearrangement of cyclohex – 2 – enones – rearrangements of 2 – cyclopentenones and related compound.

UNIT V

Theory of Concerted Reactions:

Definitions – molecular orbital – frontier orbital – frontier orbital approach –correlation diagrams – the aromatic transition state concept – general rule for pericycle reactions.

Electro cyclic Reactions:

Definition – thermal electro cyclic reactions – photochemical electro cyclic reactions – metal catalyzed electro cyclic reactions.

Cycloadditions:

Introduction – selection rules for thermal polyene cyclo additions – Diels – Alder reaction

– The retro diels – alder reaction – 1,3, - Dipolar cycloadditions – Retro – 1,3 – dipolar cyclo additions.

References:

1. Gilchrist,PL.,and R.C. Storr (1972). Organic Reactions & Orbital Symmetry. CUP ArchivePublishers.
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Part I – M. Phil.,/ Ph.D.,

CHEMISTRY

Paper-III: Special Paper III-Electrochemistry

(Effective from the academic year 2019-2020 and onwards)

Course Objectives

This course enables the students

- To provide knowledge on fundamental understanding of chemical kinetics and to establish a relationship between the rate of reaction and the concentration of the reactants (the rate law, or rate equation).
- To apply the chemical kinetics concept to study the enzyme mechanisms.
- To provide knowledge to the students about coulometric methods and its application.
- To investigate the adsorption, classification of adsorption and factors affecting of adsorption over corrosion application.
- To remember the basic polarography concepts.
- To understand the theories of catalysis and types of catalysis.

Course outcomes

On the completion of this course, students have to

1. Student understood theories of reaction rates, how reaction rates are measured and represented in rate laws.
2. Understood the applications of chemical kinetics in studying enzyme mechanisms
3. Provided the knowledge of coulometric methods and applications.
4. Evaluated the electrochemical principles involved in corrosion and energy storage.
5. Remembered the basic polarography techniques.
6. Understood the theories of catalysis and types of catalysis

UNIT I

Introduction and Principles:

Definition –Cost of corrosion-importance of corrosion studies-classification of corrosion–expressions for corrosion rate.Electrochemical principles of corrosion : Faraday's laws –Types of electrochemical cells formed in corrosion process. thermodynamic principles of corrosion : Electrochemical series/ standard electrode potentials and thermodynamic corrosion theory-Galvanic series of metals and alloys and limitations. Forms of corrosion (Definition –cause and effects) : Galvanic –Crevice –Pitting -Intergranular – Selective leaching –Erosion-Stress-Hydrogen damage.

UNIT II

Kinetics of Corrosion: Importance –Graphical presentation of kinetic data –exchange current density –different types of polarization of electrodes.Activation polarization and Tafel plots – Mixed potential theory – Application of electrode kinetics to experimental observations-Faradic impedance and corrosion.

UNIT III

Kinetics of Passivity: Introduction-electrochemical behaviour of active/passive metals-Flade potentials-criteria for selecting a metal exhibiting passivity-effects of various factors on electrochemical behaviour and corrosion rate of metal exhibiting passivity-measured versus theoretical anodic polarization behaviour-Theories of passivity.

UNIT IV

Monitoring of Corrosion: Determination of corrosion and corrosion inhibition parameters-Non-elecrochemical methods:Coupon-Electrical resistance-Gasometeric methods:Electrochemical methods: Polarisation-Galvanostatic-Potentiostatic –Potentiodynamic-AC impedance-Hydrogen permeation.

UNIT V

Corrosion control: Metals and alloys-metal purification-non metallic-cathodic and anodic protection – comparison.Alteration of environment : Changing the medium –use of inhibitors-classification of inhibitors –mechanism of inhibition-Coating (Elementary ideas only).

References:

1. Herbert H.Uhlig and Winston Review.R. (1984). Corrosion and Corrosion control(An introduction to corrosion science and engineering) ,Third Edition,A Wiley Interscience Publication, NewYork.
2. Mars Fontana G. (1984).Corrosion Engineering, Third Edition, Mc.Graw HillBook Company,Singapore.
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4. Raj Narayan.P. (1983).An introduction to metallic corrosion and its prevention,Oxford and IBH Publishing C., NewDelhi.
5. Schmitt G. (1984). Application of inhibitors for acid media ,Corros.J,73.

Part I – M. Phil.,/ Ph.D.,
CHEMISTRY
Paper-III: Special Paper IV-Environmental Chemistry

(Effective from the academic year 2019-2020 and onwards)

Course Objectives

The course enables the students to

- Understand the industrial gases and inorganic chemicals which have an impact on the environment.
- Study about the general principles of metallurgy.
- Learn the environment and its segments.
- Discuss about the water pollution and water treatment.
- Explain the application of bio-catalysis in energy saving techniques.
- Apply this technique to design energy saving devices with eco-friendly method.

Course Outcomes

The course enables the students to

1. Understood the industrial gases and inorganic chemicals which have an impact on the environment.
2. Studied about the general principles of metallurgy.
3. Learned the environment and its segments.
4. Discussed about the water pollution and water treatment.
5. Explained the application of bio-catalysis in energy saving techniques.
6. Appling this technique to design energy saving devices with eco-friendly method.

UNIT-1

Chemistry of Water and Waste water:

Basic principles and their significance with special reference to colour, turbidity, alkalinity, acidity, chemical coagulation, hardness, water softening, disingection, residual chlorine and chlorine demand, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, nitrogen, phosphate, sulphate, gas analysis, enzymes, factors affecting enzyme activity, bio-chemistry of carbohydrates, proteins, fats and oils under aerobic and anaerobic conditions, detergents and their degradation, composition and characteristics of sewage.

UNIT II

Chemistry of air pollutants-I

Introduction, definition, classification of air pollutants, effect of air pollutants on man, materials, animals and plants, ambient air quality standards, harmful concentrations, geographical and meteorological factors in air pollution control, measurement of gas flows, volume, quantity and velocity.

UNIT III

Chemistry of air pollutants-II

Methods of sampling, particulate collection by liquid scrubbing, centrifugal spray scrubbers, venturi scrubbers, foam scrubbers; field sampling techniques such as deposition, absorption, filteration, condensation, adsorption, adhesion, electrostatic precipitation, thermal precipitation, analysis of air pollutants such as particulates sulphur dioxide, carbon monoxide, oxides of nitrogen, hydrogen sulphide, etc., control measures.

UNIT IV

Chemistry of solid wastes:Chemistry of composting: mechanism involved in the decomposition of organic materials like hemicellulose, proteins, carbohydrates, food materials, organic insecticides, form wastes, etc., by aerobic and anaerobic processes.

UNIT V

Chemistry of Incineration and Pyrolysis: Incineration; definition; Incineration of solid waste; combustion characteristics of various inorganic and organic materials; heating values- determination of heating values of combustible liquidandsolidwastes;airrequirementforcombustion;fateoftraceconstituentssuchassulphur during incineration; gaseous pollutants; definition of pyrolysis; chemical changes taking place in organic and inorganic materials during pyrolysis; importance of pyrolysis in the solid waste disposal; chemistry of recycling of solid waste; recycling and reuse of materials such as paper, plastic, glass, etc.

References:

1. American Public Health Association Inc., New York, (1976). Standard methods for the examination of water and wastewater.
2. Hagerty, D.J.,J.L.Pavoni and J.E.Heer, (1973). Jr., Solid waster management,Van Nostrand Reinhold Co., Newyork.
3. Jacobs, M.B., (1960). Chemical analysis of Air pollutants, Interscience, New york.
4. Leithe, W. (1971). Translated by R.Kenor, The analysis of air pollutants, Ann Arbor
5. Ross, R.D,(1972). Air pollution and Industry, Van Nostrand Reinhold Co.,New York

6. Sawyer,C.N. and PL.Mccerty,(1978). Chemistry of Environmental Engineers,Mc.Graw HillPublishers.
7. Stern, A.C., Ed.,(1968). Air pollution, Vol.1, 2 and 3,Academic press, New York.
8. Strauss, W.Ed.,(1978). Air pollution control,part 1,2 and 3, Wiley Interscience, New york,
9. Stumm.W. and J.J.Morgan,(1972). Aquatic Chemistry, Wiley Interscience.
10. Wilson, D.G,(1977). Hand book of solid waste management, Van NostrandReinhold Co., New york.

Part I – M. Phil.,/ Ph.D.,
CHEMISTRY
Paper-III: Special Paper V- Chemistry of Crystalline solids
(Effective from the academic year 2019-2020 and onwards)

Course Objectives

The course enables the students to

- To understand the crystal system
- To learn about X-ray diffraction studies
- To know about crystal phenomena
- To understand the various types of solids and its properties
- To learn about conductors and insulators
- To gain knowledge about phase transition and its classification and transformations.

Course Outcomes

The course enables the students to

1. Understood the crystal structure
2. Learnt about X-ray diffraction studies
3. Knowledge about crystal phenomena
4. Understand the various types of solids and its properties
5. Learnt about conductors and insulators
6. Gained knowledge about phase transition and its classification and transformations

UNIT I

The crystal systems – lattices and crystal structures – symmetry properties – crystal classes – space groups – experimental methods of X-ray diffraction for powder and singlecrystal samples – structural analysis and refinement – electron and neutron diffraction in thedetermination of structures.

UNIT II

Crystal growth phenomena – introduction – nucleation – theories of nucleation –classical theories of nucleation – Gibbs Thomson equation for vapour – modified Thomson'sequation for melt – Gibbs Thomson's equation for solution – energy of formation of anucleus – spherical nucleus – cylindrical nucleus – heterogeneous nucleation – cap shapednucleus, disc shapednucleus.

UNIT III

Types of solids – close packing of spheres – binding in crystals – the bond model –non-stoichiometry – defects in solids – imperfection and physical properties – electrical,opticalmagnetic and mechanical properties – magneticmaterials– mixed oxides – spinels,insulators – semiconductors and superconductors.

UNIT IV

Low temperature solution growth- solution, solubility and super solubility –expression of super saturation – methods of crystallization – by slow cooling of solutions –by solvent evaporation – temperature gradient method. crystal growth system – constant temperature bath – crystallizer – filtration assembly – seed, seed mount platform and crystal revolution – unit – gel growth – introduction – principle of gel growth – various types of gel– structure of gel – growth of crystals in gels – importance of gel technique – experimentalprocedure – single diffusion method – double diffusion method – chemical reduction method– solubility reduction method – growth from the melt – Bridgman technique – Czochralskitechnique – zone refining.

UNIT V

Phase transitions – definition – Burger's classification – thermodynamic classification– Landau theory of phase transition – first order and second order transitions – structural changes with increasing temperature and pressure – martensitic transformations – order –disorder transitions. Thermal analysis – basic Principles – instrumentation – applications of thermogravimetry – differential thermal analysis and differential scanning calorimetry.

REFERENCES:

1. Anthony R.West (1987),Solid State Chemistry and its applications — John Wileyand Sons.
2. Azarof,L.V, (1960), Introducation to solids.
3. Chakrabarthy.D.K,(1966) Solid State Chemistry — New Age internationalpublishers
4. Charles Kittel, Principles of solid statePhysics.
5. Cheetham A.K. and Peter Day (1991). Solid State Chemistry Techniques – Edited by– OxfordSciencePublications.
6. Dent Glasser.L.S (1982)Crystallography and its applications —ELBS.
7. John Enemark, (1988) Introducing Chemists to X-ray Structure Determination,Journal of Chemical education,June.
8. Moore.W.J, (1962),PhysicalChemistry.
9. Dr..Santhana Raghavan.P and Dr.P.Ramasamy ,Crystal Growth Process and Methods– K.R.V.Publications.

Part I – M. Phil.,/ Ph.D.,

CHEMISTRY

Paper-III: Special Paper VI- Organometallic Chemistry of Transition metals

(Effective from the academic year 2019-2020 and onwards)

Course objectives

This course enables the students

- To learn about nature of the bonding between organic ligands and metals.
- To understand about the metal alkyl complexes.
- To learn about the alkene and cyclopentadienyl complexes.
- To understand about the usage of organometallic compounds as catalysts
- To learn about the organometallic compound used as the catalyst in hydrogenation and hydroxylation of olefins.
- To study the concept of oxidation and polymerization of olefins.

Course Outcomes

On the completion of the course

1. Learned about the Alkyls and Arene complexes
2. Understood the bonding in olefin, acetylene and allyl systems
3. Known about the concepts of synthesis, structure and bonding in metallocenes
4. Understood the Organometallic reaction mechanisms and its applications
5. Learned about the Catalysis, hydrogenation of olefins and oxoprocess
6. Studied the concept of oxidation of olefins and polymerization

UNIT I

Definition of organometallic compound – 18 electron rule – effective atomic number rule – classification of organometallic compounds – the metal carbon bond types –ionic bond – sigma covalent bond – electron deficient bond – delocalised bond –dative bond – metal carbonyl complexes – synthesis, structure and reactions of metalcarbonyls – the nature of M-CO bonding – binding mode of CO and IR spectra of metal carbonyls – metal carbonyls – metal carbonyl anions– metal carbonyl hydrides– metal carbonyl halides – metal carbonyl clusters – Wades rule and isolobalrelationship – metal nitrosyls – dinitrogen complexes – dioxygen complexes.

UNIT II

Metal alkyl complexes – stability and structure – synthesis by alkylation of metal halides, by oxidative addition, by nucleophilic attack on coordinated ligands – metal alkyl and 18 electron rule– reactivity of metal alkyls – M-C bond cleavage reactions– insertion of CO to M-C bonds –

double carbonylation – insertions of alkenes andalkynes – insertions of metals with C-H bonds – alkylidene and alkylidyne complexes– synthesis of alkylidene complexes in low oxidation states and in high oxidationstates – bonding in alkylidene complexes – synthesis and bonding in alkylidynecomplexes – reactivity of alkylidene and alkylidynecomplexes.

Alkene complexes – synthesis of alkene complexes by ligand substitution, by reduction and by metal atom synthesis – bonding of alkenes to transition metals –bonding in diene complexes – reactivity of alkene complexes – ligand substitution –reactions with nucleophiles – olefin hydrogenation – hydrosilation – Wacker process– C-H activation of alkenes – alkyne complexes – bonding in alkyne complexes –reactivity of alkynes – alkyne complexes in synthesis – cobalt catalysed alkynecycloaddition.

UNIT III

Cyclopentadienyl complexes – metallocenes – synthesis of metallocenes – bonding in metallocenes – reactions of metallocenes – CpFe/Cp2Fe+ couples in biosensors – bent sandwich complexes – bonding in bent sandwich complexes – metallocene halides and hydrides – metallocene and stereospecific polymerization of 1-alkenes –cyclopentadiene as a non-spectator ligand – monocyclopentadienyl (half-sandwich) complexes – synthesis and structures of allyl complexes – arene complexes –synthesis, structure and reactivity of arene complexes – multideckercomplexes.

UNIT IV

Role of organometallic chemistry in catalysis: Coordinative unsaturation – oxidative addition – addition reactions of specificmolecules – hydrogen addition – HX addition – addition of X2 – addition of RX –addition reactions of Si-H, C- C, C-Si and Si-Si bonds – elimination reactions - eliminations – alkane activation – intramolecular and intermolecular C-H activation– activation ofsulphur heterocycles – insertion of carbon monoxide – isocyanideinsertion – alkene insertion – alkyne insertion.

UNIT V

Homogeneous catalysis by transition metal complexes: Hydrogenation reactions – reversible cis-dihydro catalysts – monohydride catalysts – hydrogenation of alk-1-ene – asymmetric hydrogenation –role of ruthenium complexes in 2001 Nobel Prize for chemistry- transfer hydrogenations – hydrosilation and hydroboration reactions – water gas shift reaction – reduction of carbon monoxide by hydrogen – hydroformylation of alkenes – alcohol carbonylation – decarbonylation reactions – C-C cross coupling and related reactions – alkene oligomerisations and polymerizations – Zeigler-Natta polymerization – alkene dimerisation and oligomerisations – valence isomerisation of strained hydrocarbons – alkene and alkyne metathesis – oxidations of alkanes and alkenes – oxygen transfer reactions – supported homogeneous and phase transfer catalysis.

References

1. Bockmann.M,(1996),Organometallics 1, complexes with transition metal-carbon bonds, Oxford science publications, Oxford.
2. Bockmann.M,(1996),Organometallics 2, complexes with transition metal-carbon bonds, Oxford science publications, Oxford.
3. Cotton.F.A, G. Wilkinson, C. A.Murillo and M. Bochmann, (1999).Advanced Inorganic Chemistry, Sixth Edition, John Wiley and sons, Inc, NewYork.
4. Haiduc.I and J. J. Zuckerman, Walter de Gruyter,Brelin, (1985).Basicorganometallic chemistry.
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Part I – M. Phil.,/ Ph.D.,

CHEMISTRY

Paper- III: Special Paper VII: Chemistry of Biomolecules

(Effective from the academic year 2019-2020 and onwards)

Course Objectives

The students enable to

- Identify their chemical elements and the difference between simple sugars and complex carbohydrates.
- Compare and contrast the structure and function of the following carbohydrates and where they are found: glucose, glycogen, starch, cellulose, chitin.
- Determine presence of biomolecules like carbohydrates, proteins, lipids, etc. in known• and unknown samples.
- Determine the extent of adulteration in samples containing biomolecules.
- Identify their chemical elements and functional groups .Recognize the structure of an amino acid and the peptide bond that connects di-, tri, and polypeptides. Recognize the presence of 20 amino acids and that not all are essential amino acids.
- Identify their chemical elements and learn their property of insolubility in water.

Course Outcomes

The students have knowledge that

1. Identify their chemical elements and the difference between simple sugars and complex carbohydrates.
2. Compare and contrast the structure and function of the following carbohydrates and where they are found: glucose, glycogen, starch, cellulose, chitin.
3. Determine presence of biomolecules like carbohydrates, proteins, lipids, etc. in known• and unknown samples.
4. Determine the extent of adulteration in samples containing biomolecules.
5. Identify their chemical elements and functional groups .Recognize the structure of an amino acid and the peptide bond that connects di-, tri, and polypeptides. Recognize the presence of 20 amino acids and that not all are essential amino acids.
6. Identify their chemical elements and learn their property of insolubility in water.

UNIT-I

SUGARS:Introduction, classification of sugars. Sugars in edible nuts-cashew Synthetic sugars.

UNIT II

NON SUGARS: Classification-characterisation-reactions-structural elucidation of starch and cellulose. Starch in edible nuts-cashew-analysis of starch: anthrone, phenol-sulphuric acid, O-toluidine methods.

UNIT III

PROTEINS: Classification-characterisation, reactions of proteins.1o,2o,3o,4o-structurestudies ofproteinsbyX- ray crystallography. Proteins in edible nuts-aibumin-biological importance. Analysis of proteins: Biurette method, F olin-lowry,Kjeldhal method, Bradford'smethod.

UNIT IV

ALLERGENTS: Introduction-tree nut allergents-analysis of tree nut allergen ts ELISA method, hyper sensitivity- types of hyper-sensitivity.

UNIT V

TECHNIQUES OF FOOD PRESERVATION: Preservatives: introduction, classification: class1, class II preservatives. Processing and packaging of food items with specific cases of edible nuts-cashew. Application of preservatives in packaging and value added products of edible nut-cashew.

References:

1. Organic chemistry of natural products: Gurdeep.R-Chatwal.
2. Text book of Biochemistry: Edward Staunton, JohnTvanbrnggel, WibrtStodd.
3. Immunology:Kuby.
4. Text book of Biochemistry with clinical correlation:Devlin.
5. Proteins in Chemistry: Henry.O.Daley J.R.,Robert.F.O'Malley.

Part I – M. Phil.,/ Ph.D.,
CHEMISTRY
Paper- III: Special Paper VIII: Polymer Chemistry
(Effective from the academic year 2019-2020 and onwards)

Course Objectives

The course enables the student

- To study about the basic concepts of polymerization.
- To explains the coordination polymerization and apply the Ziegler-natta catalyst in polymer synthesis.
- To understand the molecular weight determination methods of the polymer and apply it identifies the polymer properties.
- To discuss about the polymer processing and properties of commercial polymers
- To apply the polymer processing technique to prepare the polymer products
- To list out the commercial polymers and its application

Course outcomes

The students have

1. Studied about the basic concepts of polymerization.
2. Explained the coordination polymerization and apply the Ziegler-natta catalyst in polymer synthesis.
3. Understood the molecular weight determination methods of the polymer and apply it identifies the polymer properties.
4. Discussed about the polymer processing and properties of commercial polymers
5. Applied the polymer processing technique to prepare the polymer products
6. Remembered the commercial polymers and its application

UNIT-I

Chemistry of Polymerization

Addition polymerization – Free radical polymerization – Initiation, Propagation and termination – i9nhibitors and retarders. Ionic polymerization – cationic and anionic-Living polyers. Co-ordination polymerization – Zeigler – Natta catalysts. Condensation polymerization – Extend of reaction and DP – Carother's equation and its significance. Three dimensional polymerization – cross linking – gel point – Ring scission polymerization.

UNIT II

Kinetics of Polymerization

Kinetics of free-radical polymerization- Kinetic chain length and DP. Derivation for rate expression and expression for kinetic chain length and hence degree of polymerization. Kinetics of polycondensation with polyester as example. Simple kinetic expression – catalyzed and uncatalyzedpolycodensation.

UNIT III

Techniques of Polymerization

Bulk polymerization – solution polymerization – Suspension polymerization – Emulsion polymerization – Advantages and disadvantages of these techniques – comparison of the above.

UNIT IV

Characterization of Polymers

Molecular weight determination – Method based on colligative property measurements – cryoscopy – ebullioscopy – osmometry – membrane osmometry- vapour –pressure osmometry – Methods based on viscosity. Measurements – viscometry –Light scattering method – ultracentrifuge technique- End group analysis – GPC method. Thermal methods of analysis in polymers – TGA, DTA,DSC.

UNIT V

Polymer structure and Physical Properties

Crystalline melting point, Glass transition temperature – Properties involving deformations.

References:

1. Billmeyer, F.W. (1984) A Text Book of Polymer Science, Wiley – InterSciencePublication
2. Gowariker V.R Viswanathan. N.V Sreedhar. J (1986) Polymer Science, New Age International (P) LtdPublishers
3. Odian G. (2004) Principles of Polymerization, Wiley InterSciencePublications
4. Cowie J.M.G. (1991) Polymers: Chemistry & Physics of Modern Materials, 2nded. Chapman &Hall
5. Arora. M.G Singh M., Yadav M.S (1994) Polymer Chemistry, Anmol Publishers Pvt.Ltd.,

KARPAGAM ACADEMY OF HIGHER EDUCATION – COIMBATORE – 641 021

Part I – M. Phil.,/ Ph.D.,

COMMERCE

Paper-I: Research Methodology and Pedagogy

(Effective from the academic year 2019-2020 and onwards)

COURSE OBJECTIVES:

To make the researchers

1. To understand the concept of research, Research Process, research design, sampling techniques, hypothesis writing and report writing.
2. To analyse the research problem and design the blue print to capture data and analyse the same using appropriate statistical techniques and apply the learning lifelong.
3. To Critically formulate the research design and sampling design suitable for the problem.
4. To communicate orally and written form the research problem, research design, sampling techniques.
5. To design a report to communicate the findings
6. To understand the objectives and roll of Higher education.

COURSE OUTCOMES:

Learners should be able to

1. Comprehend the meaning of research, theory of induction, deduction, research process, research design, sampling techniques, hypothesis writing and report writing
2. Analyze the research problem and design the blue print to capture data and analyse the same using appropriate statistical techniques and apply the learning lifelong.
3. Critically formulate the research design and sampling design suitable for the problem.
4. Communicate orally and written for the research problem, research design, sampling techniques.
5. Design a report to communicate the findings.
6. Understand the objectives and roll of Higher education

UNIT I

Research - Scope and Significance - Types of Research – Research Process - Characteristics of Good Research - Identifying Research problem – Sampling Design –meaning – Steps in sampling-criteria for good sample design – Types of Sample Design- Probability and non-probability sampling methods. Measurement-Meaning – types of scales.

UNIT II

Review of Literature – Data Collection-Types of Data-Sources –Methods of Data Collection- Observation, Interview Schedule, Questionnaire – Steps for Constructing a Questionnaire-Establishing, reliability and validity-data processing-Coding-editing and tabulation of data.

UNIT III

Mean, Median and Mode-Parametric Test-Hypothesis testing-Z-test, t-test, F-test, Chi-square test-ANOVA-Correlation, Multiple Regression, Factor Analysis, Non-Parametric tests-Basic of Psychometric Test: Sign test, H test, U test and Run test.

UNIT IV

Report Writing: Meaning, Techniques and Precautions of Interpretation - Significance of Report Writing - Difference Steps in Writing Report - Layout of Research Report - Types: Technical Report, Popular Report - Mechanics of Writing a Research Report- Precautions for writing report-Norms for using Tables, Charts and diagram. Appendix:-Index, Bibliography.

UNIT V

Objectives and roll of higher education – Important characteristics of an effective Lecture – Quality teaching and learning – Lecturer preparation –Characteristics of instructional design – Methods of teaching and learning; Large group – Technique – Lecturer, Seminar, Symposium, Team Teaching, Project, Small group Technique –Simulation, role playing Demonstration, Brain storing, Case discussion and assignment, Methods of evaluation – Self evaluation, student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education – 'e' learning researches – web based learning.

REFERENCES:

1. Donald R.Cooper (2000). Business Research Methods, Tata Mc graw Hill, New Delhi
2. Gupta S.P. (2000), Statistical Methods, Sultan Chand& Sons, New Delhi.
3. Kothari, C.R (2002), Research Methodology, WishwaPrakasam, New Delhi
4. Krishnaswami, (2003), Mewthodology of research in social Sciences, himalaya Publishing House, New Delhi
5. Pannerselvam, R. (2004 Research Methodology, Prentice Hall of India, New Delhi
6. Sterling (2003), Research Methods for Management and Commerce, Tata MC Graw Hill, New Delhi
7. Vedanayagam, E.G (1989) Teaching technology for college teachers. New Delhi: Sterling Publishers(P) Ltd.,
8. Rajasekar S (2005) Computer Education and Educational computing, Hyderabad, Neelkamal Publications
9. Kumar K.L (1997) Educational Technologies, New Delhi, New Age International.
10. KanthiSwarup P.K Gupta, Man Mohan "Operations Research", Sultan Chand and sons, New Delhi.

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KARPAGAM ACADEMY OF HIGHER EDUCATION – COIMBATORE – 641 021

Part I – M. Phil.,/ Ph.D.,

COMMERCE

Paper- II: Subject Paper: Statistical Analysis for Business Research

(Effective from the academic year 2019-2020 and onwards)

COURSE OBJECTIVES:

To make the researchers

1. To understand and apply the descriptive analytical tools
2. To know the univariate tools and its application
3. To comprehend the application of Bivariate analysis
4. To understand and compute the multivariate analysis.
5. To understand the correlation analysis
6. To understand the Importance of SPSS and the features for entering the data according to the variable type

COURSEOUTCOMES:

Learners should be able to

1. Compute descriptive statistics and graphically represent the data.
2. Perform univariate and bivariate analysis.
3. Perform multivariate analysis.
4. Perform the correlation analysis
5. Demonstrate capabilities of problem-solving, critical thinking, and communication skills to infer the output.
6. Understand the Importance of SPSS and the features for entering the data according to the variable type

UNIT I

Business Statistics – Meaning and Definition – Scope and Functions – Advantages and Limitations – Meaning of Data, Variables, Random Variable, Population and Sampling Techniques – Measures of Central Tendency – Mean, Median – Measures of Dispersion-Standard Deviation and Co-efficient of Variation.

UNIT II

Correlation Analysis – Simple Rank, Partial and Multiple Correlation – Auto Correlation – Regression Analysis – Simple Liner Regression, use of dummy variables.

UNIT III

Testing of Hypothesis – Z test, T test – Chi Square Test – F test and ANOVA – Excel and SPSS packages for statistical applications.

UNIT IV (Theory Only)

Multivariate Analysis; Principle Component Analysis – Factor Analysis –Discriminate Analysis and Path Analysis.

UNIT V

Non Parametric Statistics in Data Analysis – The Sign Test – Runs Test – Mann Whitney – U Test – Kruskal – Wallys Test – Time Series Analysis.

Note: The question paper shall cover 20% theory & 80% problem.

REFERENCES

1. Gupta S.P (2006) Statistical methods, Sultan Chand& Sons, New Delhi.
2. Manoharan.M (2005) statistical Methods, Asian Publishing House, New Delhi.
3. Levin and Rubin (2006). Statistics for management, Asian Publishing House, New Delhi.
4. Kendall (2006) Multivariate analysis, Himalaya publishing House, Mumbai.
5. Sanchetti&Kapoor(2007) advanced statistical methods, Wiley Eastern, Bombay.

KARPAGAM ACADEMY OF HIGHER EDUCATION – COIMBATORE – 641 021

Part I – M. Phil.,/ Ph.D.,

COMMERCE

Paper- III: Special Paper I: Financial Management

(Effective from the academic year 2019-2020 and onwards)

COURSE OBJECTIVES:

To make the researchers

1. To Understand the Concept of financial management, objective of financial management the major four decisions taken by finance manager and its impact and enrich the lifelong learning.
2. To analyse the alternatives using appropriate tools and techniques.
3. To solve the problems and take decisions based on the result.
4. To communicate orally and in written formthe concepts and solutions.
5. To analyse cases in a team and exhibit leadership skills.
6. To plan and manage the cash flows.

COURSE OUTCOMES:

Learners should be able to

1. Understand the Concept of financial management, objective of financial management, the major four decisions taken by finance manager and its impact and enrich the lifelong learning.
2. Analyse the alternatives using appropriate tools and techniques.
3. Solve the problems and take decisions based on the result.
4. Communicate orally and in written form the concepts and solutions.
5. Analyse cases in a team and exhibit leadership skills.
6. Plan and Manage the cash flows in companies.

UNIT I

Financial Management – Meaning - Nature and Scope - Objectives – Role and Functions of Financial Manager- Time value of money – Present Value, Future Value and Compound analysis- Identification of research problems.

UNIT – II

Cost of Capital- Meaning and importance- Cost of debt, Preference Share, Equity Share and Retained Earnings- Weighted Average cost of capital- Capital Budgeting- Techniques – Pay back period, Net Present Value, Return on Investment and Internal Rate of Return- Identification of research problems.

UNIT – III

Leverage: Meaning – Financial Leverage - Operating Leverage - EBIT- EPS analysis- Capital structure – Theories of Capital Structure – Net Income Approach – Net Operating Income Approach - MM Hypothesis – Traditional Approach – Determinants of capital structure – Optimum Capital Structure- Identification of research problems.

UNIT – IV

Dividend Theories – Walter's model – Gordon and Mm's models – Dividend policy – forms of Dividend – Determinants of dividend policy. Working capital Management – Meaning – Objectives – Importance –Computation of working capital - Determinants of working capital- Identification of research problems.

UNIT – V

Management of Working Capital Components – Cash management – Inventory management - Receivables management. Reports of Various Working capital committees.

Note: The question paper shall cover 50 % theory and 50% problems

REFERENCES

1. Khan and Jain (2006). Financial Management. Tata Mc Graw Hill Publishers Pvt. Ltd., New Delhi.
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3. Kulkarni P.V (2003) Financial Management. Himalaya Publishing house, Mumbai.
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KARPAGAM ACADEMY OF HIGHER EDUCATION – COIMBATORE – 641 021

Part I – M. Phil.,/ Ph.D.,

COMMERCE

Paper- III: Special Paper II - Marketing Management

(Effective from the academic year 2019-2020 and onwards)

COURSE OBJECTIVES:

To make the researchers

1. To Understand the Concept of marketing, and 4Ps of Marketing
2. To communicate orally and in written form the concepts of marketing and 4 Ps of marketing
3. To apply the marketing concepts and skills lifelong.
4. To analyse the business case studies and try to apply the theoretical learning into lifelong practice.
5. To Critically evaluate the appropriate alternatives and draw a solution.
6. To Work in team and exhibit leadership skills

COURSE OUTCOMES:

Learners should be able to

1. Understand the Concept of marketing, and 4Ps of Marketing
2. Communicate orally and in written form the concepts of marketing and 4 Ps of marketing
3. Apply the marketing concepts and skills lifelong.
4. Analyse the business case studies and try to apply the theoretical learning into lifelong practice.
5. Critically evaluate the appropriate alternatives and draw a solution.
6. Work in team and exhibit leadership skills

UNIT I

Marketing management- Introduction, Importance- Core Marketing concepts, Product planning and development – Product policy decisions – Product Line and Product Mix – Product Life Cycle – Brand Management. Pricing system – Procedure for Price Determination – Advertisement and Sales promotion- Identification of research areas.

UNIT II

Market segmentation- need for segmentation, benefits of segmentation- base for segmentation – segmenting consumer markets and business markets. Consumer behavior, types of buyer behavior- buying decision of organizational buyers-organizational buying process- Identification of research areas.

UNIT III

Marketing Research- Introduction, Objectives and Importance, Scope of Marketing Research, Marketing Research Process, Applications of Marketing Research- Limitations of Marketing Research – Marketing Information System - Ethics in Marketing Research- Identification of research areas.

UNIT IV

Indian Marketing Environment- Emerging profile of the Indian market, changing the demographic structure-Opportunities in Rural Markets – Rural buying behaviour-Marketing and Society- Social responsibility and Marketing Ethics - Experiences marketing in India - Identification of research areas.

UNIT V

Global Marketing- Introduction, Importance of Global Marketing- The role of Orientations, The forces affecting Global Marketing- Global Marketing Strategy. E-marketing – Introduction, role of the internet, Types of E-Markets, Marketing mix in E-Marketing, Advantages and Limitations of E-marketing- - Identification of research areas.

REFERENCES

1. Karunakaran.Dr (2007). Marketing Management. Himalaya Publishing house, Mumbai.
2. Philip Kotler and Gary Armstrong (2007). Principles of Marketing. Prentice Hall of India Pvt Ltd., New Delhi.
3. Rajan Nair (2006). Marketing Management. Sultan Chand& Sons, New Delhi.
4. Mamoria C.B and SatishMamoria (2006). Marketing Management. Patna. KitabMahal.
5. Naresh K. Malhotra (2002). Marketing Research. Pearson Education, New Delhi.
6. Varshney R.L and Bhattacharya.B (2006) International Marketing Management. Sultan Chand& Sons, New Delhi.
7. Nandagopal and Vivek (2006).Marketing Research. Asian Publications, New Delhi.

KARPAGAM ACADEMY OF HIGHER EDUCATION – COIMBATORE – 641 021

Part I – M. Phil.,/ Ph.D.,

COMMERCE

Paper- III: Special Paper III : Human Resource Management

(Effective from the academic year 2019-2020 and onwards)

COURSE OBJECTIVES:

To make the researchers

1. Describe nature and scope of Human Resources management
2. Evaluate human resource planning, recruitment process and selection methods in the organization
3. Discuss need for motivating employees in an organization.
4. Assess labour relations, industrial disputes and settlement in the organization
5. To know the concept of industrial relations.
6. To know the concept of Collective Bargaining and its significance to a company.

COURSE OUTCOMES:

Learners should be able to

1. Understand the HR environment in India and human resource functions within organizations
2. Plan human resources requirement and formulate HR policy of the organisation with regard to recruitment, selection, training and career planning.
3. Appraise the employee's performance and formulate compensation policy which helps to make organizational excellence.
4. Understand the importance of career planning, job evaluation and factors influencing compensation levels.
5. Analyse the ethical issues in HR management
6. To take decisions in a manner of Collective Bargaining.

UNIT – I

Human Resource Management – Meaning – Significance- Functions –Strategy and tactics-Evolution and Development of HRM- Job design-Job Analysis –Job description – Job specification- Identification of research areas.

UNIT -II

Recruitment-Definitions-Objectives, Corporate Mission-Objectives-strategies, tactics and recruitment-Sources and Techniques of recruitment – E-recruitment. Selection, Placement and Induction- Human Resource Development: Conceptual Analysis - Identification of research areas.

UNIT -III

Performance Appraisal-Methods-System- Counseling – Managerial appraisal. Employee training – Training methods- Training procedure- Evaluation of training Programme – career planning and development-Identification of research areas.

UNIT -IV

Internal Mobility and External Mobility-Organizational change and development- Job Evaluation – Wage and salary administration- Fringe Benefits-Human Relations- Identification of research areas.

UNIT -V

Globalization and Human Resource Management- Introduction- Impact on employment , Human Resource Development, Wages and Benefits, Trade Unions, Collective Bargaining, Participative Management and Quality Circles. Total Quality and Human Resource Management- Identification of research areas.

REFERENCES

1. Gupta C.B (2007) Human Resource Management. Sultan Chand& Sons, New Delhi.
2. Prasad L.M (2000). Human Resource Management. Sultan Chand& Sons, New Delhi.
3. Memoria C.P (2004). Personnel Management. Sultan chand& Sons, New Delhi
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KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
FACULTY OF ARTS, SCIENCE AND HUMANITIES
DEPARTMENT OF COMPUTER SCIENCE
M. Phil.,/ Ph.D.,
(Scheme of Examination for 2019 – 2020 onwards)

Code	Course(s)	ESE(Marks)	Exam Hrs
19RCS101	Research Methodology and Pedagogy	100	3
19RCS201	Advanced Trends in Computer Science	100	3
19RCS301	Cryptography and Network Security	100	3
19RCS302	Advanced Networking	100	3
19RCS303	Data Mining and Warehousing	100	3
19RCS304	Digital Image Processing	100	3
19RCS305	Soft Computing	100	3
19RCS306	Web Technology	100	3
19RCS307	Software Engineering	100	3
19RCS308	Cyber Security	100	3
19RCS309	Mobile Computing	100	3
19RCS310	Cloud Computing	100	3

19RCS101 Paper-I Research Methodology and Pedagogy 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100

End Semester Exam : 3 Hours

Course Objectives

- To impart knowledge in the concept of problem identification and research methodology
- To familiarize with basic of *research* and the *research* process
- To demonstrate the different types of research and its applicability
- To comprehend the knowledge of social research
- To exhibit in sampling design and sampling techniques
- To enrich the knowledge in writing a good research report.

Course Outcomes (COs)

1. Read, interpret, and critically evaluate social research.
2. Identify, explain, and apply the basic concepts of research, such as variables, operationalization, sampling, reliability, and validity.
3. Recognize the ethical issues involved in research, and practice ethical research standards.
4. Identify and explain the difference between quantitative, qualitative, and mixed methods research and what types of research questions can be answered with each method.
5. Use theory and previous research to create research questions and hypotheses and to identify and analyze the appropriate method and variables needed for research questions.
6. Use a variety of research methods through hands-on experience.

UNIT I - RESEARCH METHODOLOGY

Research Methodology: Meaning of Research – Objectives of Research – Motivation in Research – Types of Research – Research Approaches – Significance of Research – Research methods versus methodology. Research and Scientific Method – Importance of knowing how Research is done – Research process – Criteria for good Research – Problems encountered by Researchers in India. Journal Reading Techniques - Defining the Research problem – What is the Research Problem – Selecting the Problem – Necessity of Defining the problem – Technique involved in Defining the Problem – An illustration – Conclusion.

UNIT II - METHODS OF DATA COLLECTION

Collection of primary data – Collection of data through questionnaires – Schedules – Differentiation between questionnaires and schedules – Other methods of data collection – Collection of secondary data – Selection of appropriate method for data collection– Guidelines for constructing questionnaire/Schedule–Guidelines for successful Interviewing – Difference between survey and experiment – Data Collection using Journals

UNIT III - RESEARCH DESIGN

Need for Research Design – Features of good design – Important concepts relating to Research Design – Different Research Design – Basic principles of Experimental Designs – Conclusion – Developing a Research Plan. Significance of Report Writing – Different steps in writing Report – Layout of the Research Report – Types of Reports – Oral presentation –

Mechanics of writing a Research Report – Precautions for writing a Research Reports – Conclusions.

UNIT IV - STATISTICAL ANALYSIS

Central tend in correlation, auto correlation and regression analysis, curve fitting - probability models-distribution. Testing of hypothesis- Analysis variance, testing means for small and large sequence. Simulation-render generation techniques and distribution monte carlo model. Data Analysis: Mathematical and statistical analysis using software tools.

UNITV - PEDAGOGICAL METHODS IN HIGHER EDUCATION

Objectives and roll of higher education- important characteristics of an effective Lecture-Quality teaching and learning- Lecture preparation Characteristics of instructional design Methods of teaching and learning: Large Group – Technique-Lecture Seminar, Symposium, Tam Teaching, Project, Small group Technique- Simulation, role playing Demonstration, Brain storing, case discussion and assignment, Methods of evaluation- Self evaluation, student evaluation. Diagnostic testing remedial teaching Question banking-Electronic media in education –'e' learning researches web based learning.

SUGGESTED READINGS

1. Deepak Chawla , Neena Sondhi. (2016). Research Methodology: Concepts and Cases. 2nd Edition. Vikas Publishing House Private Ltd, New Delhi.
2. C.R. Kothari. (2018). Research Methodology – Methods and Techniques. 2nd Edition. New Age International (P) Limited. New Delhi.
3. Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams . (2018). The Craft of Research . 3rd Edition, University of Chicago Press.
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5. www.dcs.gla.ac.uk/~johnson/teaching/research_skills/research.html
6. http://www.csc.liv.ac.uk/~ullrich/COMP516
7. http://www.idi.ntnu.no/~thomasos/paper/interpretive.pdf
8. Vedanayagam, E.G .(1989). Teaching technology for college teachers. Sterling Publishers(P) Ltd., New Delhi.
7. Kumar K.L. (1997) Educational Technologies, New age International. New Delhi.
8. Winkler, Anthony C. & Jo Roy Mc Cuen. (1985). Writing a research Paper: A Handbook, 2nd edition, Harcourt,NY.

19RCS201 Paper II: Advanced Trends in Computer Science 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100

End Semester Exam : 3 Hours

Course Objectives

- To impart the basic concepts of data structures and algorithms
- To understand concepts about searching and sorting techniques
- To Understand basic concepts about stacks, queues, lists, trees and graphs
- To understand the principles of distributed Component technologies like CORBA and Agile.
- To get a thorough knowledge of J2EE and Web services protocols
- To introduce various techniques of the grid computing

Course Outcomes(Cos)

1. Give a comprehensive introduction of common data structures, and algorithm design and analysis.
2. Understand concepts about searching and sorting techniques
3. Understand basic concepts about stacks, queues, lists, trees and graphs
4. Understand the distributed Component technologies like CORBA and Agile.
5. Get a thorough knowledge of J2EE and Web services protocols
6. Introduce various techniques of the grid computing

UNIT I - ALGORITHMS AND ANALYSIS

Elementary Data Structures, Greedy Method: Knapsack Problem – Job Sequencing With Deadlines – Optimal Merge Patterns, Dynamic Programming: Multistage Graphs Optimal Binary Search Trees – 0/1 Knapsack – Reliability Design – The Traveling Salesperson Problem – Flow Shop Scheduling.

UNIT II - BASIC SEARCH AND TRAVERSAL TECHNIQUES

The Techniques –Code Optimization – Biconnected Components And Depth – First Search. Backtracking: The 8 – Queens Problem – Sum of Subsets – Hamiltonian Cycles – Knapsack Problem.

UNIT III - COMPUTATIONAL MATHS

Mathematical logic : Statements and notation, Connectives, Well formed formulas, Truth Tables, tautology, equivalence implementation, Normal torms. **Graph theory:** epresentation of Graph, DFS,BFS, Spanning Trees, planer Graphs. Graph Theory and Applications, Basic Concepts Isomorphism and Sub graphs Multi graphs and Euler circuits, Hamiltonian graphs, Chromatics Numbers

UNIT IV -DISTRIBUTED OBJECT MANAGEMENT

Object oriented Methodologies-Virtual Programming, Agile, XP, Scrum Process- Object design – design patterns Distributed Objects And Components – From Distributed Objects To Components – 3 Tier Client Server, Object Style – CORBA – Distributed Objects, CORBA Style – OMG's Object Management Architecture – CORBA 2.0 – CORBA Object Services – CORBA Common Facilities – CORBA Business Objects.

J2EE: Overview – Multi – Tier Architecture – The Enterprise Application – Clients – Sessions Management – Web Tier –ELB Tier. Web Services: XML Fundamentals – SOAP – WSDL – UDDI .

UNIT V - GRID COMPUTING

Introduction: Early Grid Activities, Current grid activities, Overview of grid business area, Grid Infrastructure and its relationship with other distributed architectures. Open grid service architecture (OGSA), Data management services, Overview of Globus GT3 Toolkit, Introduction to cloud computing and its issues.

SUGGESTED READINGS

1. Adam Drozdek. (2012). Data Structures and algorithm in C++. 3rd edition. Cengage Learning, New Delhi.
2. Sartaj Sahni. (2011). Data Structures, Algorithms and applications in C++. 2nd edition. Universities Press, New Delhi.
3. Mark Allen Weiss. (2011). Data Structures and Algorithms Analysis in Java.3rd edition. Pearson Education, New Delhi.
4. Sandeep Chatterjee, James Webber. (2010). Developing Enterprise Web Services, 1st Edition, Pearson Education.
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6. Robert Orfali, DanHarkey, Jan Edwards. (2008). The Essential Client/Server Survival Guide, 2nd edition .Galgotia Publications.
7. Janakiram, D. (2005). Grid Computing – A Research Monograph. TataMcGraw Hill Publishing Company Limited, New Delhi
8. C.J.Date. (1999). An Introduction to Database Systems ,6th edition .Addison Wesley
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11. Peter Coad / Edward Yourdan. (2001). Object Oriented Analysis, 2nd edition. Pearson Education.
12. Joshy Joseph, craiz. (2000). Grid Computing,1st Edition. IBM Press.
13. Thomas H.Corman, Charles E.Leiserson, Ronald L.Rivest. (1998). Introduction to Algorithms , Prentice Hall of India.
14. Ramakrishnan, Gehrke. (2003). Database Management Systems, Mc Graw Hill Publication, 3rd Edition.
15. Grady Booch. (2000). Object Oriented Analysis and Design, Pearson Education, 2nd Edition.

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2. www.apl.jhu.edu/~hall/java/FAQs-and-Tutorials.html
3. www.microsoft.com/Net
4. www.w3schools.com/ngws/default.asp
5. www.w3.org/XML
6. www.w3schools.com/xml
7. www.compinfo-center.com/apps/rdbms.htm
8. www.grid2002.org
9. www.gridcomputing.com

19RCS301 Paper – III: Special Paper I -Cryptography and Network Security 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100
End Semester Exam : 3 Hours

Course Objectives

This course will provide students with a theoretical knowledge to understand the fundamental principles of access control models and techniques and,

- To understand theory of fundamental cryptography, encryption and decryption algorithms
- To know about various encryption techniques.
- To understand various Block Ciphers, DES and AES algorithms
- To understand the concept of Public key cryptography.
- To study about message authentication and hash functions
- To impart knowledge on web security, electronic mail security, firewalls

Course Outcomes (COs)

On successful completion of the course the student should be able to:

1. Classify the symmetric encryption techniques
2. Illustrate various Public key cryptographic techniques
3. Evaluate the authentication and hash algorithms.
4. Summarize the intrusion detection and its solutions to overcome the attacks.
5. Understand basic concepts of system level security
6. Build secure authentication systems by use of message authentication techniques.

UNIT I - INTRODUCTION TO CRYPTOGRAPHY

Services. Mechanisms and Attacks – The OSI Security Architecture – A Model for Network Security – Classical Encryption Techniques – Symmetric Cipher Model – Substitution Techniques – Transporation Techniques – Rotor Machines – Steganography.

UNIT II - SIMPLIFIED DES

Block Cipher Principles – The Data Encryption Standard – The Strength of DES – Differential and Linear Cryptanalysis – Block Cipher Design Principles – Block Cipher Modes of Operation.

UNIT III – PUBLIC KEY CRYPTOSYSTEM

RSA Algorithm – Key Management – Diffie–Hell man Key exchange – Introduction to Elliptic Curve Cryptography. Message Authentication and Hash functions – Authentication Requirements – Authentication Functions – Message Authentication Codes – Hash Functions – Security of Hash functions and MAC.

UNIT IV - DIGITAL SIGNATURES AND AUTHENTICATION PROTOCOLS

Digital Signature Standard – Authentication Applications – Kerberos – X.509 Authentication services and Encryption Techniques. E–mail Security – PGP – S / MIME – IP Security

UNIT V - WEB SECURITY

Secure Socket Layer – Secure Electronic Transaction. System Security – Intruders and Viruses – Firewalls– Password Security

SUGGESTED READINGS

1. Deepti Mittal, Ajay Raj. (2015). Cryptography and Network Security. 1st Edition, Laxmi Publication Private Ltd, Delhi.
2. K.HarBaskar . (2015). Cryptography and Network Security – A Practical Approach. 1st Edition, Laxmi Publication Private Ltd, Delhi.
3. William Stallings. (2012). Cryptography and Network Security. 4th Edition, Pearson Education, Delhi.
4. Behrouz A. Forouzan. (2010). Cryptography and Network Security. Special Indian Edition, Tata McGraw Hill, Delhi.
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9. William Stallings.(1998).Cryptography and Network Security. 3rd Edition, Pearson Education, New Delhi.

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3. http://www.rsa.com
4. http://www.nsa.gov/home_html.cfm

19RCS302 Paper – III: Special Paper II - Advanced Networking 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100

End Semester Exam : 3 Hours

Course Objectives

- To have an architectural overview of the TCP/IP Protocol Suite
- To understand about subnets using IP classes
- To understand the key features and functions of ARP Protocol.
- To understand how basic routing protocol works.
- To understand about Ad–Hoc/Mobile Routing, sensor networks, MANET
- To understand the concepts of Network Service Quality and Resource Reservation and NS2 simulator tool

Course Outcomes (COs)

At the completion of the course, students will:

1. Identify the functions/ services of TCP/IP component and layer
2. Have the ability to analyze and differentiate networking protocols used in TCP/IP protocol suite.
3. Understand the routing IP datagrams and checksum.
4. Exposed to unicast and multicast routing.
5. Understand about Ad–Hoc/Mobile Routing, sensor networks, MANET
6. Understand the concepts of Network Service Quality and Resource Reservation and NS2 simulator tool

UNIT I – INTRODUCTION

Internet Protocol review, Router Basics – forwarding versus routing – ISPs – Evolution of the Internet Architecture – IP Addressing and Allocation Techniques – NAPs – Autonomous Systems.

UNIT II - ROUTING PROTOCOL FOUNDATIONS

Distance vector and link state – Dijkstra's algorithm – IGPs and EGPs – RIP – OSPF – ISIS. Introduction to BGP – EBGP and IBGP

UNIT III - INTERDOMAIN ROUTING AND BGP

Border Gateway Protocol details – messages and state machines – route aggregation. Policy and BGP – BGP decision process – Access lists, prefix lists, AS paths, Community – Route maps – Attributes – AS_Path, local preference, MED, Community, ATOMIC_AGGREGATE, Aggregator, Origin, NEXT_HOP, AS–SET – Route filtering. Architecture and BGP – Redundancy, symmetry, load balancing – Confederations, route reflectors.

UNIT IV - AD–HOC/MOBILE ROUTING

Peer to Peer Overlay Networks – Mesh Networks – Sensor Networks – MANET

UNIT V- NETWORK SERVICE QUALITY AND RESOURCE RESERVATION

Queues and Delays – Queuing and Scheduling – A Reservation Protocol – Differentiated Services Network simulator tools NS2

SUGGESTED READINGS

1. Andrew S. Tannenbaum. (2010). Computer Networks. 5th Edition. Pearson Education.
2. Forouzan, B. A.(2011). Data Communications and Networking .4th edition. THM, New Delhi.
3. Bassam Halabi. Internet Routing Architectures. (2014). Cisco Press, New Riders Publishing, ISBN 1-56205-652-2
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19RCS303 Paper – III: Special Paper III - Data Mining and Warehousing 4H – 4C
Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100
End Semester Exam : 3 Hours

Course Objectives

- To identify the scope and essentiality of Data Warehousing and Mining.
- To analyze data, choose relevant models and algorithms for respective applications.
- To study spatial and web data mining.
- To develop research interest towards advances in data mining.
- To introduce students to the basic concepts and techniques of Data Mining.
- To develop skills of using recent data mining software for solving practical problems.

Course Outcomes (COs)

1. Understand Data Warehouse fundamentals, Data Mining Principles
2. Design data warehouse with dimensional modeling and apply OLAP operations.
3. Identify appropriate data mining algorithms to solve real world problems
4. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
5. Describe complex data types with respect to spatial and web mining.
6. Benefit the user experiences towards research and innovation integration

UNIT I - INTRODUCTION: FUNDAMENTALS OF DATA MINING

Data Mining Functionalities - Classification of Data Mining systems - Major issues in Data Mining - Data Warehouse and OLAP Technology for Data Mining Data Warehouse - Multidimensional Data Model - Data Warehouse Architecture - Data Warehouse Implementation - Further Development of Data Cube Technology - From Data Warehousing to Data Mining.

Data Preprocessing: Needs Preprocessing the Data - Data Cleaning - Data Integration and Transformation - Data Reduction - Discretization and Concept Hierarchy Generation - Online Data Storage. Preparing Data for Mining: Variable Measures.

UNIT II - DATA MINING PRIMITIVES

Languages, and System Architectures: Data Mining Primitives - Data Mining Query Languages - Designing Graphical User Interfaces Based on a Data Mining Query Language Architectures of Data Mining Systems.

Concepts Description: Characterization and Comparison: Data Generalization and Summarization - Based Characterization - Analytical Characterization: Analysis of Attribute Relevance - Mining Class Comparisons: Discriminating between Different Classes - Mining Descriptive Statistical Measures in Large Databases.

UNIT III - MINING ASSOCIATION RULES IN LARGE DATABASES

Association Rule Mining - Mining Single -Dimensional Boolean Association Rules from Transactional Databases - Mining Multilevel Association Rules from Transaction Databases - Mining Multidimensional Association Rules from Relational Databases and Data

Warehouses - From Association Mining to Correlation Analysis – Constraint - Based Association Mining.

Classification and Prediction: Issues Regarding Classification and Prediction - Classification by Decision Tree Induction - Bayesian Classification - Other Classification Methods – Prediction - Classifier Accuracy.

UNIT IV -CLUSTER ANALYSIS INTRODUCTION

Types of Data in Cluster Analysis - A Categorization of Major Clustering Methods - Partitioning Methods – Density -Based Methods - Grid-Based Methods - Model-Based Clustering Methods - Outlier Analysis. Machine Learning: Basic Concepts in machine learning - Supervised and Unsupervised Learning. Mining Spatial Databases - Mining Multimedia Databases - Mining Time-Series and Sequence Data - Mining Text Databases - Mining the World Wide Web - Visual Data Mining

UNIT V - OVERVIEW OF DATA MINING TOOLS

Applications:

Data Mining: Data Mining in Bio Informatics - Data Mining in Banking - Data Mining in Tele communications - Data Mining in Crime Detection - Data Mining in Oil and Gas Industry - Data Mining in Pharmaceutical Industry - Data Mining in Student recruiting and retention - Data Mining in Electronic commerce .
Defining Privacy for Data Mining - Trends in Spatial data mining.

Data Warehousing: Case Studies-Data warehousing in Government and Education – Insurance - Manufacturing Industry – Marketing - Multi-Industry.

SUGGESTED READINGS

1. Han, Kamber & Pei. (2013). Data Mining: Concepts and Techniques. 3rd Edition. University Press.
2. Zaki & Meira. (2014) . Data Mining and Analysis Fundamental Concepts and Algorithms. Prentice Hall of India, New Delhi .
3. Agarwal . (2015). Data Mining: The Textbook. Prentice Hall of India, New Delhi
4. K.P.Soman, Shyam Diwakar, V.Ajay. (2006). Insight into Data Mining Theory and Practice, Prentice Hall of India.
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14. http://robotics.stanford.edu/~nilsson/mlbook.html
15. http://www.twocrows.com/applics.html

19RCS304 Paper – III: Special Paper IV - Digital Image Processing 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100

End Semester Exam : 3 Hours

Course Objectives

- To make the students learn the fundamental theories and techniques of digital image processing.
- To study the mathematical transforms necessary for image processing, image manipulation and a preliminary understanding of Computer Vision.
- To make students to understand the image degradation and enhancement.
- To understand the basic relationships between pixels in an image
- To know various segmentation techniques, and object descriptors.
- To implement pattern recognition to enhance an image.

Course Outcomes(COs)

1. Perform image manipulations and analysis in many different fields.
2. Apply knowledge of computing mathematics science and engineering to solve problems in multidisciplinary research.
3. Implement the understanding in sharpening the image.
4. Perform the image segmentation using the compression method.
5. Understand the image to represent as an region.
6. Analyze the basic algorithms used for image processing &image compression with morphological image processing.

UNIT I – INTRODUCTION

Digital image processing – Origins of digital image processing- Examples of fields that use digital image processing-Fundamental steps in digital image processing- Components of an image processing system-Representing digital image.

UNIT II - BASIC RELATIONSHIPS BETWEEN PIXELS

Basic gray level transformations- Histogram processing - Basic spatial filtering- Smoothing special filtering-Image Degradation/Restoration process-Noise Models.

UNIT III - IMAGE SEGMENTATION: THRESHOLDING

Edge Based Segmentation – Region Based Segmentation – Matching. Image Compression: Error Criterion - Lossy Compression - Lossless Compression.

UNIT IV - SHAPE REPRESENTATION AND DESCRIPTION

Region Identification - Contour Based Representation And Description – Region Based Shape Representation And Description

UNIT V - INTRODUCTION TO INFORMATION CODING

Introduction to image compression techniques Image Recognition: Introduction – Statistical Pattern Recognition - Neural Net- Syntactic Pattern Recognition - Graph Matching - Clustering

SUGGESTED READINGS

1. Rafael C. Gonzalez, Richard E. Woods. (2016). Digital Image Processing, 3rd Edition, Pearson Education, Delhi.
2. T.Veerakumaran, S.Jayakumar.(2009).Digital Image Processing, 1st Edition, Mcgraw Higher Ed, Delhi.
3. Castleman .(2007). Digital Image Processing, 1st Edition, Pearson Education Limited, Delhi.
4. Milan Sonka and Vaclav Hlavac and Roger Boyle. (2004). Image Processing, Analysis and Machine Vision. 2nd Edition. Vikas Publishing House, NewDelhi.
5. Nick Efford. (2000). Digital Image Processing – A Practical introduction using JAVA. 1st Edition , Pearson Education Limited, Delhi.
6. Chanda. B and Dutta Majumder .D. (2000). Digital Image Processing and Analysis. 1st Edition, Prentice Hall of India, New Delhi

Web Site References

1. www.icaen.uiowa.edu/~dip/lecture/lecture.html
2. www.ece.ucsb.edu/~manj/ecei81bso4/reviue(gw2002).pdf
3. www.wikipedia.org/wiki/image_processing
4. http://unjobs.org/authors/rafael-c.-gonzalez/image processing

19RCS305 Paper – III: Special Paper V – Soft Computing 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100
End Semester Exam : 3 Hours

Course Objectives

- To understand the scope and evolution of soft computing
- To learn the various soft computing frame works
- To be familiar with design of various neural networks
- To be exposed to fuzzy sets and fuzzy logic
- To understand fuzzy measures and reasoning
- To learn genetic programming.

Course Outcomes(COs)

1. Understand the scope and evolution of soft computing
2. Learn the various soft computing frame works
3. Be familiar with design of various neural networks
4. Be exposed to fuzzy sets and fuzzy logic
5. Understand fuzzy measures and reasoning
6. Learn genetic programming.

UNIT I - FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS

Biological prototype, Artificial neuron, Single layer artificial, neural networks, multilayer artificial neural networks, training of artificial neural networks.

UNIT II - PERCEPTIONS

Perceptron Representation, perceptron learning, perceptron Training algorithm. Back propagation: Introduction to back propagations and Back propagation training algorithm, counter propagation networks.

UNIT III - KOHONEN SELF-ORGANIZING NETWORKS

Introduction, the Kohonen algorithm, weight training, Grossberg layer, Training the Grossberg Layer.

UNIT IV - HOPFILED NETWORKS

Introduction, The Hopfiled model, Hopfiled network algorithm, Boltzmann's machine applications of Hopfiled Networks,Associative Memories, Bi- directional Associative Memories.Adaptive Resonance Theory: Architecture of Adaptive Resonance Theory,Algorithm, Applicability of Artificial neural Networks to pattern Recognition and Image Processing, Dimensionality of neural Networks for pattern Recognition- Case Studies

UNIT V - FUZZY ARITHMETIC

Fuzzy numbers, linguistic variables, arithmetic operations on intervals, fuzzy numbers, and lattice of fuzzy numbers, Possibility theory**:** fuzzy measures, evidence theory, fuzzy sets and possibility theory, possibility Vs probability theory, Fuzzy logic: Multivalued logics, propositions, quantifiers, linguistic hedges, inferences. Uncertainty based information, Fuzzy systems: fuzzy controllers, fuzzy systems and neural networks, fuzzy neural networks, fuzzy automata, dynamic systems- Applications

SUGGESTED READINGS

1.Chandra .S.S.V. (2014). Artificial Intelligence and Machine Learning. Kindle Edition.

2. Dr.R.P.Das. (2012). Neural Networks and Fuzzy Logic. 1st Edition, Tata Mcgraw Hill, Delhi

3. Flasiński, Mariusz. (2016). Introduction to Artificial Intelligence. Tata Mcgraw Hill, Delhi.

4. Dr.R.P.Das. (2012). Neural Networks and Fuzzy Logic. 1st Edition, Tata Mcgraw Hill, Delhi.

5. Neural computing: Theory and practice – Waserman

6. Sets and Fuzzy logic theory and applications—George J. Klir/Bo Yuan

7. S.N. Sivanandam, S. Sumathi and S. Deepa. (2006). Introduction to Neural Networks using MAT LAB 6.0, 1st Edition, Tata Mcgraw Hill, Delhi

8. Simon Haykin. (2003). Neural Networks. 1ST Edition, New Delhi: Pearson Education.

9. An introduction to Neural Computing – I. Alexander and Helen MartWilliam Jackson.

10. Robert J Schaluoss. (1997). Artificial Neural Networks. 1ST Edition, New Delhi: McGraw Hill.

11.Kishan Mehrotra, Chiluvuri K. Mohan and Sanjay Rana. (1997).Elements of Artificial Neural Networks. 1ST Edition, Mumbai: Penaram International.

Web Site References

1. www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/cs11/report.html
2. http://www.statsoft.com/textbook/stneunet.html
3. http://www.fuzzy-logic.com

19RCS306 Paper – III: Special Paper VI: Web Technology 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100

End Semester Exam : 3 Hours

Course Objectives

- To understand the fundamentals of HTML, CSS and JavaScript and use different objects
- To understand XML , Namespace and W3C XML Schema
- To know the basics of JSP, its objects and forms
- To relate JSP and Java Bean through its components
- To develop web application that deals with database and website development.
- To get Familiar with Document Object Model for XML

Course Outcomes(COs)

1. Create a client side scripting web application using HTML forms, CSS and Java Script
2. Understand the Document Object Model for XML and JavaScript.
3. Understand XML , Namespace and W3C XML Schema
4. Understand the server side scripting of JSP, its objects and forms
5. Relate JSP and Java Bean through its components
6. Develop web application that deals with database and website development.

UNITI - HTML, DHTML

HTML : Overview of HTML – Basic Concepts – HTML and Images – Lists- Formatting Tags –Links and Addressing – Tables – Frames –Layers –Styles Sheets – Forms –HTML and Media Types. DHTML – Object Model –HTML and Scripting access – CSS.

UNIT II - SCRIPTING LANGUAGES

Java Script : Introduction – Programming Fundamentals – Variables – Data Types – Statements- Functions and Objects – Navigator Object Model – Cookies. CGI &Perl : Concepts of CGI – Perl – Basics – Variables – Arrays – Controlling Program Flow – Perl Functions- File Handling – Database Connectivity.

UNIT III - XML

XML – XML Fundamentals –Creating XML Documents – Well Formed and Valid XML Documents –General Syntax – Components of XML Documents – Elements, Attributes and Entities – XML Data Design – DTD – XML Schema- XSTL.

UNIT IV -SERVLETS AND JSP

Servlet Architecture Overview- Servlet Life cycle- Parameter Data – Sessions- Cookies – Data Storage –Servlet and Concurrency. JSP: Introduction – JSP and Servlets- Running JSP Applications – Basic JSP – Java Bean Classes and JSP – Tag Libraries and Files.

UNIT V -CASE STUDY

Develop Blogging application and transform the Blogging Application from a loose collection of various resources to an integrated web application.

SUGGESTED READINGS

1. David Flanagan. (2014). Javascript: The Definitive Guide (6th ed.). O’Reilly Media.
2. Dave Mercer. (2012). ASP.NET – Beginner’s Guide(2nd ed.). New Delhi: MCGraw Hill
3. Thau. (2008). The Book of JavaScript: A Practical Guide to Interactive WebPages.
4. Jeffrey C. Jackson. (2007). Web Technologies, Pearson Education, 1st Edition.
5. David Flanagan. (2006). Javascript: The Definitive Guide. O’Reilly Media.
6. Paul Wilton. (2005). Beginning JavaScript. 2nd Edition. Wiley Dreamtech India(P) ltd, New Delhi.
7. Thomas A Powell. (2000). The Complete SUGGESTED READINGSHTML, 2nd Edition, Tata McGraw Hill Publishing, New Delhi.
8. Rohit Khurana. (2000). Java Script, APH Publishing Corporation. New Delhi.
9. Ivan BayRoss. (2000). HTML, DHTML, Java Script, Perl CGI, BPB Publications, 1st Edition.
10. Sybex. (2001). XML Complete, BPB Publications, 1st Edition.
11. Deitel Nieto. (2000).World Wide Web. 3rd Edition, Pearson Education, New Delhi.

Web Site References

1. http://www.w3schools.com/js/default.asp
2. http://www.w3schools.com/xml/default.asp
3. www.amazon.com/web-server-technology
4. http://www.brics.dk/ixwt

19RCS307 Paper – III: Special Paper VII: Software Engineering 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100

End Semester Exam : 3 Hours

Course Objectives

- To Apply their knowledge of mathematics, sciences, and computer science to the modeling, analysis, and measurement of software artifacts.
- To Work effectively as leader/member of a development team to deliver quality software artifacts.
- To Analyze, specify and document software requirements for a software system.
- To implement given software design using sound development practices.
- To Verify, validate, assess and assure the quality of software artifacts.
- To Design, select and apply the most appropriate software engineering process for a given project, plan for a software project, identify its scope and risks, and estimate its cost and time.

Course Outcomes(COs)

1. Apply their knowledge of mathematics, sciences, and computer science to the modeling, analysis, and measurement of software artifacts.
2. Analyze, specify and document software requirements for a software system.
3. Implement a given software design using sound development practices.
4. Verify, validate, assess and assure the quality of software artifacts.
5. Design, select and apply the most appropriate software engineering process for a given project, plan for a software project, identify its scope and risks, and estimate its cost and time.
6. Express and understand the importance of negotiation, effective work habits, leadership, and good communication with stakeholders, in written and oral forms, in a typical software development environment.

UNIT I - THE EVOLVING ROLE OF SOFTWARE

Software - software crisis - software process model. Component based development: - The formal methods model – fourth generation techniques. Software Project Planning – Project Planning Objectives - Software Scope – Resources. System planning and initial investigation, bases for planning – Investigation

UNIT II - ANALYSIS CONCEPTS AND PRINCIPLES

Requirement analysis principles – The Information domain – modeling – partitioning – Essential and implementation views. Software prototyping methods and tools. Specification: Specification principles – representation – software requirements specification.

UNIT III - DESIGN CONCEPTS AND PRINCIPLES

The Design process: design and software quality – The Evolution of Software Design. Design principles:- Design concepts – effective modular design – the design model – design documentation – Software Architecture.

UNIT IV - SOFTWARE TESTING TECHNIQUES

Testing Techniques/Tools selection process – Selecting Techniques/tools – Structural System Testing techniques- Functional System Testing Techniques – Unit Testing Technique – Functional Testing and Analysis – Functional Testing – Test factor/Test Technique Matrix- The Cost of Computer Testing – Life Cycle Testing concept – Verification and validation in the software. Assess Project Management Development Estimate and Status - Develop Test Plan - Requirements Phase Testing -Design Phase Testing -Program Phase Testing

UNITV - SOFTWARE QUALITY ASSURANCE

Case studies: WinRunner – QTP (Quick Test Professional)

SUGGESTED READINGS:

1. Pressman, R.S. (2009). Software Engineering: A Practitioner‘s Approach. 7^{th} edition. McGraw-Hill, New Delhi.
2. Aggarwal, K.K., & Singh, Y. (2008). Software Engineering. 2^{nd} edition. New Age International Publishers.
3. Sommerville, I. (2007). Software Engineering. 8^{th} edition. Addison Wesley. New Delhi.
4. Bell, D. (2005). Software Engineering for Students. 4^{th} edition. Addison- Wesley, New Delhi.
5. Mall, R. (2004). Fundamentals of Software Engineering. 2nd edition. Prentice-Hall of India, New Delhi.
6. Richard Fairley. (1997). Software Engineering Concepts. 8^{th} Edition. Tata McGraw Hill Publishing Company, New Delhi.
7. Elias M. Awad.(1996). System Analysis and Design. 2^{nd} Edition. BPB Publication, New Delhi.

Website Reference

1. www.opensourcetesting.org
2. www.onestoptesting.com
3. www.cs.queensu.ca
4. www.ece.cmu.edu

19RCS308 Paper – III: Special Paper VIII: Cyber Security 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100

End Semester Exam : 3 Hours

Course Objectives

- To state the basic concepts in information security, including security policies, security models, and security mechanisms.
- To provide an exposure to the spectrum of security activities methods methodologies and procedures with emphasis on practical aspects of Information Security.
- To understand principles of web security.
- To gain knowledge about securing both clean and corrupted systems, protect personal data, and secure computer networks.
- To understand key terms and concepts in cyber law, intellectual property and cybercrimes, trademarks and domain theft.
- To provide the learner will be able to examine secure software development practices.

Course Outcomes (COs)

A student who successfully completes this course should at a minimum be able to:

1. State the basic concepts in information security, including security policies, security models, and security mechanisms.
2. Explain concepts related to applied cryptography including the four techniques for crypto-analysis symmetric and asymmetric cryptography, digital signature, message authentication code, hash functions and modes of encryption operations.
3. Explain common vulnerabilities in computer programs including buffer overflow Vulnerabilities time-of-check to time-of-use flaws incomplete mediation.
4. The learner will gain knowledge about securing both clean and corrupted systems, protect personal data, and secure computer networks.
5. The learner will understand key terms and concepts in cyber law, intellectual property and cybercrimes, trademarks and domain theft.
6. The learner will be able to examine secure software development practices.

Unit I - INTRODUCTION TO CYBERCRIME

Definition and Information Security-who are cybercriminals? - Classification of cybercrimes. Cybercrime: The legal perspectives- cybercrimes: An Indian Perspective - cybercrime and the Indian ITA2000: Hacking and the Indian law(s) - A Global Perspective on cybercrimes: cybercrime and the Extended Enterprise - cybercrime Era: Survival Mantra for the Netizens - Concluding Remarks and Way Forward to Further Chapters.

Unit II - CYBER OFFENSES

How Criminals Plan Them: Introduction: categories of Cybercrime -How criminals Plan the Attacks: Reconnaissance Passive Attacks Active Attacks Scanning and Scrutinizing Gathered Information Attack(Gaining and Maintaining the system Access) -social Engineering: Classification of Social Engineering – Cyber talking: Types of stalkers Cases Reported on Cyber stalking How stalking Works? real-life incident of Cyber stalking -Cybercafe and Cybercrimes - Botnets: The Fuel for cybercrime: Botnet - Attack Vector-Cloud Computing: Why cloud computing? Types of Services Cybercrime and Cloud Computing.

Unit III – CYBERCRIME

Mobile and wireless Devices-Introduction - Proliferation of Mobile and Wireless Devices - Trends in Mobility-Credit Card Frauds in Mobile and Wireless Computing Era: Types and Techniques of Credit Card Frauds - Security challenges Posed by Mobile Devices - Registry Settings for Mobile Devices - Authentication Service security: cryptographic security LDAP Security RAS Security Media Player Control Security Networking API Security - Attacks on Mobile/Cell Phones: Mobile Phone Theft Mobile Viruses Mishing Vishing Smishing Hacking Bluetooth.

Unit IV - MOBILE DEVICES

Security Implication for Organizations – Managing Diversity and Proliferation of Hand-Held Devices Unconventional/ Stealth Storage Devices Threats through Lost and Stolen Devices Protecting Data on lost devices Educating the Laptop Users - Organizational Measures for Handling Mobile devices - Related Security Issues: Encrypting Organization Databases Including Mobile Devices in Security Strategy -Organizational Security Policies and Measures in mobile Computing Era: Importance of Security polices relating to mobile Computing Devices Operating Guidelines for Implementing Mobile Devices Security Polices Organizational Policies for the Use of Mobile Hand - Held Devices - Laptops: Physical Security Countermeasures.

Unit V - TOOLS AND METHODS USED IN CYBERCRIME

Introduction - Proxy Servers and Anonymizers - Phishing: How Phishing Works? - Password Cracking: Online Attacks Offline Attacks Strong Weak and Random Passwords Random passwords - Keyloggers and Spywares: Software Keyloggers Hardware Keyloggers Anti Keylogger Spywares - Virus and Worms: Types of Virus - Trojan Horses and Backdoors: backdoor How to protect from Trojan Horses and Backdoors - Steganography: Steganalysis - DoS and DDoS Attacks: DoS AttacksClassification of DoS Attacks Types or Levels of DoS Attacks Tools Used to Launch DoS Attacks DDoS Attacks How to Protect from DoS/DDoS Attacks – SQL Injection: Steps for SQL Injection Attacks How to Prevent SQL Injection Attacks - Buffer Overflow: Types of Buffer Overflow How to Minimize Buffer Overflow - Attacks on Wireless Networks: Traditional Techniques of Attacks on Wireless Networks Theft of Internet Hours and Wi-fi-based Frauds and Misuses How to Secure the Wireless Networks.

SUGGESTED READINGS

1. 1.Nina Godbole & SUNIT Belapure. (2013). CYBER SECURITY. Wiley India Pvt. Ltd. New Delhi
2. 2.Charles ,P. Pfleeger ,& Shari, L. Pfleeger. (2003).
3. 3.Dieter Gollmann . (2006). Computer Security. 2nd edition. John Wiley & Sons.
4. Godbole, N. (2009). Information Systems Security: Metrics Frameworks and Best Practices. Wiley India. New Delhi
5. 5.Marther, T., Kumaraswamy, S.,& Latif, S. (2009). Cloud Security and Privacy: An Enterprise Perceptive on Risk and Complaince. O'Reilly.

WEB SITES

1. http://www.csc.ncsu.edu/faculty/ning
2. csrc.nist.gov/publications/nistpubs/800-12/handbook.pdf
3. www2.warwick.ac.uk/fac/sci/dcs/teaching/modules/cs134/

19RCS309 Paper – III: Special Paper IX: Mobile Computing 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100
End Semester Exam : 3 Hours

Course Objectives

- To learn about the concepts and principles of mobile computing;
- To explore both theoretical and practical issues of mobile computing;
- To develop skills of finding solutions and building software for mobile computing applications.
- To identify the use of mobile wireless technologies
- To know the types of mobile wireless technologies that are currently being used
- To understand the working of mobile wireless technologies access to network resources.

Course Outcomes (COs)

1. Grasp the concepts and features of mobile computing technologies and applications
2. Have a good understanding of how the underlying wireless and mobile communication networks work, their technical features, and what kinds of applications they can support
3. Identify the important issues of developing mobile computing systems and applications
4. Organize the functionalities and components of mobile computing systems into different layers and apply various techniques for realizing the functionalities;
5. Develop mobile computing applications by analyzing their characteristics and requirements, selecting the appropriate computing models and software architectures, and applying standard programming languages and tools;
6. Organize and manage software built for deployment and demonstration.

UNIT I - MEDIUM ACCESS CONTROL

Motivation for Specialized MAC-SDMA-FDMA-TDMA-CDMA- Comparison of Access mechanism – telecommunication: GSM-DECT-TETRA-UMTS-IMT-200 - Satellite Systems :Basics – routing- Localization- Handover- Broadcast Systems : Overview _ Cyclic Repetition of Data- digital Audio Broadcasting - Digital Video Broadcasting

UNIT II - WIRELESS LAN

Infrared Vs Radio Transmission – Infrastructure Networks- Ad Hoc Network- IEEE 802.11 – HIPERLAN- Bluetooth – Wireless ATM: Working Group- Services- References Model- Function – Radio Access Layer – Handover- Location Management- Addressing Mobile Quality of Service- Access Point control Protocols

UNIT III - MOBILE IP

Goals – Assumptions and Requirement –Entities- IP packet Delivery –Agent Advertisement and Discovery – Registration – Tunneling and encapsulation- Optimization –Reverse Tunneling- Ipv6- DHCP- Ad hoc Networks

UNIT IV - TRADITIONAL TCP

Indirect TCP- Snooping TCP – Mobile TCP –Fast retransmit/ Fast Recovery-Transmission/timeout Freezing- Selective Retransmission – Transaction Oriented TCP

UNIT V - WAP ARCHITECTURE

– Datagram protocol – Transport Layer Security – Transaction protocol- Session Protocol-application Environment – Wireless Telephony Application

SUGGESTED READINGS

1. Ashok, K.Talukder,& Roopa, R. Yavagal. (2008). Mobile Computing. Tata Mc-Graw Hill Publishing Company Pvt Ltd, New Delhi.
2. Raj Kamal . (2011). Mobile Computing. Pearson Education. Tomasz Imielinski,
3. Henry F. Korth . (2014). Mobile Computing. Springer , US.
4. Mischa Schwartz. (2005). Mobile Wireless Communications. Cambridge University Press.
5. J.Schiller. (2000). Mobile Communication, Addison Wesley.
3. William Stallings. (2004). Wireless Communication and Networks, Pearson Education
4. Singhal. (2003). AP-Wireless, Application Protocol, Pearson Education.
5. Lother Merk,Martin, S.Nicklaus and Thomas Stober. (2003). Principles of Mobile Computing, Second Edition,Springer.
6. William C.Y.Lee. (1993). Mobile Communication Design Fundamentals, John Wiley.

19RCS310 Paper – III: Special Paper X: Cloud Computing 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External:100 Total: 100

End Semester Exam : 3

Course Objectives

To learn about the basic things involved in cloud computing and its architecture.

- To know the basics of cloud computing and its types.
- To know about the services such as IaaS, PaaS, SaaS, IDaaS and CaaS.
- To understand the Virtualization Technologies.
- To understand the Information Security, Privacy and Compliance Risks.
- To learn commercial Google Web services – Open Nebula.
- To portray the recent trends in the field of cloud computing and providing exposures to some open source and commercial clouds.

Course Outcomes (COs)

On successful completion of the course the student should be able to:

1. Understand cloud architecture and model.
2. Identify various service models of Cloud computing.
3. Explore cloud infrastructure.
4. Learn Threat issues and Database Integrity Issues.
5. Learn Open Source and Commercial Clouds such as Microsoft Azure, Amazon EC2.
6. Provide a good understanding of the concepts, standards and protocols in Cloud computing

UNIT I - INTRODUCTION TO CLOUD COMPUTING

Characteristics of Cloud Computing -Paradigm shift - Benefits of cloud computing - Disadvantages of cloud computing- Role of Open Standards-Cloud Computing Architecture: Cloud computing stack-Public cloud -Private cloud -Hybrid cloud -Community cloud

UNIT II - INFRASTRUCTURE AS A SERVICE (IAAS)

Platform as a Service (PaaS) -Software as a Service (SaaS) -Identity as a Service (IDaaS) - Compliance as a Service (CaaS)- Cloud storage.

UNIT III - VIRTUALIZATION TECHNOLOGIES

Load Balancing and Virtualization -Advanced load balancing -The Google cloud - Hypervisors -Virtual machine types -VMware vSphere - Machine Imaging -Porting Applications -The Simple Cloud API - AppZero Virtual Application Appliance

UNIT IV - CLOUD INFORMATION SECURITY OBJECTIVES

Confidentiality, Integrity, and Availability -Cloud Security Services - Relevant Cloud Security Design Principles -Cloud Computing Risk Issues -The CIA Triad
Privacy and Compliance Risks -Threats to Infrastructure, Data, and Access Control -Cloud Access Control Issues -Database Integrity Issues -Cloud Service Provider Risks Architectural Considerations
General Issues- Trusted Cloud Computing -Identity Management and Access Control

UNIT V - CASE STUDY ON OPEN SOURCE AND COMMERCIAL CLOUDS

Microsoft Azure- Amazon EC2-Google Web services-Open Nebula.

SUGGESTED READINGS

1. Dr Kumar Saurabh.(2012). Cloud Computing, 2nd Edition, Wiley India.
2. Barrie Sosinsky .(2010). Cloud Computing Bible, Wiley- India
3. Rajkumar Buyya, James Broberg, Andrzej M Goscinski. (2011). Tata Mc-Graw Hill, New Delhi.
4. Ronald L. Krutz, Russell Dean Vines. (2010). Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley –India
5. OpenNebula 3 Cloud Computing by Giovanni Toraldo, Packt Publishing.
6. Anthony T.Velte, Toby J.Velte, Robert Elsenpeter. (2010). Cloud Computing Practical Approach, 1st Edition, Tata McGraw Hill, New Delhi.
7. Nikos Antonopoulos, Lee Gillam. (2012). Cloud Computing: Principles, Systems and Applications, Springer.

WEB SITES

1. en.wikipedia.org/wiki/Cloud_computing
2. www.ibm.com/cloud-computing/in/en/
3. www.oracle.com/CloudComputing
4. www.microsoft.com/en-us/cloud/default.aspx
5. en.wikipedia.org/wiki/OpenNebula

M.Phil. / Ph.D. ENGLISH

SYLLABUS
(Effective from the Academic year 2019 – 2020 and onwards)

DEPARTMENT OF ENGLISH

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act, 1956)
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DEPARTMENT OF ENGLISH
FACULTY OF ARTS, SCIENCE & HUMANITIES
RESEARCH PROGRAM – M.Phil / PhD in English
(2019–2020 Batch and onwards)

Course code	Name of the course	Instruction hours / week	credits	Maximum Marks (100)
19RENG101	Research Methodology and Pedagogy	4	4	100
19RENG 201	Modern Literary Theory and Criticism	4	4	100
19RENG 301	English Language Teaching	4	4	100
19RENG 302	Drama			
19RENG 303	Fiction			
19RENG 304	Poetry			
19RENG 305	Linguistics			
Program Total		12	12	300

PAPER- I: RESEARCH METHODOLOGYAND PEDAGOGY

19RENG101

Course Objective:

- To understand some basic concepts of research and its methodologies.
- To identify appropriate research topics.
- To select and define appropriate research problem and parameters.
- To prepare a research proposal.
- To organize and conduct research in a more appropriate manner.
- To write a research report and thesis.

Course Outcome:

- Demonstrate the ability to choose methods appropriate to research aims and objectives.
- Understand the limitations of particular research methods.
- Develop skills in qualitative and quantitative data analysis and presentation.
- Develop advanced critical thinking skills.
- Demonstrate enhanced writing skills.
- Develop a comprehensive research methodology for a research question.

UNIT: I- Research Process

Research and writing, selecting a topic, using the library, conducting research, arriving at a thesis statement, taking notes, outlining, writing drafts and style Plagiarism.

UNIT: II- The Mechanics of Writing

Spelling, punctuation, names of persons, numbers, and titles of works in the research papers, use of questions, use of ellipsis and other alterations of sources.

UNIT: III- Documentation

Documentation sources, list of works cited and other source lists – citing print and non-print sources, citing electronic publications, compiling a bibliography or work cited, abbreviations, content notes.

UNIT: IV- Format of Thesis

Margins, heading and titles, page and chapter format, the text of the thesis, and organizing the material.

UNIT: V- Pedagogy

Objectives and Role of Higher Education – Important Characteristics of an Effective lecture – Quality Teaching and Learning – Lecture Preparation – Characteristics of Instructional Design – Methods of Teaching Learning: Large Group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project Small Group Technique – Simulation, Role Playing Demonstration, Brain Storing, Case Discussions and Assignment, Methods of Evaluation – Self Evaluation, Student Evaluation, Diagnostic Testing and Remedial Teaching – Question Banking – Electronic Media in Education: - 'e' Learning Researches – Web Based Learning.

SUGGESTED READINGS

1. *Modern Language Association*. *MLA Handbook for the Writers of Research Papers.* East West Press Seventh edition, New Delhi. 2012.Print.
2. Raimes, Ann. *Keys for Writers*. Houghton Mifflin, New York, 2002. Print.
3. Vedanayagam, E.G. *Teaching Technology for College teachers*. New Delhi: Sterling Publishers (P) Ltd., 1989. Print.
4. Kumar, K.L. *Educational Technologies,* New Delhi: New age International. 1997. Print.

PAPER-II: MODERN LITERARY THEORY AND CRITICISM

19RENG 201

Course Objective:

- To introduce scholars to the nature, function and relevance of literary criticism and theory.
- To encourage scholars to deal with highly intellectual and radical content and thereby develop their logical thinking and analytical ability.
- To develop sensibility and competence in them for practical application of critical approach to literary texts.
- To make the scholars analyse and interpret literature.
- To enhance the critical thinking of students by introducing to them a bunch of literary andpolitical theories.
- To give the scholars a firm grounding in a major methodological aspect of literary studies known as theory.

Course Outcome:

- Widens the knowledge of literary and focuses on their importance.
- Helps to write a critical appreciation.
- Provides an insight of practical criticism.
- Sets the mind towards creative writing, appreciation, critical thinking and critical analysis.
- Highlights expression of thoughts and views for critical appreciation and judgmental reviews.
- Develop a skill in applying various literary theories in interpreting a specific text.

UNIT: I

Structuralism, Post structuralism, Deconstruction

Gerard Gennette	:	Structuralism and Literary Criticism
Colin Mac Cab	:	Language, Linguistics and the Study of Literature
Derrida	:	Structure, Sign and Play in the Discourse of Human Sciences

UNIT: II

Psychoanalysis, Hermeneutics and Phenomenology

Jacques Lacan	:	The Insistence of the Letter in the Unconscious
Wolfgang Iser	:	The Reading Process: A Phenomenological Approach
Ed.Hirsch, Jr	:	Three dimensions of Hermeneutics

UNIT: III

Feminist Criticism, New Historicism, Cultural Studies

Elaine Showalter	:	Feminist Criticism in the Wilderness
Stephan Green Blat	:	The Circulation of Social Energy
Stuart Hall	:	Cultural Identity and Diaspora

UNIT: IV

Marxism, Post Modernism, Post Colonialism

Edmund Wilson	:	Marxism and Literature
Terry Eagleton	:	Capitalism, Modernism and Post modernism
Edward Said	:	'Crisis' (Selection from *Orientalism*)

UNIT: V

Eco-criticism, The Reader Response Theory, Discourse Analysis

CheryllGlotfelty et al.	:	Landmarks in Literary Ecology: The Eco-criticism Reader
Stanley Fish	:	Is There a Text in This Class
Foucault	:	Archaeology of Knowledge (Chapter- I)

SUGGESTED READINGS

1. Abrams and Harpham eds,.*A Glossary of Literary Terms*, 11th ed; cencageHarning, 2015.
2. Barry, Peter. *Beginning Theory: An Introduction to Literary and Cultural Theory*, 2013.
3. Dorairaj Joseph, *Interventions: Essays in Philosophy and Literary Theory*, 2006.
4. Leitch,et al.*The Norton Anthology of Theory and Criticism*. 2002.
5. Lodge and Wood, eds, *Modern Criticism and Theory*: *A Reader*, 2003.
6. Sethuraman, VS, *Contemporary to Postmodernism: An Anthology*, 1989.
7. Waugh, Patricia. ed, *Literary Theory and Criticism*: *An Oxford Guide,* 2006.

PAPER- III: SPECIAL PAPER
ENGLISH LANGUAGE TEACHING

19RENG 301

Course Objective:

- To acquaint the scholars with different theoretical and practical aspects of English language teaching.
- To acquaint scholars with different approaches, methods and techniques of teaching English language.
- To identify the role and importance of English as a global language.
- To familiarize the different methods and approaches of English.
- To develop a basic knowledge of the English around the world.
- To Apply different pedagogical strategies in teaching and learning process.

Course Outcome:

- Infer the technicalities involved in the teaching-learning process.
- Predict different methods and approaches for efficient teaching-learning.
- Design various teaching methodologies and practices.
- Illustrate a thorough knowledge of the methods in learning and teaching.
- Analyse and decide on the effectual methodologies for teaching-learning.
- Examine new techniques involved in pedagogy and English Language Teaching.

UNIT: I

English as an International, Colonial and National Language.

Language Pedagogy and the Teaching of English

UNIT: II

Methods and Approaches

Spoken English and the Teaching of Spoken English

Vocabulary enrichment and the Teaching of Vocabulary

UNIT: III

English Grammar and the Teaching of Grammar

Reading, Writing and the Teaching of Composition

The Teaching of Prose and Poetry

UNIT: IV

Instructional Aids and Study Aids

Test, Testing and Evaluation

Planning and Lesson planning

UNIT: V

Common Errors and Remedial English

Recent Trends in ELT: CALL, MALL, CLT, ICT

SUGGESTED READINGS

1. Teaching English: Approaches, Methods, and Techniques by N.Krishnaswamy& Lalitha Krishnaswamy, Macmillan India Limited, 2003.
2. English Language Teaching: Approaches methods Techniques by Geetha Nagaraj, Orient Longman, 2003.

PAPER- III: SPECIAL PAPER
DRAMA

19RENG 302

Course Objective:

- To identify the basic structure of drama as a major genre.
- To outline the different ages of drama in literature.
- To draw an understanding of the importance of drama in theatre arts.
- To interpret the dramatic works of different ages and authors.
- To analyse the various theoretical and critical aspects of drama.
- To examine the theatrical and societal function of drama.

Course Outcome:

- Appraise a dramatic work of art technically.
- Characterize the thematic aspect of a drama.
- Demonstrate the knowledge of stylistic techniques of dramatic masterpieces and authors.
- Interpret a literary piece in terms of different socio-political milieus.
- Compare and contrast the critical approaches of different ages.
- Devise novel theoretical and critical approaches of a dramatic work of art.

UNIT-I:

Shaw -Pygmalion

UNIT-II:

Bertolt Brecht -Mother Courage

UNIT-III:

Harold Pinter - The Birthday Party

UNIT-IV:

Girish Karnad– Hayavadhana

UNIT-V:

Tennessee Williams– Cat on a Hot Tin Roof

PAPER- III: SPECIAL PAPER
FICTION

19RENG 303

Course Objective:

- To identify the construction of fiction as a literary genre.
- To outline the diverse ages in which fiction flourished.
- To draw an understanding of the importance of fiction in the study of literature.
- To interpret the fictional works belonging to different ages and authors.
- To analyse the diverse historical, social and political milieus in relation with a text.
- To examine the unique characteristic feature of fiction in literature.

Course Outcome:

- Classify a piece of fiction using different critical and literary theories.
- Characterize the multiple thematic functions of fiction.
- Appraise the uniqueness of stylistic techniques of novelists around the world.
- Predict the socio-political and historical milieus of a work of art.
- Compare and contrast the critical approaches of different ages.
- Devise new theoretical and critical approaches to analyse a literary piece.

UNIT: I
Henry James : The Golden Bowl

UNIT: II
William Faulkner : The Sound and the Fury

UNIT: III
Patrick White : Vass

UNIT: IV
Margaret Laurence : The Stone Angel

UNIT: V
Bharati Mukherjee : Jasmine

PAPER- III: SPECIAL PAPER
POETRY

19RENG 304

Course Objective:

- To identify the origin and development of poetry as a literary genre.
- To outline the diverse ages in which poetry flourished.
- To draw an understanding of the importance of poetry in the study of literature.
- To interpret the poetry of different ages and authors.
- To analyse the diverse historical, social and political milieus found in poetry.
- To examine the unique characteristic feature of poetry in literature.

Course Outcome:

- Characterize a piece of poetry using different critical and literary theories.
- Demonstrate the multiple thematic functions of poetry.
- Appraise the uniqueness in the stylistic sophistication of poets all over the world.
- Predict the socio-political and historical milieus of a work of art.
- Compare and contrast the critical approaches of poetry in different ages.
- Devise new critical approaches to interpret a piece of poetry.

UNIT: I

Chaucer	:	Prologue to the Canterbury Tales
Milton	:	Paradise Lost - Book IX
Wordsworth	:	Tintern Abbey
Philip Larkin	:	Church Going

UNIT: II

Robert Frost	:	Mending Wall
William Carlos Williams	:	The Red Wheelbarrow
Leslie Marmon Silko	:	It was a long time before
Wallace Stevens	:	The Emperor of Ice Cream

UNIT: III

Dorothy Livesay	:	Green Rain
A.J.M. Smith	:	Ode on the death of W.B. Yeats
F.R.Scott	:	Lourentian Shield
Margaret Atwood	:	Tricks with Mirror

UNIT: IV

Tagore	:	Gitanjali(Part-I)

Kamala Das	:	An Introduction
Nissim Ezekiel	:	Enterprise
Keki N. Daruwallah	:	The Ghaghra in Spate

UNIT: V

Seamus Heaney	:	Digging
Derek Walcott	:	The Season of Phantasmal Peace
Claude McKay	:	If We Must Die
A.D. Hope	:	Australia

PAPER- III: SPECIAL PAPER
LINGUISTICS

19RENG 305

Course Objective:

- To identify the role and importance of Linguistics.
- To describe the study of linguistics as a science of language studies.
- To develop a basic knowledge of Linguistics.
- To demonstrate an understanding of the significance of linguistics.
- To discuss different linguistic approaches in language learning process.
- To formulate effective linguistic and phonetic analysis in language learning.

Course Outcome:

- Infer the technicalities involved in different types of linguistic approaches.
- Predict difference between a traditional approach and modern linguistic approach of language studies.
- Devise new strategies in technically analyzing different components of language.
- Illustrate a thorough knowledge of linguistics in learning English.
- Analyse and decide on the linguistic strategies in teaching-learning process.
- Examine new techniques in language studies and ability to apply it practically.

UNIT: I

Linguistics: An Introduction

Traditional Approaches to study of the English Language Merits and Inadequacies

Linguistics as an autonomous science

Linguistics and other disciplines

UNIT: II

Morphology: Free, Bound, Zero morphemes, Allomorphs

Semantics

UNIT: III

Clauses, Basic Patterns and Sentence Typologies

Transformational Generative Grammar

I.C. Analysis: features, merits and limitations

Phrase structure Grammar: features, merits and limitations

UNIT: IV

Phonetics, Phonology and Phonemics/Phonematics

Phoneme, Allophone, Free Variants

UNIT: V

IPA Symbols and other symbol systems

Word-stress,

Words in connected speech

Intonation

Assimilation

Broad Transcription

SUGGESTED READINGS

1. Jindal, D.V. *An Introduction to Linguistics*. London: Prentice Hall, 2010. Print.
2. Yule, George, *The Study of Language.* Chennai: Cambridge UP, 2014. Print.
3. Rajimwale, Sharad. *Elements of General Linguistics*.2vols. Delhi: Rama. 2012. Print.
4. Lyons, John. *An Introduction to Theoretical Linguistics.* Cambridge UP, 1968. Print.

RESEARCH PROGRAM
M.Phil./Ph.D. in Management
(2019-2020 Batch and onwards)

Enable | Enlighten | Enrich

KARPAGAM

ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act, 1956)

DEPARTMENT OF MANAGEMENT

FACULTY OF ARTS, SCIENCE AND HUMANITIES

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act, 1956)

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DEPARTMENT OF MANAGEMENT
FACULTY OF ARTS, SCIENCE AND HUMANITIES
M.Phil./Ph.D. in Management
(2019-2020 Batch and onwards)

Course code	Name of the course	Instruction hours/ week	Credit(s)	Maximum Marks (100)
19RMGT101	**Paper-I:**Research Methodology And Pedagogy	4	4	100
19RMGT201	**Paper-II:**General Management	4	4	100
19RMGT301	**Paper III: Special Paper I** - Advanced Entrepreneurship	4	4	100
19RMGT302	**Paper-III: Special Paper II -**Advanced Financial Management	4	4	100
19RMGT303	**Paper-III: Special Paper III -**Advanced Marketing Management	4	4	100
19RMGT304	**Paper-III: Special Paper IV -**Advanced Operations Management	4	4	100
19RMGT305	**Paper-III: Special Paper V -**Corporate Human Resource Management	4	4	100
19RMGT306	**Paper-III: Special Paper VI –**Corporate Social Responsibility, Business Ethics and Corporate Governance	4	4	100
19RMGT307	**Paper-III: Special Paper VII –**Project Management	4	4	100
19RMGT308	**Paper-III: Special Paper VIII –**System Management	4	4	100
19RMGT309	**Paper-III: Special Paper IX -**Advertising and Salesmanship	4	4	100
19RMGT310	**Paper-III: Special Paper X -**Service Marketing	4	4	100
PROGRAM TOTAL		12	12	300

19RMGT101 RESEARCH METHODOLOGY AND PEDAGOGY 4H – 4C

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the Learners

- To impart knowledge in the concept of problem identification and research methodology
- To familiarize with basic of *research* and the *research* process
- To demonstrate the different types of research and its applicability
- To comprehend the knowledge of social research
- To exhibit insampling design and sampling techniques
- To enrich the knowledge in writing a good research report.

COURSE OUTCOMES:

Learners should be able to

1. Understand the concept of research process, research design and sampling techniques
2. Assess the various research tools and techniques in order to facilitate the research work
3. Calculate and apply the measure of central tendency and dispersion in decision making
4. Understand and Exhibit the statistical tools, parametric and non-parametric in research.
5. Analyse the research problem and design the blue print to capture data and analyse the same using appropriate statistical techniques and apply the learning lifelong.
6. Design a report to communicate the findings and suggestion to make business decision

UNIT-I

Research- Scope and Significance- Types of Research- Research Process- Characteristics of Good Research- Identifying Research problem- Sampling Design- meaning- Steps in sampling-criteria for good sample design- Types of Sample Design- Probability and non-probability sampling methods. Measurement-Meaning- Types of scales.

UNIT -II

Review of Literature- Data Collection-Types of Data- Sources- Methods of Data collection-constructing questionnaire- Establishing, reliability and validity- data processing- Coding-editing and tabulation of data. Report writing- Types of Report- Steps – Precautions for writing report-Norms for using Tables, Charts and diagram. Appendix:- Index, Bibliography.

UNIT - III

Mean, Median and Mode- Parametric Test- Hypothesis testing- Z-test, t-test, F-test, Chi-square test- ANOVA- Correlation, Multiple Regression, Factor Analysis, Non- Parametric tests- Basic of Psychometric Test: Sign test, H test, U test and Run test.

UNIT -IV

Quantitative Techniques- Operations Research- Scope and Models- Linear Programming formulation- Transportation Model- Assignment Model- Mathematical formulations of problems and applications in decision making- Queuing theory- Decision Theory- Simulation model.

UNIT-V

Pedagogical methods in Higher Education

Objectives and roll of higher education- Important characteristics of an effective Lecture – Quality teaching and learning- Lecture preparation-Characteristics of instructional design- Methods of teaching-learning: Large group – Technique - Lecture, Seminar, Symposium, Team teaching, Project, Small group Technique – Simulation, role-playing Demonstration, brain storing, case discussions, and assignment, Methods of evaluation – Self evaluation, student evaluation, Diagnostic testing and remedial teaching – question banking – Electronic media in education: - 'e' learning researches – web-based learning.

REFERENCES:

1. Donald Cooper, Pamela Schindler, J K Sharma (2017), Business Research Methods, 11th edition, Mcgraw Hill, New Delhi
2. Gupta S.P (2017), Statistical Methods, Sultan Chand & Sons, New Delhi
3. C.R. Kothari, Gaurav Garg (2018), Research Methodology, 4th edition, New Age International Publishers, New Delhi
4. O.R. Krishnaswami (2018), Research Methodology, Himalaya Publishing House Pvt. Ltd. New Delhi
5. Pannerselvam, R. (2014) Research Methodology, Prentice Hall of India, New Delhi
6. K.V.Rao, (2012), Research Methodology in Commerce & Management, Sterling Publishers Pvt.Ltd, New Delhi
7. RajasekarS(2016) Computer Education and Educational Computing, Hyderabad, Neelkamal Publication.
8. Kumar K.L (2008) Educational Technologies- -A Practical Textbook for Students, Teachers, Professionals and Trainers, New Age International, New Delhi,
9. KanthiSwarup P.K Gupta (2014), Man Mohan "Operations Research", Sultan Chand and Sons, New Delhi

M.PHIL/Ph.D **2019-2020**

GENERAL MANAGEMENT **Semester – I**

19RMGT201 **4H – 4C**

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners

- To demonstrate the concepts of functions of management.
- To identifyfactors involved in human behaviour and human resource management
- To infer the knowledge on procuring and management of funds
- To familiarise with the concept of marketing management
- To analyse the production and operations management concept
- To compose the knowledge in the field of general management

COURSE OUTCOMES:

Learners should be able to

1. Demonstrate the concepts of management and the functions of management and organizational behaviour.
2. Understand the importance of human resource management in a variety of circumstances.
3. Assess the impact of the profitability and time value of money
4. Exhibit the marketing skills in various situations
5. Learners can assess the individual and group behaviour in organizations.
6. Understand and exhibit the communication skills to convey the thoughts and ideas to the individuals and group.

UNIT-I

Management: Role of Manager- Managerial Levels- Managerial Functions –Planning: Nature, purpose and objectives- Decision making: meaning, process- Organizing: Structure, Line/Staff functions, Staffing, manpower planning, Recruitment, selection- leadership, types of leaders, effective leadership

UNIT -II

Human Resource Management: Functions-Objectives- HRM in Changing environment, Job Analysis- Performance Appraisal, Methods, uses- Training and Development, Compensation Management concepts- Foundations of Organizational Behaviour- nature, role and functions- individual behavior- group behavior- transactional analysis, power and conflicts- organization culture and change.

UNIT - III

Financial Management: Objectives, goals, scope- an overview of Indian Financial system, development, reforms- Financial Statement Analysis- Limitations- cost of Capital- capital Structure- Leverages- Cost Volume profit analysis-capital Budgeting.

UNIT -IV

Marketing Management: Meaning, Nature- conceptual foundation of Marketing- Modern Concepts of Marketing- New Horizons of Marketing- Marketing systems – Marketing functions- Market segmentation- Marketing mix: Product Mix, price mix and Promotion mix.

UNIT -V

Information Systems: A framework for business users- System concepts – Organization as a system – components of Information systems- IS activities, types- System development Life cycle- Comparison, concepts and knowledge representation- managing international information system- managing information technology- Security and Ethical Challenges.

REFERENCES:

1. Bharti, P. (2018). Indian Financial System, 5/e. Pearson Education India.
2. Laudon, K. C., & Laudon, J. P. (2015). Management Information Systems: Managing the Digital Firm Plus MyMISLab with Pearson eText--Access Card Package. Prentice Hall Press..
3. Kotler, P., Keller, K. L., Ang, S. H., Tan, C. T., & Leong, S. M. (2018). Marketing management: an Asian perspective. Pearson.
4. Philip Kotler et.al, (2017), Marketing Management, 15th Edition, Pearson Education, New Delhi.
5. Chandra, P. (2017). Investment analysis and portfolio management. McGraw-Hill Education.
6. Robbins, S. P., & Judge, T. A. (2016). Organizational Behavior, Global 17th Edi□tion.

M.PHIL/Ph.D **2019-2020**

ADVANCED ENTREPRENEURSHIP **Semester – I**

19RMGT301 **4H – 4C**

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

- To provide theoretical foundations of entrepreneurship
- To acquaint students with the special challenges of starting new ventures and introducing new product and services ideas
- To train the students on entrepreneurial ethics and project management
- Knowledge on various sources of institutional finance
- Knowledge on project management and implementation
- To get acquaint with various categories of project and factors determining in successful completion of project

Course Outcomes:

1. To inculcate entrepreneurial skills and foster entrepreneurial development
2. Evaluate the best sources of finance suitable for financing projects
3. Categorize the financial plan considering the borrowing capacity of entrepreneurs
4. Design the project and undergo feasibility analysis to implement the project
5. Analyze the categories of project and define the role of project manager
6. Communicate effectively the promotion of entrepreneurship in building all-round industrialization

UNIT I

ENTREPRENEURSHIP DEVELOPMENT: Entrepreneur – Importance – Entrepreneurship Development - its importance – Role of Entrepreneurship – Entrepreneurial Environment. Evolution of Entrepreneurs - Entrepreneurship Development and Government Assistance.

UNIT II

SOURCES OF FINANCE : Various sources of finance available : Long Term Sources – Equity Shares, Preference Shares and Debentures – Kinds of Private Placements – IPO – SEBI – FDI – Institutional Finance – Banks – IDBI, IFCI, IIBI, ICICI, SIDBI, SFC's in India – Short term sources – Sources of Working Capital.

UNIT III

PREPARING THE FINANCING PLAN: General Considerations – Construction financing – Long term financing – withholding tax considerations – estimating the borrowing capacity of a project – Loan repayment parameters.

UNIT IV

PROJECT MANAGEMENT : Concept of a project – Categories of a project – Project Lift Cycle – Definition of project management – Project as a conversion process – Project Environment – Complexity of Projects – Relationship between project management and line management – Current issues in project management – System approach to project management – Roles and Responsibilities of Project Manager.

UNIT V

PROJECT PLANNING AND IMPLEMENTATION: Process of Project Planning – Managing the planning process – Evaluation and project financing – Development Banking – Investment Institutions – Means of Financing – Project Financing Package – Procuring funds. Bottlenecks in project implementation – management techniques for project management – Project Evaluation – Project Review.

REFERENCES :

1. Vasant Desai (2018), The Dynamics of Entrepreneurial Development and Management, Planning for Future Sustainable Growth, 6thedition, Himalaya Publishing House, New Delhi.
2. N.P.SrinivasanC.B.Gupta (2014), Entrepreneurial Development in India, Sultan Chand & Sons, New Delhi.
3. Robert D. Hisrich, Michel P Peter and Dean A. Shepherd (2012) Entrepreneurship, 9thedition, McGraw Hill, New Delhi
4. Harvey Maylor (2010), "Project Management", 4th edition, Financial Times/ Prentice Hall,
5. Prasanna Chandra, (2017), Project Planning, Analysis, Selection, Implementation and Review" 8thedition, McGraw Hill, New Delhi.

M.PHIL/Ph.D		2019-2020
19RMGT302	ADVANCED FINANCIAL MANAGEMENT	Semester – I 4H – 4C

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the learners

- To enable the learners to acquire knowledge in financial management
- To Impart the knowledge in finance functions, cost of capital, capital structure, capital budgeting and leverage.
- To access the concept of cost of capital and capital structure.
- To understand the importance of financial data in preparing report
- To Provide an in-depth view of the process in *financial management* of the firm.
- To Develop knowledge on the allocation of resources.

COURSE OUTCOMES:

Learners should be able to

1. Understand how funds are managed and their reflections on the fundamental decisions to be taken by the corporate world.
2. Apply the basics of Finance functions and working capital management.
3. Demonstrate an understanding of the overall role and importance of the finance function.
4. Communicate effectively using standard financial terminology.
5. Demonstrate the impact of leverage and dividend policy on stockholders.
6. Observe the functions and trends in financial markets and react.

UNIT I

Financial Management: - Financial Analysis and Control; Time value of Money; Capital Budgeting Decisions - Capital Structure - Long and Short Term Sources- Cost of Capital - Leverages- Dividend Policy - Financial Modeling

UNIT II

Working Capital Management: Concept, Need and Determinants of Working Capital- Factors Determining Working capital- Sources of Working capital Finance – Management of Cash - Receivables Management - Inventory Management

UNIT III

Security and Portfolio Management: Introduction to Securities – Markets for Securities -Risk and Return- Economic analysis- Industry analysis - Company Analysis- Security Analysis- Technical Analysis- Portfolio Analysis and Management- Financial Derivatives.

UNIT IV

Financial Markets and Institutions: Development of the Financial System in India, New Developments in the Financial System - Structure of Financial Markets: Primary and Secondary

Market, Money Market, Capital Market, Debt market - Financial Institutions: Banking and Non-Banking Institutions

UNIT V

International Financial Management: Introduction – Foreign Exchange Market – International Parity Relationships – Foreign Exchange Risk and Hedging – International Capital Investment analysis- Political risk of foreign investment- financing international operations- recent trends in international financial management
(Note: Theory- 60%; Problems- 40%)

REFERENCES:

1. Prasanna Chandra (2017), Financial Management Theory & Practice, 9thedition, McGraw Hill, New Delhi.
2. Banerjee, B. (2015). Fundamentals of financial management. PHI Learning Pvt. Ltd..
3. Nisha Aggarwal, Neeti Gupta, Shashi K.Gupta(2015), “Financial Institutions and Markets”, Kalyani Publishers
4. Petty, J. W., Titman, S., Keown, A. J., Martin, P., Martin, J. D., & Burrow, M. (2015). Financial management: Principles and applications. Pearson Higher Education AU.
5. IM Pandey (2015), “Financial Management” 11th Edition, Vikas Publishing, New Delhi.

Semester – I

19RMGT303 ADVANCED MARKETING MANAGEMENT 4H – 4C

Instruction Hours / week: L:4 T: 0 P : 0 Marks: Internal: 0 External: 100 Total: 100

End Semester Exam: 3 Hours

Course Objectives:

To make the students

- To understand the marketing concepts and conduct market analysis through environment scanning
- To recognize and apply market segmentation branding and New Product development concepts in real situations.
- To identify the importance of selecting the marketing channel and the pricing strategies and its applications.
- To recognize the growth of the service sector and strategic marketing management for services
- To understand the ethical issues related to marketing and the latest development in marketing.
- To analysis Global Marketing Management Control and Global Marketing Research

Course Outcomes:

Learners should be able to

1. Understand the core concepts of marketing and the role of marketing in business and society.
2. Perform market analysis and identify the best marketing mix.
3. Determine strategies for Planning merchandise needs and merchandise budgets
4. Understand the latest trends in marketing and apply the ethical norms in marketing domain.
5. Effectively communicate ideas, explain procedures and interpret results and solutions in written and oral forms to the team members.
6. Designing competitive strategies for Leaders and identify Future trends of International Marketing

UNIT – I

PRINCIPLES OF MARKETING

Marketing Concepts – Marketing Environment– Market Segmentation – New Product Decision Process – Types of new products. Marketing Mix – Product Life Cycle – Managing the product in Product Life Cycle. Physical Distribution – Importance and role of distribution in marketing – Marketing as promotion tools. Pricing - Market Evaluation and Controls.

UNIT – II

SERVICES MARKETING

Introduction - growth of the service sector -marketing mix in services marketing - the seven Ps - strategic marketing management for services - delivering quality services - developing appropriate and effective communication about service quality. marketing of services with special reference to: financial services - health services - hospitality services including travel, hotels and tourism.

UNIT - III

RURAL AND INDUSTRIAL MARKETING

Economy - Rural - Rural Marketing - Concept and Scope - Selection of Markets - Pricing strategy - pricing policies -Distribution -' Logistics Management. Introduction to Industrial Markets - Strategic Industrial Marketing (S.T.P.) - Marketing Information Systems and Marketing Research. Classification of Industrial Products and Services - Formulating Channel Strategies - Developing Marketing Strategies and Programs for Industrial Goods / Services.

UNIT – IV

RETAIL MARKETING

An overview of retailing - Types of stores - Product retailing vs. Service retailing -Retail store location and layout - Planning merchandise needs and merchandise budgets - Communicating with the retail customer - Globalisation and changing retail formats. - Virtual store - E-relating International Retailing.

UNIT – V

INTERNATIONAL MARKETING

International Marketing – Meaning – Definition-Role of Export in Economic Development - Export procedure and documentation -India's export performance – problems in export trade – Developing consumer products for Global markets – Global Marketing Management Control – Global Marketing Research – Future trends of International Marketing.

REFERENCES:

1. Bagozzi, R. P., Rosa, J. A., Celly, K. S., & Coronel, F. (2018). Marketing-Management. Walter de Gruyter GmbH & Co KG.
2. Chitty, W., D'Alessandro, S., & Gray, D. (2019). Services marketing. Oxford University Press Australia and New Zealand.
3. Kashyap, P. (2016). Rural marketing. Pearson Education India.
4. G Krishnamacharylu and LaithaRamakrishna(2009), Rural Marketing, Pearson Education, New Delhi.
5. Wirtz, J., & Lovelock, C. (2016). Services marketing. World Scientific Publishing Company..
6. Haider, A. A., Zafar, A., Khalid, A., Majid, A., Abdullah, M. A., &Sarwar, M. B. (2019). Marketing Management..
7. VarshneyR .L . and Bhattacharya (2012), "International Marketing Management. – An Indian Perspective" 24th edition, S.Chand and Sons. New Delhi
8. BalagopalT.A.S(2014), "Export Management". Himalaya Publishing House, New Delhi.

M.PHIL/Ph.D		**2019-2020**
		Semester – I
19RMGT304	**ADVANCED OPERATIONS MANAGEMENT**	**4H – 4C**

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:
To make the students

- To understand the Operations management and operation strategy concepts and its application in business.
- To recognize the importance of various production systems.
- To formulate the production planning and control systems and ensure efficient scheduling for production.
- To understand and apply the technology in production.
- To understand the quality management practice and TQM tools and its application in improving the organizational performance.
- To understand the concept of organization transformation and re-engineering.

COURSE OUTCOMES:
Learners should be able to

1. Understand the core features of the operations and production management function at the operational and strategic levels.
2. Evaluate and decide the best plant and factory location and layout.
3. Forecast the requirement and make accurate production planning , inventory planning and schedule the production.
4. Obtain the knowledge of applying a quality management TQM tools to improve organizational effectiveness.
5. Effectively communicate ideas, explain procedures in oral and written forms to different audiences.
6. Creating and delivering products & services to customers and improving process & supply chain performance

UNIT -I
Concept of Operations Management - Characteristics of Manufacturing sector and service sector - Evolution of Operations Management Discipline - Concepts and Calculations of Productivity - Productivity Techniques - Productivity improvement measures. Impact of Technology on Production; Economics and Social Issues – Automation – Operation strategy and competitiveness Management.

UNIT - II
Types of production systems - Job shop industry, Process Industry, Project type of industry, Mass production Industry with product layout, process layout and cellular manufacturing system. Design of the systems and procedures: Product Decision and Process Selection.

UNIT - III

Design of Production, planning and control system – design on scheduling system – design of inventory system – design of maintenance system - Supply chain Management Logistics management- NW-1, MRP-11, ERP and use of Simulation technique for decision making.

UNIT - IV

Concept of Total Quality Management - Quality Philosophies of Deming, Cross by and Miller - Statistical Quality Control technique - Continuous' Improvement Strategies, Deming -wheel - Taguichi Techniques, Seven- QC tools - TQM culture, Quality Circle Six Sigma - ISO Certification Process.

UNIT - V

Principles of organizational transformation and re-engineering - methodology -guidelines Analytical and process tools and techniques Information and communication technology - Enabling role of IT in re-engineering - synchronous manufacturing – production planning and financial planning - Human aspects of production management.
(Note: Theory- 60%; Problems- 40%)

REFERENCES:

1. Heizer, J., Render, B., & Munson, C. (2017). Operations management. Pearson Education Limited.
2. Lee J. Krajewski, Manoj K. Malhotra, Larry P. Ritzman (2015), Operations Management: Processes and Supply Chains, 11th edition, Pearson Education, New Delhi.
3. Mahadevan, B. (2015). Operations management: Theory and practice. Pearson Education India.Mahadevan, B. (2015). Operations management: Theory and practice. Pearson Education India.
4. Chary, S. N. (2009). Production and operations management. 4-th edition..
5. Samuel K.Ho (2002), TQM, An Integrated approach, Crest Publishing House
6. Modrak, V. (Ed.). (2014). Handbook of research on design and management of lean production systems. IGI Global.
7. Slack, N. (2018). Essentials of operations management. Pearson UK.
8. Bhat, S., &Aswathappa, K. (2010). Production and operations management. Himalaya Publishing House.

M.PHIL/Ph.D **2019-2020**

19RMGT305	**CORPORATE HUMAN RESOURCE MANAGEMENT**	**Semester – I** **4H – 4C**

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

To make the students

- To gain knowledge of HR planning, Selection, Recruitment, job analysis and its interrelations.
- To understand the concepts and practical implications of performance management, Training methods and career planning.
- To know about Conditions for failure and success in OD and efforts of OD
- To be familiar with Employee relations and its application for the development of Human resources.
- To understand the methodstoimprovequalityofworklife and Work stress management
- To acquire knowledge in Interpersonal Interventions & Comprehensive interventions

CourseOutcomes:

Learners should be able to

1. Assess the importance of HRM and effects of Workforce Diversity and Cultural Diversity
2. Evaluate the Cultural Difference and HRM
3. Understand the compensation and reward system applicable to the industry and International Recruitment Policy, Selection criteria, Training Development
4. Understand and apply the appropriate employee relations measures.
5. Understand the HR functions and latest developments in the field of HR and effectively communicate ideas, explain procedures and interpret results and solutions in written and oral forms to different audiences.
6. Make any manager to identify various activities related to Human Resources, Job involved in HR, Training, Compensation and Labour welfare practices

UNIT I

Human Resource Management: Nature-Scope- importance- strategic HRM. Recruitment & Selection - Process- Methods. Training and development-types of training-Evaluation of Training. Performance appraisal-Methods-360 feedback-Potential Appraisal-Process-Difference between performance and potential appraisal-career guidance-counseling-HR audit. Recent trends in HR.

UNIT -II

Organization Behavior: Personality Determinants-Types - Values - Types. Attitudes – components - formation of attitude. Emotional intelligence-components. Work stress management-nature-causes of stress-effects of stress- managing stress-managing organizational change-counseling.

UNIT III
Human Resource Development:HRD-meaning-Scope-difference between personnel management and HDR-key performance area-role analysis-transactional analysis-Executive Development-Management Development.

UNIT IV
Organization Development: OD-Concepts-Nature-Scope, Conditions for failure and success in OD efforts-OD Intervention-Team Intervention, Interpersonal Interventions & Comprehensive interventions:

UNIT V
International HRM: Cultural Difference and HRM. International Recruitment Policy-Selection criteria - Training Development – Compensation - Repatriation. Workforce Diversity. Cultural Diversity.

REFERENCES:

1. Aswathappa, (2013), Human Resource Management, 7th edition, Mc Graw Hill, New Delhi.
2. Rao, V.S.P., (2016), Human Resource Management, Taxmann Publications Pvt. Ltd, New Delhi.
3. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra (2016), Organizational Behavior, 16th edition, Pearson Education, New Delhi.
4. McShane (2017), Organizational Behavior, 6th edition, McGraw Hill Education, New Delhi.
5. Tripathi, P.C.(2010), Human Resource Development, .Sultan Chand & Sons, New Delhi
6. French Wendell L, Bell Jr Cecil H , Vohra Veena (2017), Organization Development: Behavioral Science Interventions for Organizational Improvement, 6th Edition, Pearson Education, New Delhi.

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Semester – I

19RMGT306 **CORPORATE SOCIAL RESPONSIBILITY, BUSINESS ETHICS AND CORPORATE GOVERNANCE** **4H – 4C**

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

To make the students

- To develop knowledge and understand about the theoretical perspectives and frameworks of corporate governance, ethical, and social dimensions.
- To learn the ethics to be followed in management and various areas to protect the interests of beneficiaries
- To assess and understand social responsibility of business and its impact.
- To provide clear understanding of constitution of board and powers of directors
- To understand issues related to business and good governance necessary for long term survival of business.
- To learn new trends in corporate social responsibility

Course Outcomes:

Learners should be able to

1. Inculcate the ethical practices in personal and organizational life
2. Practice ethical and morals in business to protect the long term interest of the shareholders and create policies that adopt by laws.
3. To define the powers and responsibilities of board of directors
4. Maintain and transfer sense of social responsibility to create effective developments in organization and society
5. Analyze ethical issues related to business and good governance necessary for long term survival of business.
6. Evaluate the emerging Areas and Trends in Corporate Social Responsibility

UNIT – I CORPORATE SOCIAL RESPONSIBILITY

Introduction – System Concept of Business Society – Business and Society Relationship – Business Environment – Business in a Social World – Social Responsibility – Corporate Social Responsibility – Corporate Social Accountability – Social Responsibility Tools – Globalization and the perspectives of CSR – Corporate Legislations – Labour Legislations – Stakeholders Legislations – Environmental Legislations and Overview of Air and Water Pollution Control Acts.

UNIT – II ETHICS AND SOCIAL RESPONSIBILITY

Introduction – Approaches to Ethics – Meaning of Ethics – Major Attributes of Ethics – Business Ethics – Factors that influence Ethics – Importance of Ethics – Ethics in Management – Organisational Ethics – Ethical Aspects in Marketing – Mass Communication and Ethics – Television – Whistle blowing - Intellectual Property and Ethics – Ethical Investing – Ethics in

Financial Services – Professional Ethics – Introduction – Engineering Ethics – Principles of Medical Ethics.

UNIT – III CORPORATE GOVERNANCE
Introduction – Meaning of Corporate Governance – Definitions – Significance – Importance – Nature of Corporate Governance – Features of Corporate Governance – Objectives of Corporate Governance – Reasons for Corporate Governance Failure – Certain New Initiatives in Governance – Benefits of Corporate Governance – Consequences of Bad Governance – Requirements to Strengthen Corporate Governance – Corporate Governance Models – Global Corporate Governance Forum – Sustainability and Corporate Governance – Sustainability Reporting : Discipline, Mission, Principles and Dimensions – Corporate Governance and National Economy – Corporate Governance and Corporate Administration – Corporate Governance – Indian Experience.

UNIT – IV SOCIAL ACCOUNTING, AUDITING AND REPORTING
Introduction - Social Accounting - Social Auditing - Corporate Social Reporting - Auditing the Social Reporting Process – Secretarial Audit – Legal Framework – Corporate Board Management – Structure and Composition of the Board – Composition of Board – Size of the Board - Powers of the Board of Directors – Responsibilities – Functions of the Board – Code of Conduct for Board Members – Effectiveness of the Board.

UNIT – V CONTRIBUTION OF NGO's TO CORPORATE SOCIAL RESPONSIBILITY
Introduction – Characteristics of an NGO – Types of NGO's – Social Welfare Schemes of the Government – United Nations Development Programme – United Nations Children's Fund. Stakeholders' perspectives of business ethics, corporate governance and CSR.

REFERENCES:

1. V.Balachandran and V.Chandrasekaran (2011), Corporate Governance, Ethics and Social Responsibility, PHI Learning Private Ltd, New Delhi.
2. Khanka, S. S. (2014). Business Ethics and Corporate Governance (Principles and Practices). S. Chand Publishing.
3. Ferrell, O. C., &Fraedrich, J. (2015). Business ethics: Ethical decision making & cases. Nelson Education.
4. Crane, A., Matten, D., & Spence, L. (Eds.). (2019). Corporate social responsibility: Readings and cases in a global context. Routledge.
5. Singh, S. (2005). Corporate governance: global concepts and practices. Excel Books India.

Semester – I

19RMGT307 PROJECT MANAGEMENT 4H – 4C

Instruction Hours / week: L:4 T: 0 P : 0 Marks: Internal: 0 External: 100 Total: 100

End Semester Exam: 3 Hours

Course Objectives:

- To make students understand all aspects of Project Management covering project identification formulation, planning, scheduling & control.
- Enable students to acquire concepts, tools & techniques of project management.
- To sensitize the students to complexities of project management.
- To enhance the students of project financing and development banks
- To know the implementation of project and preparation of project report
- To evaluate the project performance and evaluation of costs.

Course Outcomes:

1. Inculcate in the students the expertise required for formulating project ideas and projecting cash flows as well as evaluation of project proposals.
2. To analyze the feasibility of project taking into consideration all parameters to successful implementation of project
3. To know the difficulties in project implementation and provide solutions
4. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
5. Helps students to develop project models
6. Initiate students to carry out social and government projects

UNIT- I

The Nature and Purpose of Project Management: Definition, Objectives, Characteristics, Importance, Types, Steps in identification of projects, Project Life Cycle, Project Planning Project Uncertainty, Management action, Investment returns and Corporate Strategy.

UNIT - II

Project Planning and Evaluation: Scope, Problem statements, Project Goals, Success criteria, assumptions and risk factors, approval process, strategic planning, financial evaluation. Evaluation and uses of Hurdle rate, cash flow for project appraisal, investment analysis using capital budgeting, project rating index.

UNIT - III

Project implementation and Monitoring: Project Resource Requirements, Types of Resources, Project Procurement, Inventory Management, Project Logistics, Network Analysis, Pert, CPM and GERT- Resources Allocation and Resource Leveling Managing Risk in Projects, Project Audits, Project Communication, Post Project Reviews.

UNIT -IV

Financing of Projects: Raising Finance In Domestic Market And International Market, Infrastructure Financing, Tax Planning While Financing For Projects, Managing Strategic

Change, Technical, Commercial, Financial And Managerial, Appraisal, Economic And Environment Appraisal, Social Cost Benefit Analysis, Preparation Of Project Report.

UNIT –V

Closing of Project: Types of Project Termination, Strategic Implications, Project Trouble, Termination Strategies, Evaluation of Termination Possibilities, Termination Procedures, Human Factors in Project Management, Legal Aspects in Project Management

REFERENCES:

1. Kerzner, H. (2017). Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons.
2. Harvey Maylor (2017), Project Management, 4th edition, Pearson Education, India.
3. GopalakrishnanP.(2014), Textbook of Project Management, Laxmi Publications, New Delhi.
4. Meredith, J. R., Mantel Jr, S. J., & Shafer, S. M. (2017). Project management: a managerial approach. John Wiley & Sons.
5. Narendra Singh (2009), Project Management and Control, Himalaya Publishing House, New Delhi.
6. Prasanna Chandra, (2017), Project Planning, Analysis, Selection, Implementation and Review" 8^{th}edition, McGraw Hill, New Delhi.
7. Nagarajan, K. (2005). Elements Of Project Management [As Per Uptu Syllabus]. New Age International.
8. Clifford F. Gray, Erik W. Larson, "Project Management the Managerial Process, 3rd Edition, McGrawhill,2007
9. Heagney, J. (2016). Fundamentals of project management. Amacom.

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Semester – I

19RMGT308 **SYSTEM MANAGEMENT** **4H – 4C**

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

To make the students

- To understand the concept of Metrics in the process and project domains and Software Project planning
- To gain the knowledge of hardware and operational design of data warehouses
- To obtain the knowledge of Project Scheduling and tracking
- To understand Electronic Commerce for Service Industries and Business-to-Business Electronic Commerce
- To comprehend on the concept of Internet , World Wide Web and Internet Protocols
- To know about Visualization techniques, Knowledge discovery process and Recent trends in Information technology

Course Outcomes:

Learners should be able to

1. Understand the basic principles, concepts and applications of data warehousing and data mining,
2. Comprehend the importance of a task set for the software project.
3. Visualize the techniques of clustering, classification, association finding, feature selection and its importance in analysing the real-world data.
4. Understand the Conceptual, Logical, and Physical design of DSS
5. Exhibit behaviour and performance that demonstrates enhanced competence in decision-making, group leadership, oral and written communication, critical thinking, analysing, planning and team work.
6. Understand Reliability models for software quality and TQM for Software Quality

UNIT- I:

Software Project Management – Concepts and 3 P's (People, problem and process) - Metrics in the process and project domains, - Software Project planning – objectives, scope - Software project estimation – Popular decomposition techniques – problem-based - process-based - Project Scheduling and tracking – relationship between people and effort – defining a task set for the software project.

UNIT-II:

Decision Support Systems – Definition – Characteristics & capabilities Classes of DSS - DSS hardware and software – Group DSS – components & typology – Constructing of DSS – Components of DSS-database, Model base, Communication subsystem & User –a DSS – development process- DSS applications – Portfolio Management – Human Resource Management, Marketing Decision Support System.

UNIT-III:
Foundations of Electronic Commerce - Electronic Commerce for Service Industries - Business-to-Business Electronic Commerce - Intranet and Extranet - Electronic Payment Systems - Overview of Enterprise Systems – Evolution – Risks and Benefits - Trends in ERP Systems.

UNIT-IV:
Internet and World Wide Web, Internet Protocols – Marketing on Web – Advertising, e-mail Marketing, e-CRM; Business Oriented e-commerce – e-Government - E payments – Characteristics of payment of systems, protocols, E-cash, E-cheque and Micropayment systems.

UNIT – V:
PLC – concepts – models for software and process models – Reliability models for software quality - ISO 9000 for Software Quality – CMM, CMMI, PCMM - TQM for Software Quality - Overview: Definition, History, Myths, Transition to Client Server Computing, Database Architectures, Advantages and Disadvantages of Client Server Architecture – Recent trends in Information technology.

REFERENCES:

- Mall, R. (2018). Fundamentals of software engineering. PHI Learning Pvt. Ltd..
- Laudon, K. C., &Traver, C. G. (2016). E-commerce: business, technology, society.
- Marakas, G. M. (2003). Decision support systems in the 21st century (Vol. 134). Upper Saddle River, NJ: Prentice Hall.
- Leon, A. (2008). ERP demystified. Tata McGraw-Hill Education
- Chan, H., Lee, R., Dillon, T., & Chang, E. (2007). E-commerce, fundamentals and applications. John Wiley & Sons.
- Stellman, A., & Greene, J. (2005). Applied software project management. " O'Reilly Media, Inc.".

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Semester – I

19RMGT309 **ADVERTISING AND SALESMANSHIP** **4H – 4C**

Instruction Hours / week: L:4 T: 0 P : 0 **Marks: Internal: 0 External: 100 Total: 100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the students

- To understand the marketing concepts and conduct market analysis through environment scanning
- To analysis Customer relationship marketing Consumer rights and practices.
- To recognize and apply market segmentation branding and New Product development concepts in real situations.
- To identify the importance of selecting the marketing channel and the pricing strategies and its applications.
- To understand the distribution channels and its types.
- To recognize the role of advertising, sales promotion, public relations, and market research in the success of marketing a product.

COURSE OUTCOMES:

Learners should be able to

1. Understand the core concepts of marketing and the role of marketing in business and society.
2. Perform market analysis and identify the best marketing mix.
3. Analyze the importance of consumer buying motives & consumer behavior.
4. Determine strategies for developing new products and services for the right target segment by conducting marketing research.
5. Understand the latest trends in marketing and apply the ethical norms in marketing domain.
6. Effectively communicate ideas, explain procedures and interpret results and solutions through advertising and Sales promotion.

UNIT I

Marketing: Concepts, Nature, Scope and Importance of Marketing: Evolution of Marketing Concepts - Marketing Mix: Process of Marketing Management - Consumer Behaviour- Theories and Buying Motives- market segmentation - Customer Relationship Marketing (CRM) - Consumerism - Consumer Rights - Consumer Protection Council and its Functions.

UNIT II

Product Decisions: Product - Concept and Classification; Major Product Decision; New Product Development - Packaging and Labeling; Product Support Service; Branding Decision; Product Life Cycle - Concepts and Appropriate Strategies adopted at different stages.

UNIT III

Pricing Decisions: Factors affecting Price Determination -- Pricing Policies and Strategies - Methods of Pricing; Discounts and Rebates; Price Adjustment Strategies.

UNIT IV

Distribution Decisions: Channels of Distribution - Concepts and Importance; Different types of appraisal of distribution middlemen and their functions - Channel Management, Selection, Motivation and Performance appraisal of distribution middlemen; Retailing and Wholesaling: Types of retail formats: Retail theories: Retailing strategies: Non-store retailing; Wholesaling -nature and importance, types of wholesalers.

UNIT V

Advertising: Definitions, Nature, Scope, Objectives - Types - Advertising as a communication Process - Advertising Campaign - Advertising Strategies -Advertising Effectiveness-

Sales Promotions: Promotion Mix - Selling Process - Personal Selling - Qualities of a Salesman - Selection of sales personnel -Sales training - Tools and Techniques of Sales Promotion.

REFERENCES:

- Kotler, P., Keller, K. L., Ang, S. H., Tan, C. T., & Leong, S. M. (2018). *Marketing management: an Asian perspective*. Pearson.
- Stead, M., & Hastings, G. (2018). Advertising in the social marketing mix: getting the balance right. In *Social Marketing*(pp. 29-43). Psychology Press.
- Dibb, S., Simkin, L., Pride, W. M., & Ferrell, O. C. (2005). *Marketing: Concepts and strategies* (p. 850). Houghton Mifflin.
- Baker, M. J. (2014). *Marketing strategy and management*. Macmillan International Higher Education.
- Jobber, D., & Lancaster, G. (2006). *Selling and sales management*. Pearson Education.
- Ingram, T. N., LaForge, R. W., Williams, M. R., &Schwepker Jr, C. H. (2015). *Sales management: Analysis and decision making*. Routledge.

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Semester – I

19RMGT310 **SERVICE MARKETING** 4H – 4C

Instruction Hours / week: L:4 T: 0 P : 0 Marks: Internal: 0 External: 100 Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the students

- To Understand the Services, marketing of services, marketing mix, pricing and segmentation for services marketing.
- To comprehend on the consumer behaviour of services sector and emerging issues in services sector.
- To evaluate the Gap in services sector using tools and techniques.
- To understand the concept of marketing strategy for service products requires a different sort of approach, which is different from the traditional goods marketing.
- To understand the uniqueness of the services characteristics and its marketing implications.
- To provide an in-depth appreciation and understanding of the unique challenges inherent in managing and delivering quality services.

COURSE OUTCOMES:

Learners should be able to

1. Understand the Services, marketing of services, marketing mix, pricing and segmentation for services marketing.
2. Comprehend on the consumer behaviour of services sector and emerging issues in services sector.
3. Evaluate the Gap in services sector using tools and techniques.
4. Demonstrate capabilities of analysing problems, team work and communication skills
5. Understand the role of marketing strategic business in service sector
6. Gain knowledge on operations and financial aspects in market and Tourism industry

UNIT I

Service — Definition - Service Economy - Evolution & Growth of Service Sector - Nature and Scope of Services — Classification of Services & Characteristic of Services — Distinction Between Goods & Services — Challenges and Issues in Services Marketing.

UNIT — II

Purchase Process for Services — Consumption Value — Purchase Model — Service Marketing Opportunities — Expanding Marketing Mix — Service Market Segmentation — Targeting &Positioning - _Marketing of Services & Service -Product, Pricing, Place, Promotion, People, Physical Evidence.

UNIT — III

Service Quality — Principles of Service Quality — Service Expectations — Perceptions of Service — Factor Influencing Service Expectations — Measuring Service Quality — SERVQUAL — S ERVPERF Model — Gap Model of Service Quality — Service Quality Function Development.

UNIT — IV

Service Delivery — Importance of Customers in Service Delivery - Customers Role -Designing Service Delivery System — Service Channel — Service Marketing Triangle Service Marketing Communication — Communication Strategy — Guidelines for Development.

UNIT — V

Service Strategies for Health — Education — Hospitality — Tourism and Transportation — Financial — Information Technology

REFERENCE :

- Lovelock, C., & Patterson, P. (2015). Services marketing. Pearson Australia.
- Verma, H. V. (2012). Services marketing: Text and cases, 2/e. Pearson Education India.
- Wilson, A., Zeithaml, V., Bitner, M. J., &Gremler, D. (2016). Services marketing: Integrating customer focus across the firm.
- Srinivasan, R. (2014). Services marketing: the Indian context. PHI Learning Pvt. Ltd

DEPARTMENT OF MATHEMATICS
FACULTY OF ARTS, SCIENCE AND HUMANITIES
RESEARCH PROGRAM – M.Phil / Ph.D in Mathematics
(2019–2020 Batch and onwards)

Course code	Name of the course	Instruction hours / week	Credits	Maximum Marks (100)
Paper-I				
19RMAT101	Research Methodology and Pedagogy	4	4	100
Paper-II				
19RMAT201	Advanced Algebra and its Applications	4	4	100
19RMAT202	Algebra and Mathematical Analysis			
19RMAT203	Partial Differential Equations			
19RMAT204	Stochastic Processes			
Paper-III				
19RMAT301	Fuzzy Mathematics	4	4	100
19RMAT302	Advanced Topics in Fluid Dynamics			
19RMAT303	Hydrodynamic and Hydromagnetic Stability			
19RMAT304	Queueing Theory			
Program Total		**12**	**12**	**300**

Paper-I

19RMAT101 RESEARCH METHODOLOGY AND PEDAGOGY 4H – 4C

Instruction Hours / week: L: 4 **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to learn

- Fundamentals of research terminology.
- The ethical principles of research, ethical challenges and approval processes.
- The quantitative, qualitative and mixed methods approaches to research.
- The components of a literature review process.
- How to critically analysed published research.
- About e-learning researches and web-based learning.

Course Outcomes (Cos):

After completing this course, the student will be able to:

1. Understand the basic framework of research process.
2. Understand the various research concepts of Implicit functions and extremum problems.
3. Know about the Oscillations of second order equation
4. Understand the basic concepts of LATEX.
5. Study about the Quality teaching and learning.
6. Acquiring the knowledge of e-learning researches and web-based learning.

UNIT – I

Research Methodology – Meaning of research, Objectives of Research, Motivation in Research – Types of Research – Research approaches – Research methods, Versus Research Methodology – Research process – Scientific method – Criteria for good research, Defining the research problem – Necessity of defining the problem – Techniques involved in defining the problem, Research Design – Meaning and need for Research Design – Features of good design – Important concepts relating to research design.

UNIT – II

Implicit functions and extremum problems: Introduction – Functions with non zero Jacobian determinant – Inverse function theorem – Implicit function theorem – Extrema of real valued functions of one variable and several variables. Rank Theorem – Determinants – Derivatives of Higher order-Differentiation of Integrals.

UNIT – III

Oscillations of second order equation-Fundamental results – Sturms comparison theorem – elementary linear oscillations – comparison theorem of Hille winter – Oscillations of $x'' + a(t)x = 0$ elementary non linear oscillations – stability of linear and non linear systems – elementary critical points – system of equations with constant coefficient – the linear equations with constant co efficient – Lyabunov stability – Stability of quasi linear systems.

UNIT- IV

LATEX: The Basics - The Document -Bibliography - Bibliographic Databases - Table of contents, Index and Glossary - Displayed Text - Rows and Columns -Typesetting Mathematics - Typesetting - Several Kinds of Boxes - The figure environment -Cross References in LATEX - Footnotes, Marginpars, and Endnotes.

UNIT-V

Objectives and roll of higher education – Important characteristics of an effective Lecture – Quality teaching and learning – Lecture preparation – Characteristics of instructional design – Method of teaching and learning: Large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing Demonstration, Brain Storing, case discussion and assignment, Methods of evaluation – Self evaluation, Student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education: e-learning researches – web based learning.

SUGGESTED READINGS

1. Kothari, C. R., (2014). Research Methodology, Method and Techniques, Second Edition, New age International publishers, New Delhi.
2. Rudin. W., 1976. Principles of Mathematical Analysis, McGraw Hill, New York.
3. Earl A. Coddington, (2002). An introduction to Ordinary Differential Equations, Prentice Hall of India Private limited, New Delhi. (For Unit III)
4. Krishnan E., (Sep 2003). Latex Tutorials – A primer, Indian TEX users group, Trivandrum, India.
5. Panneerselvam. R, (2013). Research Methodology, Second Edition, Prentice Hall of India, New Delhi.
6. Gupta. S. P, (2011). Statistical Methods, Fourth Edition,Sultan Chand & Sons, New Delhi.
7. Vedanayagam E. G (1989). Teaching Technology for College teachers, New Delhi.
8. Kumar. K. L. (2004). Educational Technologies, New age International, New Delhi:
9. Winkler, Anthony C., and Jo Roy McCuen (1985). Writing a research paper: A Handbook, 2nd edition, Harcourt, New York.

M.Phil / Ph.D Mathematics **2019-2020**

Paper-II

19RMAT201 ADVANCED ALGEBRA AND ITS APPLICATIONS 4H – 4C

Instruction Hours / week: L: 4 **Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to learn

- The concepts of finite and algebraic extensions.
- Primitive elements and Purely inseparable extensions.
- Approximation by continuous functions
- Perturbations methods and Parametric Perturbation
- Topological preliminaries and theorems.
- The concepts of diffusion equation with sources and elementary solutions of diffusion equation.

Course Outcomes (Cos):

After completing this course, the student will be able to:

1. Understand the Field Extensions and Normal extensions.
2. Study Riesz Representation Theorem and Topological preliminaries.
3. Understand the concepts of convex functions and inequalities.
4. Know about the Asymptotic expansion and sequential convergent versus asymptotic series.
5. An understanding of the Role of co-ordinate system.
6. Know about the diffusion equation with sources, elementary solutions of diffusion equation and separation of variables

UNIT – I

Field Extensions – Finite and algebraic extensions – Algebraic closure – Splitting fields and Normal extensions - Separable extensions – Finite fields – Primitive elements – Purely inseparable extensions.

UNIT-II

Positive Borel Measure –Riesz Representation Theorem: Topological preliminaries - Riesz Representation Theorem – Regularity properties of Borel measures – Lebesgue measure – Continuity properties of measurable functions.

UNIT-III

L^p spaces: Convex functions and inequalities – The L^p spaces – Approximation by continuous functions.

UNIT-IV

Perturbations methods – Parametric Perturbation – Algebraic equation – The Vanderpol Oscillator – Co-ordinate Perturbation – The Bessel Equation of zeroth order-simple examples – Order Symbols and Gauge function – Asymptotic expansion and sequential convergent versus asymptotic series – Non uniform expansion – Straight forwarde expansion and sources of non-uniformity – Infinite domain – Duffing equation – A model for weak nonlinear instability – A small parameter multiplying the highest derivative – A second order example – Relaxation oscillation – Type change of PDE – A simple example – The presence of singularities – Shifting Singularity – Role of co-ordinate system.

UNIT - V

Elementary solutions of onedimensional wave equation-Vibrating membranes-Applications of calculus of variations-three dimensional problems – general solutions of the wave equation – Green's function for the wave equation – Non homogeneous wave equation. The use of integral transform, the use of green's function – The diffusion equation with sources - elementary solutions of diffusion equation-Separation of variables.

SUGGESTED READINGS

1. Serge Lang.,(2007). Algebra, Addison Wesley Publishing Company, Inc., Amsterdam.
2. Walter Rudin., Real and Complex Analysis, 3rd edition, McGraw Hill Book Company, New York.
3. Ross. S (2014). A first course in Probability, 9th edition, Pearson Education, Delhi
4. Ian.N.Sneedon,(1988). Elementary partial differential equations,TataMcgraw Hill Ltd.

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Paper-II

19RMAT202 ALGEBRA AND MATHEMATICAL ANALYSIS 4H – 4C

Instruction Hours / week: L: 4 **Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to learn

- To solve systems of linear equations and application problems requiring them.
- About and work with vector spaces and subspaces.
- The basic concepts of groups and rings.
- The Structure of rings and simple and primitive rings.
- The concepts of separation theorems in the plane.
- The basic concepts of properties of the spectrum and more results on the Spectra.

Course Outcomes (Cos):

After completing this course, the student will be able to:

1. Understand the fundamental concepts of Commutative rings and Modules.
2. Know about the Structure of Rings.
3. Investigate symmetry using group theory
4. Know about the Cauchy's Integral formula.
5. Understand the concepts of Spectral results for Hilbert Space Operators.
6. Study more results on the spectra of self adjoint operators.

UNIT – I

Commutative rings and Modules : Chain Conditions – Prime and Primary Ideals – Primary Decomposition – Noetherian rings and Modules – Ring Extensions – Dedikind Domains – The Hilbert Nullstellensatz.

UNIT – II

The Structure of Rings: Simple and Primitive Rings – The Jacobson Radicals – Semi simple Rings – The Prime Radical; Prime and Semi prime Rings – Algebras – Divisions Algebras.

UNIT – III

The Fundamental Group: Homotopy of paths- The fundamental Group – Covering Spaces – The fundamental group of the circle – Retractions and fixed points – The fundamental theorem of Algebra – The Borsuk – Ulam Theorem – Deformation retracts and Homotopy type – The fundamental Group of S^n- Fundamental groups of some surfaces.

UNIT – IV

Separation Theorems in the plane: The Jordan Separation Theorem – Invariance of Domain- The Jordan Curve Theorem – Imbedding Graphs in the plane – The winding Number of a simple closed curve – The Cauchy's Integral formula.

UNIT – V

Operators on Hilbert Spaces: Adjoint of an operator – Self Adjoint -Normal and unitary operator- Hilbert-Schmidi operator. Spectral results for Hilbert Space Operators - Some properties of the Spectrum- More results on the Spectra of Self Adjoint Operators.

SUGGESTED READINGS

1. Thomas W.Hungerford., (2011). Algebra, Springer , New Yark.
2. James.R. Munkers., (2002). Topology, Prentice Hall of India Pvt. Ltd., New Delhi
3. Simmons. G.F.,(2004). Introduction to Topology and Modern Analysis, Tata McGraw Hill Publishing Company, New Delhi.

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Paper-II

19RMAT203 PARTIAL DIFFERENTIAL EQUATIONS 4H – 4C

Instruction Hours / week: L: 4 **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to learn

- The fundamentals of partial differential equations.
- Laplace's equation and its properties.
- The fundamentals of wave equations.
- Numerical methods for the approximation of their solution.
- Partial derivative equation techniques to predict the behaviour of certain phenomena.
- Applications of the calculus of variations.

Course Outcomes (Cos):

After completing this course, the student will be able to:

1. Apply partial derivative equation techniques to predict the behaviour of certain phenomena.
2. Extract information from partial derivative models in order to interpret reality.
3. Study the solution of linear hyperbolic equations.
4. Understand the concepts Laplace's equation.
5. Know about the wave equations and its applications.
6. Study the separation of variables and use of integral transforms.

UNIT – I

Nonlinear partial differential equations of the first order: Cauchy's method of characteristics –Compatible systems of first order equations – Charpit's method- Special types of first order equations – Jacobi's method.

UNIT – II

Partial differential equations of second order: The origin of second-order equations – Linear partial differential equations with constant coefficients – Equations with variable coefficients –Characteristic curves of second–order equations- Characteristics of equations in three variables.

UNIT – III

The solution of linear hyperbolic equations – Separation of variables – The method of integral transforms – Nonlinear equations of the second order.

UNIT – IV

Laplace's equation : The occurrence of Laplace's equation in physics- elementary solution of Laplace's equation – Families of equipotential surfaces - boundary value problems – Separation of variables- Problems with axial symmetry.

UNIT – V

The wave equation: The occurrence of wave equation in physics – Elementary solutions of the one-dimensional wave equation – vibrating membranes: Applications of the calculus of variations – Three dimensional problems. The diffusion equations: Elementary solutions of the diffusion equation – Separation of variables- The use of integral transforms.

SUGGESTED READINGS

1. Sneddon I. N.(2006). Elements of Partial Differential Equations, McGraw-Hill Book Company, Singapore.
2. Robert C.McOwen.,(2004). Partial Differential Equations, Pearson Education, First Indian Reprint.
3. Phoolan Prasad and Renuka Ravindran., (2005). Partial Differential Equations, New Age International Pvt Ltd, New Delhi .
4. Sharma J.N., and Kehar Singh.,(2014). Partial Differential Equations for Engineers and Scientists, Narosa Publishing House, New Delhi.
5. Williams W.E.,(1980). Partial Differential Equations, Clarender Press, Oxford.

M.Phil / Ph.D Mathematics **2019-2020**

Paper-II

19RMAT204 **STOCHASTIC PROCESSES** **4H – 4C**

Instruction Hours / week: L: 4 **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The mathematical theory of random variables and random processes.
- How queueing theory are used as tools and mathematical models in the study of networks.
- The theoretical concepts and techniques for solving problems that arises in practice.
- The Markovian models in reliability theory.
- Laplace transforms and its properties.
- Poisson process and related distribution.

Course Outcomes (COs)
On successful completion of the course, students will be able to:

1. Capable to expose the students to different types mathematical models with a view of random processes.
2. Understanding in the concept of Brownian motion.
3. Formulate some real-life problems into queueing models.
4. Study Poisson process, related distribution and birth and death process.
5. Understand the Poisson process and related distribution.
6. Know about Laplace transforms of a probability distribution a random variable.

UNIT-I

Generating function – Laplace Transform – Laplace (stieltjes) transforms of a probability distribution a random variable – Classification of distributions.

UNIT-II

Stochastic processes – Notation – Specification – Stationery process – Markov Chains – Definition and example and higher transition probabilities.

UNIT –III

Classification of states and chains – Determination of higher transition probabilities – Stability of a Markov system - Limiting behavior.

UNIT-IV

Poisson process and related distribution – Generalization of Poisson process - Birth and Death process. Renewal processes - Renewal processes in continuous time – Renewal equation – Altering renewal processes.

UNIT- V

Reliabilty –Markovian models in reliability theory – Shock models and wear processes.

SUGGESTRD READINGS

1. MedhiJ.,(1982).Stochastic process, New age International Private Limited publishers.
2. Samuel Karlin.,(1975). First course in stochastic process, Academic press.
3. Srinivasan S., Kidambi., and K.M. Mehta.,(1988). Stochastic Processes, 2nd edition, Tata McGraw Hill Publishing Company, New Delhi.
4. Saeed Ghahramani.,(2015).Fundamentals of Probability with Stochastic Processes, 3rd edition, Prentice Hall.
5. Sheldon Ross.,(2014). Introduction to Probability Models, 11th edition, Academic press.

M.Phil / Ph.D Mathematics **2019-2020**

Paper-III

19RMAT301 **FUZZY MATHEMATICS** **4H – 4C**

Instruction Hours / week: L: 4 **Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to learn

- The basic mathematical elements of the theory of fuzzy sets.
- Differences and similarities between fuzzy sets and classical sets theories.
- The concepts of crisp set, fuzzy logic and fuzzy graphs.
- The need of fuzzy sets, arithmetic operations on fuzzy sets,
- Fuzzy relations, Fuzzy measures, Decision making in fuzzy environments.
- How to solve problems that are appropriately solved by neural networks, fuzzy logic, and genetic algorithms.

Course Outcomes (Cos):

After completing this course, the student will be able to:

1. Understand about the concepts of fuzzy sets and fuzzy logic.
2. Acquire the knowledge on general aggregation operations.
3. Know about the fuzzy relation equation and fuzzy graphs.
4. Describe the probability measures and fuzzy measures of fuzziness.
5. Import the knowledge on the Decision making in fuzzy environments.
6. Understand decision making in fuzzy environments**.**

UNIT - I

Crisps sets and Fuzzy sets: Introduction –Crisp Sets: An overview-The notion of fuzzy sets – Basics concepts of fuzzy sets –Classical logic: An overview-Fuzzy logic.

UNIT- II

Operations on Fuzzy sets: Fuzzy complement - fuzzy union – fuzzy Intersection – combinations of operation – General Aggregation operations.

UNIT - III

Fuzzy relations and Fuzzy graphs: Crisp and fuzzy relations – Binary relations-Binary relations on a single set – Equivalence and similarity relations-Compatibility or Tolerance relations – ordering- Morphisms – Fuzzy relation equations – Fuzzy graphs.

UNIT- IV

Fuzzy Measures: Belief and Plausibility Measures – Probability Measures – Possibility and necessity measures-Relationship among classes of Fuzzy measures of Fuzziness.

UNIT- V

Decision making in fuzzy environments: Fuzzy Decisions – Fuzzy Linear programming – symmetric Fuzzy LP – Fuzzy LP with crisp objective function – Fuzzy Dynamic Programming-Fuzzy Dynamic with Crisp state Transformation Function- fuzzy multi criteria Analysis– Multi objective Decision Making (MODM) – Multi Attributive Decision making (MADM).

SUGGESTED READINGS

1. George J.Klir and Tina A.Folger., (2015). Fuzzy sets – Uncertainty and information, Prentice – Hall of India Pvt. Ltd. Chapters: I, II, III & IV.
2. Zimmermann H.J.,(2007). Fuzzy set theory and its applications , Fourth Edition Springer . Chapter XIV.

M.Phil / Ph.D Mathematics **2019-2020**

Paper-III

19RMAT302 **ADVANCED TOPICS IN FLUID DYNAMICS** **4H – 4C**

Instruction Hours / week: L: 4 **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to

- Understand the dynamics of fluid flows and the governing non dimensional parameters.
- Make the students to acquire the knowledge on the properties of two dimensional flow.
- Familiarize the concept of equation of motion in rotating co-ordinate system.
- Describe the main properties of the system of equations.
- Introduce the system of Magnetohydrodynamics equations and main theorems that follow from the Magnetohydrodynamics system.
- Understand the importance of fluid dynamics in diverse real life applications.

Course Outcomes (Cos):

After completing this course, the student will be able to:

1. Solve and Classify the fluids based on the physical properties of a fluid.
2. Compute correctly the kinematical properties of a fluid element.
3. Apply correctly the conservation principles of mass, linear momentum, and energy to fluid flow systems.
4. Extend the physics and mathematical properties of fluid flow by governing Navier-Stokes equations with proper boundary conditions and obtain solution.
5. Equip the student with the basic mathematical background and tools to model fluid motion.
6. Develop a physical understanding of the important aspects that govern fluid flows that can be observed in a variety of situations in everyday life.

UNIT – I

Steady unidirectional flow – Poiseuille flow – Two dimensional flow – Paint-Brush model – unsteady unidirectional flow – Flow with circular stream lines – Flow fields in which inertia forces are negligible – Lubrication theory.

UNIT – II

Thermal boundary layer in laminar flow: Derivation of the energy equation – Temperature increase through adiabatic compression – Stagnation temperature – Theory of similarity in heat transfer – Exact solutions for the problem of temperature distribution in a viscous flow – Boundary layer simplifications.

UNIT – III

Equation of motion in rotating co-ordinate system – Potential vorticity – vorticity equation – Ertel's theorem – Non dimensional parameters – Rossby number – Ekman number – Geostrophic flow – Taylor – Proudman theorem – Taylor coloumn.

UNIT – IV

Magnetohydrodynamics: Electrodynamics of moving media – The electromagnetic effects and the magnetic Reynolds number – Alfen's theorem – The magnetic energy – The mechanical equations – Basic equations for the incompressible MHD – Steady Laminar motion – Hartmann flow.

UNIT – V

Magnetohydrodynamic waves – waves in an infinite fluid of infinite electrical conductivity – Alfen's waves – Magnetohydrodynamic waves in a compressible fluid – Magneto acoustic waves – Slow and Fast waves – Stability – Physical concepts – Linear-Pinch –Kink – Sausage and Flute types of instability – Method of small oscillations – Jeans criterion for gravitational stability.

SUGGESTED READINGS

1. Batchelor. G.K.,(2002). An Introduction to Fluid Dynamics, Cambridge University Press.
2. Schlichting. H.,(2003). Boundary – Layer Theory, Springer.
3. Friedlander. S.,(1980). An Introduction to the Mathematical Theory of Geophysical Fluid Dynamics, Elsevier.
4. Ferraro .V.C.A and Plumpton. C.,(1972). An Introduction to Magneto Fluid Dynamics, Oxford University.

M.Phil / Ph.D Mathematics **2019-2020**

Paper-III

19RMAT303 HYDRODYNAMIC AND HYDROMAGNETIC STABILITY 4H – 4C

Instruction Hours / week: L: 4 **Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to

- Learn the concept of stability of hydrodynamics systems.
- Impart the basic knowledge of hydromagnetic systems.
- Disseminate the importance of rotation of fluid in stability analysis.
- Introduce the system of Magnetohydrodynamics equations and magnetohydrodynamics system.
- Learn the Perturbation Techniques for determining the stability of superposed fluids.
- Understand the concept of important instabilities like Rayleigh-Taylor, Kelvin-Helmholtz instability.

Course Outcomes (Cos):

After completing this course, the student will be able to:

1. Describe the fundamental principles of the motion of ideal (inviscid) and real (viscous) fluid flows.
2. Apply analytical concepts to analyze a range of two-dimensional engineering fluid flows, with appropriate choice of simplifying assumptions and boundary conditions.
3. Provide the details of the derivation of ideal and resistive Hydrodynamic equations.
4. Demonstrate the basic properties of Hydrodynamic fluids.
5. Equip to solve the fluid flow analysis electromagnetic fields.
6. Analyze the analytical technique to characterize the hydrodynamic stability.

UNIT – I: Introduction:

Basic Concepts - Analysis in terms of normal modes - Non-dimensional number.

UNIT – II: Benard Problem:

Basic hydrodynamic equations. Boussinesqapproximation.Perturbationequations.Analysis into normal modes.Principle of exchange of stabilities.Equations governing the marginal state. Exact solution when instability sets in as stationaryconvection for two free boundaries.

UNIT – III

The effect of rotation: The Perturbation equations. Analysis in terms ofnormalmodes.Variational Principle for stationary convection. Solutions when instability setsin as stationary convection for two free boundaries. On the onset of convection asoverstability; the solution for the case of two free boundaries.

UNIT – IV

The effect of magnetic field: The Perturbation equations. The casewhen instability sets in as stationary convection; Avariational principle. Solutions forstationary convection and for overstability for the case of two free boundaries.**The stability of superposed fluids.**

UNIT – V

(i) **Rayleigh-Taylor instability:**The Perturbation equations. Inviscidcase(the case of two uniform fluids of constant density separated by a horizontal boundary, the case of exponentially varying density). Effect of rotation.Effect of vertical magnetic field.

(ii) **The Kelvin-Helmholtz instability:** The perturbation equations, the case of two uniform fluids in relative horizontal motion separated by a horizontal boundary, the effect of rotation, the effect of horizontal magnetic field.

SUGGESTED READINGS

1. Chandrasekhar. S.,(1981). Hydrodynamic and Hydromagnetic Stability, Dover Publications.

2. Drazin. P.G and Reid. W.H.,(2004). Hydrodynamic Stability, Cambridge University Press

M.Phil / Ph.D Mathematics **2019-2020**

Paper-III

19RMAT304 **QUEUEING THEORY** **4H – 4C**

Instruction Hours / week: L: 4 **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

This course enables the students to learn

- The fundamentals of Markov Chains.
- Classical queueing models.
- Various Markovian queuing systems.
- Multi server queueing models.
- Solve finite input source queues.
- Develop queueing models to analyze computer networks.

Course Outcomes (Cos):

After completing this course, the student will be able to:

1. Masteryin concepts of discrete and continuous time Markov Chains
2. Explain single server queues
3. Examine steady state solution of important queues.
4. Investigate multi sever queues solution.
5. Understand input source models.
6. Model real life queueing scenarios into mathematically.

UNIT I

Introduction-Markov Chains- Basic ideas-Classification of states and chains-Sojourn time - Transition density matrix or infinitesimal generator - Limiting behavior: ergodicity - Transient solution -Alternative definition.

UNIT II

Birth-and-Death Processes: Special case: M/M/1 queue -Pure birth process-Yule-Furry process. Queueing Systems: General Concepts: Basic characteristics -The input or arrival pattern of customers -The pattern of service -The number of servers -The capacity of the system - The queue discipline. The Simple M/M/1 Queue : Steady-state solution of M/M/l - Waiting-time distributions - The output process -Semi-Markov process analysis.

UNIT III

System with Limited Waiting Space: The M/M/1/K Model: Steady-state solution - Expected number in the system L_K - Equivalence of an M/M/l//K model with a two-stage cyclic model - Birth-and-Death Processes: Exponential Models - The M/M/∞ Model: Exponential Model with an Infinite Number of Servers.

UNIT IV

The Model M/M/c : Steady-state distribution - Expected number of busy and idle servers - Waiting-time distributions - The output process .The M/M/c/c System: Erlang Loss Model: Erlang loss (blocking) formula: Recursive algorithm -Relation between Erlang's B and C formulas .

UNIT V

Model with Finite Input Source : Steady-state distribution: M/M/c//m (m>c). Engset delay model- Engset loss model M/M/c//m/(m > c) - The model M/M/c//m(m ≤ c).

SUGGESTED READINGS

1. Medhi J., (2003). Stochastic models in Queueing theory, 2e, Academic press.
2. Donald Gross, John F. Shortle , James M.Thompson , Carl M., and Harris , (2008). Fundamentals of Queueing theory, Wiley.
3. Narayan Bhat U.,(2008). An introduction to Queueing theory: Modelling and Analysis in Applications, Birkhauser Basel.

DEPARTMENT OF MICROBIOLOGY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
RESEARCH PROGRAM – M.Phil / PhD in Microbiology
(2019–2020 Batch and onwards)

Course code	Name of the course	Instruction hours/ week	Credits	Maximum Marks (100)
19RMB101	Research Methodology and Pedagogy	4	4	100
19RMB201	Recent Trends in Microbiology	4	4	100
19RMB301	Industrial and Pharmaceutical Microbiology	4	4	100
19RMB302	Immunotechnology and Biotechnology			
19RMB303	Virology			
19RMB304	Medical Microbiology			
Program Total		**12**	**12**	**300**

19RMB101 PAPER – I: RESEARCH METHODOLOGY AND PEDAGOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:
This course is designed to enable students to:

- Identify and discuss the role and importance of research in the social sciences.
- Identify and discuss the issues and concepts salient to the research process.
- Identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.
- Identify and discuss the concepts and procedures of sampling, data collection, analysis and reporting.
- To discuss the principle and working mechanisms of instrumentation and its application.
- To prepare a project proposal by using various research designs
- To organize and conduct research (advanced project) in a more appropriate manner

COURSE OUTCOMES:

1. Students will be able to explain key research concepts and issues
2. Students will be able to read, comprehend, and explain research articles in their academic discipline.
3. Understanding the nature of problem to be studied and identifying the related area of knowledge.
4. Reviewing literature to understand how others have approached or dealt with the problem.
5. Collecting data in an organized and controlled manner so as to arrive at valid decisions.
6. Analyzing data appropriate to the problem and making generalizations.

UNIT – I (Spectroscopy and Chromatography)
Spectroscopy: Principles and instrumentation and applications of UV-Visible light spectroscopy, UV-Visible absorption spectroscopy, Spectrofluorimeter, Atomic spectroscopy, IR spectroscopy, NMR spectroscopy and MALDI-TOF. Chromatographic techniques: Principles of column chromatography. Instrumentation of Low pressure liquid chromatography (LPLC), High performance liquid chromatography (HPLC) Fast protein liquid chromatography (FPLC), Perfusion chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Affinity chromatography, Gas chromatography (GC – MS).

UNIT – II (Research design)
Research: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems. Research Designs – Features of good designs. Sampling design: Meaning – Concepts – Steps in sampling – Criteria for good sample design.

UNIT – III (Sample design and analysis)
Scaling measurements – Techniques – Types of scale**.** Correlation – Meaning and definition - Scatter diagram – Karl pearson's correlation coefficient. Rank correlation. Regression: Regression in two variables – Regression coefficient problems – uses of regression. Hypothesis testing – Errors in Hypothesis testing - large sample test (Z – test) single and two tailed test, Small sample test (t – test)-Single mean-Two mean-Paired t-test, F – test, Chi– square test –Single variance-Goodness of fit, SPSS Software, Anova – one way and two way. – CRD, RBD Designs. RSM (Response Surface Methodology). Thesis report writing.

UNIT – IV (Computer Applications)
Spreadsheet tool - Introduction to spreadsheet application, features and functions, using formulas and functions, data storing, features for statistical data analysis, generating charts/ graph and other features. Tools used may be Microsoft Excel, Open office or similar tool. Presentation tool - Introduction to presentation tool, features and

functions, creating presentation, customizing presentation, showing presentation. Tools used may be Microsoft Power Point, Open Office or similar tool. Web Search - Introduction to internet, use of internet and WWW, using search engine like Google, Yahoo etc, using advanced search techniques. Plagiarism software, Literature search, Endnote, Mendeley and its application.

UNIT – V (Pedagogical Methods in Higher Learning)
Historical Perspectives – Objectives and role of Higher Education – Learning and Learning Hierarchy – Information processing – Learning Events and Outcomes – Motivation. Education Evaluation: A Conceptual Framework – Methods of Evaluation – Self Evaluation and Student Evaluation in Higher Education – Question Banking – Diagnostic Testing and Remedial Teaching.

REFERENCES:

1. Boyer, R. 2006 Modern Experimental Biochemistry. 3rd Edition. Addision Wesley Longman. New Delhi.
2. Wilson, K and J. Walker 2006. Principles and techniques of biochemistry and molecular biology, 6th Low Price Edition, Cambridge University Press, India
3. David Friedfelder 2001. Physical Biochemistry. 5th Edition Oxford Publishers. New York.
4. Kothari, C. R. 2005. Research Methodology-Methods and Techniques, Wiley International Ltd, UK
5. S. Palanichamy and M. Manoharan 2001. Statistical methods for biologists, Palani Paramount Publications, Palani.
6. R. Rajaram, 2008. Basic Computer Science and Communication Engineering Second Edition. SCITECH Publication India Private Limited, Chennai, India.

19RMB201 PAPER – II: RECENT TRENDS IN MICROBIOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

- The objective of the course is to equip the students to gain bimolecular knowledge and analytical skills at an advanced level.
- Emphasizes to apply knowledge acquired about prokaryotic and eukaryotic cellular processes, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms in environment and biological systems to various conditions.
- The students will acquire the skills to qualify for a broad range of positions in research, industry, consultancy, education and public administration, or for further education in a doctoral program.
- Students will be able to address broad range of fields including microbial physiology, environmental microbiology, food science, microbiology, microbial genetics, molecular biology and systems biology.
- Knowledge provided will be on the understanding on the fundamental principles of microbiology.
- The main knowledge provided will be of the main microbiological techniques to be applied in the laboratory.

COURSE OUTCOMES:

1. Students will be developing skills to identify and evaluate critically the principles and the mechanisms underlying the different fields of microbiology.
2. Analyse different applications of microbiology in industry and medicine.
3. Students able to acquired knowledge to use bacteria in lab and sterilization techniques.
4. Design an experiment to test a hypothesis or fundamental concept in microbiology and perform basic microbiological lab techniques.
5. Upon completion, students gained the knowledge of most common medically important organism and the infections they cause.
6. Different approaches, techniques and tools used to identify pathogens and control them.

UNIT – I (General Microbiology)

History of Microbiology, microbial groups and their taxonomic position, in relation to other living organisms. Prokaryotes and eukaryotes. Classification and nomenclature of bacteria. Structure, morphology and reproduction of bacteria, fungi, yeast, algae, protozoa, mycoplasma, rickettsiae. Viruses – structure and life cycle of bacteriophage. Microbial growth-physical conditions required for bacterial growth. Ecosystems – concepts, structure and function of major ecosystems. Types – Terrestrial, aquatic, marine. Nutrient cycles.

UNIT – II (Microbial physiology and genetics)

Structure and function of cell organelles. Fundamentals of cell organelles. Enzymes and factors affecting enzymatic reactions. Fundamentals of bioenergetics, glycolysis, Krebs cycle, oxidative phosphorylation, Anaerobic respiration, fermentation. Structure and functions of DNA and RNA. Genetic code, protein synthesis, mutations. Genetic recombination methods in bacteria-transformation transduction and conjucation. Mendelian Genetics, Basics of Molecular Genetics, Genetics Engineering and recombinant DNA technology.

UNIT – III (Medical Microbiology)

Diseases caused by microbes in humans. Collection – transportation – handling and examination of pathological specimens – methods of isolation, identification and interpretation of pathogenic organisms – Antibiotic susceptibility testing. Bacterial infections - *Staphylococcus sp., E.coli.;* Protozoan infections - *Entamoeba histolytica, Ascaris lumbricoides, Wuchereria bancrofti.;* Viral infection – *HIV, Hepatitis;* Fungal infection – *Aspergillosis.*

UNIT – IV (Environmental Microbiology)
Aquatic environment - microbiology of water - water pollution and water borne pathogens. Bacteriological examination of water, indicator organism. Microbiology of sewage - Chemical and biochemical characteristic of sewage. Methods of sewage treatment - physical screening, chemical, Biological (sludge digestion; activated sludge, aerating filters, oxidation pond)

UNIT – V (Patenting and IPR)
Patenting – fundamental requirements – multicellular organisms and its patenting. Patenting the genes, Regulating - recombinant technology, Food and food ingredients. Discrepancies in biotechnology / chemical patenting. IPR – historical perspective – recent developments – IPR in India, IPR and the rights of farmers in developing countries.

REFERENCES:

1. Prescott, M., J.P Harley and D.A. Klein 1993. Microbiology. 2nd Edition, McGraw-Hill Inc. New York
2. Micheal T. Madigan, J.M. Martinko and J.Parker 2003. Brock Biology of Microorganisms. 10th Edition. Prentice Hall. New Jersey
3. Shuler, M.L. and F. Kargi 2005. Bioprocess engineering basic concepts. Pearson Education, New Delhi.
4. Hugo, W.B and A.D. Russell 2007. Pharmaceutical Microbiology, 7th Edition, Publisher Blackwell Science Ltd.
5. Ananthanarayanan R and C.K. Jayaram Panicker 2005. Text Book of Microbiology. 7th Edition. Orient Longman. New Delhi.
6. Jawetz, E.; J.L., Melnic and E.A. Adelberg 2001. Review of Medical Microbiology. 22nd Edition Lange Medical Publishers, New York.
7. Glick,B.K and Pasternak,J.J. 2003. Molecular Biotechnology: Principles and applications of recombinant DNA" 3rd Edition. ASM Press, Washington
8. Jagadish Chander. 1996. A Text book of medical Mycology. Interprint, New Delhi
9. Parija, S, C. 1996. Text Book of Medical Parasitology, Orient Longmans, Chennai, India.

19RMB301 PAPER – III: INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

- Enable Graduates to enter industry with an appropriate level of understanding of the need for both the science.
- Ability to apply the techniques used in industries.
- To produce new drug.
- To equipped with a theoretical and practical understanding of industrial microbiology.
- To enable the inoculum development for various fermentation process.
- Appropriate use of free cell immobilization and enzyme immobilization.

COURSE OUTCOMES:

1. Students are capable of describing a large number of substrates that are used for the industrial fermentation processes.
2. Have developed an understanding of different types of reactors or fermenters which are used for laboratory, pilot and industrial scale fermentations and their processes parameters.
3. Have acquired a detailed knowledge of number of products which are produced by industrial fermentation processes.
4. Know about design of bioreactor, factors affecting growth and production.
5. Understand the rationale in medium formulation and design for microbial fermentation, sterilization of medium and air.
6. Discuss microbial contamination, product spoilage and antimicrobial preservation of cosmetic products.

UNIT – I

History and chronological development of industrial microbiology. Industrially important strains – Isolation and preservation. Inoculum development for various fermentation processes. Strain development – mutation, recombinant DNA technology and protoplast fusion

UNIT – II

Fermentation – Submerged fermentation: batch, fedbatch and continuous fermentation and solid state fermentation. Types of fermentors (Tower, cylindroconical and airlift) – batch fermentation – continuous fermentation. Fermentor design – body construction – mass transfer – oxygen transfer – effect of viscosity, Aeration, Agitation, pH – scale-up process.

UNIT – III

Production of beverages: beer and wine, Vitamin: B12 and riboflavin, Antibiotics: penicillin and streptomycin, Production of enzymes: amylase and proteases. Free cell immobilization and enzyme immobilization techniques. Production of Single cell protein – bakers yeast, spirulina, red algae. Downstream process – intracellular and extracellular product separation. Liquid extraction, precipitation, floatation and filtration: Micro filtration and Ultra filtration.

UNIT – IV

Clinical uses of antimicrobial drugs, Microbial spoilage and preservation of pharmaceutical products, Sterilization of pharmaceutical products, Applications of microorganism in the pharmaceutical sciences

UNIT – V

Role of precursors and steering agents in production of antibiotics, vitamins and enzymes. Antiseptics-disinfectants - preparation, standardization. Quality control of Pharmaceutical products – Injectables, IV fluids and pyrogen testing.

References

1. Patel, A.H. 2003. Industrial microbiology, Macmillan India Ltd. New Delhi
2. Prescott and Dunn's 1983. Industrial microbiology, CBS Publishers, New Delhi
3. Stanbury, P.T. and A. Whitaker 2005. Principles of Fermentation Technology, Pergamon Press, NY
4. Atlas R.N and R. Bartha 2007. Microbial Ecology-Fundamental and Applications. 4th Edition. Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi
5. Michael J Waites 2007. Industrial microbiology, Blackwell publishing.UK
6. Mansi, E.M.T. and C.F.A. Bryce 2000. Fermentation Microbiology and Biotechnology, Taylor and Francis, New York.
7. Shuler, M.L. and F. Kargi 2005. Bioprocess engineering basic concepts. Pearson Education, New Delhi.
8. Hugo, W.B. and A.D. Russell 2007. Pharmaceutical Microbiology, 7th Edition, Blackwell Science Ltd, Oxford.

19RMB302 PAPER – III: IMMUNOTECHNOLOGY AND BIOTECHNOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

- To provide students with a foundation in immunological processes and critical thinking.
- To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology
- To be able to clearly state the role of the immune system, compare and contrast the innate versus adaptive immune systems
- To be able to articulate the roles of innate recognition receptors (i.e. Toll-Like Receptors) in immune responses
- To be able to compare and contrast humoral versus cell-mediated immune responses and to distinguish various cell types involved in immune responses and associated functions.
- Students be able to understand the role of cytokines in immunity and immune cell activation and identify and characterize cytokines of particular immune importance.

COURSE OUTCOMES:

1. Conceptualized the protective role of the immune system of the host and developed an understanding of the basic components.
2. The mechanisms underlying the immune system and its response to pathogenic microorganisms.
3. Students able to conduct experiments for growing common bacteria in different microbiological media, antibiotic sensitivity determination and antigen antibody reaction (precipitation test in the agarose).
4. Understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation.
5. Emphasize to describe lymphocyte development and the expression of their receptors.
6. Have a knowledge to provide an overview of the interaction between the immune system and pathogens.

UNIT – I

Cells and Organs of immune system, T / B cell – maturation, activation – receptor, Cytokines – structure and fuctions, Antigen – Structure and chemical make-up, Immunoglobulin – structure - Organization and expression of Immunoglobulin genes, Purification of antigens and immunoglobulins., MHC – structure and functions, HLA tissue typing,

UNIT – II

Antigens - Antibody reactions, *In vitro* methods – Agglutination – Passive and reverse passive agglutination, Precipitation – reactions in gels – Immuno diffusion – Counter immuno electrophoresis, Complement fixation test, Immunofluorescence, ELISA, RIA, Immuno electron microscopy, Forensic serology.

UNIT – III

Introduction to genetic engineering, Restriction enzymes – types and nomenclature - classification – and uses, Cloning Vectors – types of vectors, Prokaryotic hosts: *E. coli*, Eukaryotic hosts: Yeast cell. Gene cloning - construction of cDNA and genomic libraries - selection and screening method of recombinants - Screening of recombinants for Site directed Mutagenesis by SSCP, heteroduplex analysis.

UNIT – IV

Isolation of DNA and RNA – Handling and quantification of nucleic acids, radiolabelling and non radiolabelling of nucleic acids, Gel electrophoresis - Blotting techniques, Hybridization and heteroduplex analysis, Molecular diagnostics of genetic disease using PCR / OLA, DNA diagnostic system in forensic sciences.

UNIT – V

Genetic engineering of plants and animals: Gene transfer techniques into plant and animal cell. Plants as tool for recombinant protein production; Development and use of transgenic animals; transgenic mice – methodology and applications. Ethical issues of gene cloning.

REFERENCES

1. Richard A. Goldsby, Thomas J.Kindt. Barbara A. Osborne 2000. Kuby Immunology. 5th Edition. W.H. Freeman and Company, New York.
2. Frank C. Hay and Olwyn M.R. Westwood 2002. Practical Immunology. 4th Edition, Blackwell Science Ltd. Oxford.
3. Roitt, I.M. Brostaff, J.J. and D.K. Male 2000. Immunology. 6th Edition. C.V. Mosby Publishers. St. Louis.
4. Winnacker, E.L. 2003. From genes to clones. Introduction to Gene Technology.1st Edition VCH. Weinhein.
5. Brown, T.A. 2006. Gene Cloning and DNA analysis; An Introduction. 5th Edition. Blackwell Publishing, UK
6. Glick, B.K and J.J. Pasternak 2003. Molecular Biotechnology. Principles and applications of recombinant DNA. 3rd Edition. ASM Press, Washington
7. Old, R.M and S.B. Primrose 2003. Principles of Gene manipulation. 6th Edition. Blackwell Scientific Publication. London.
8. Watson, J.D., M. Gilman, J. Wikowski 2001. Recombinant DNA. 2nd Edition. Scientific American Books. W.H. Freeman & Co. NY.

19RMB303 PAPER – III: VIROLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

- To describe the structure and replication strategies of the individual viruses discusses including the processes of entry into cells, control of gene transcription.
- To define the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation.
- To describe the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNA viruses.
- Perform laboratory investigations for the diagnosis of infectious diseases caused by viruses.
- Identify various viral diseases of human, different diagnostic techniques and also with various methods involved in infection control
- Describe the processes involved in the anti-tumor effects of "anti-tumor" viruses.

COURSE OUTCOMES:

1. Students able to explain the rationale behind the Baltimore classification system of viruses and present example viruses for each Baltimore group
2. Students able to explain viral replication strategies and compare and contrast replication mechanisms used by viruses relevant for human disease
3. This course has been intended to provide the learner insights into helpful areas of virology which plays an essential role in application-oriented biology.
4. Provides computational skill on used for laboratory diagnosis of viral infections.
5. Able to describe viral strategies to evade host immune and cellular factors.
6. Coherently analyse and report outcomes of virological research in oral and written output

UNIT -I

History of Virology, Brief outline of virology: discovery of virus, General properties of viruses, Classification of viruses, Preservation of viruses, & Cultivation of viruses.

UNIT -II

Viruses & Human diseases: DNA viruses: Pox virus, Herpes virus, adenovirus. Papova virus, Hepadna virus, Pathogenesis & Laboratory diagnosis.

UNIT -III

Viruses & Human diseases: RNA viruses: Orthomyxo viruses, Paramyxo viruses, Influenzae and other arthropod born viruses, Retroviridae. Emerging Viral infection – SARS-CoV, Bird flu and Nipha Virus.

UNIT - IV

Virus – Host interaction, immunity to viral diseases. Antiviral agents and Viral Vaccines. Immunization Schedules.

UNIT -V

Epidemiology and Laboratory diagnosis of viruses: Electron microscopy, molecular and sero diagnosis of viral infections, PCR; Sequencing & genotyping.

REFERENCES

1. Medical Virology – Morag C, and Timby M.C. X Edition (1994) Churchill Livingstone, London.
2. Introduction to Modern Virology – Dimmock N.J. Primrose SB. IV Edition (1994). Blackwell Scientific Publications, Oxford.

3. Virology – Contrat H.F. Kimball PC and Levy JA. IIIrd Edition. (1994). Prentice Hall, Englewood cliff, New Jersy.
4. Principles of Bacteriology, Virology and Immunology – Topley & Wilson's (1995). Edward Arnold, London.
5. Virology -3rd Edition 1996, Fiels DN (Edn.) Lippincott – Raven.
6. Principles of Virology -2nd Edition 2004, SJ Flint Edn. ASM Press.
7. Clinical Virology -2nd Edition 2002, Doughlas D Richman (Edn.) ASM Press.
8. Essentials of Diagnostic Virology – 2000, Gregory A Storch, Churchill Livingstone.
9. Principles of Molecular Virology, 1997. 2nd ed. A.Cann. Academic Press.
10. David Greenwood, Richard C.B, Slack, John Forest Peuthere (1992). "Medical Microbiology". 14th Edn. ELBS with Churchill Livingstone.

19RMB304 **PAPER – III: MEDICAL MICROBIOLOGY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Medical Bacteriology introduces basic principles and then applies clinical relevance of many etiological agents responsible for global infectious diseases.
- The infectious disease cycle of the pathogens enables to solve the epidemics.
- The territory covered by infections and the immune response
- We focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career and able to establish the medical laboratory.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora.

COURSE OUTCOMES

1. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response toinfection.
2. Application of molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobialagents.
3. Demonstrate an understanding of skin and respiratory tract infections (microbial causes, pathogenesis, transmission of infection, diagnosis, prevention and treatment) by being able to identify a unknown organisms in clinical samples, and describe the pathogenesis of important pathogens.
4. It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
5. To understand the importance of pathogenic bacteria in human disease with respect to infections of. the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue
6. Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.

UNIT – I

Laboratory precaution and guidelines – collection – transportation – handling and examination of pathological specimens – methods of isolation, identification and interpretation of pathogenic organisms – Antibiotic susceptibility testing. Infections – types – methods – Infectious disease cycle. Quality control in microbiology lab and automation in medical microbiology.

UNIT – II

Gram positive organisms: Morphology, cultural characteristics, antigenic property, pathogenecity, laboratory diagnosis and Treatment. *Staphylococcus* sp., *Streptococcus* sp., *Bacillus* sp., *Corynebacterium* sp., *Clostridium* sp. and *Mycobacterium* sp.

UNIT – III

Gram negative organisms: Morphology, cultural characteristics, antigenic property, pathogenecity, laboratory diagnosis and Treatment. *E.coli, Klebsiella* sp., *Proteus* sp., *Pseudomona*s sp., *Vibrio* sp., *Salmonella* sp., *Shigella* sp., *Treponema* sp., *Neisseria* sp. and *Haemophilus* sp. MDR, XDR and PDR.

UNIT – IV

Superficial mycosis - *Pityriasis versicolor, Tinea nigra, piedra.* Cutaneous mycosis Dermatophytes. Systemic mycosis - Coccidiomycosis - Blastomycosis – Histoplasmosis. Opportunistic mycosis, Candidosis, Aspergillosis, Zygomycosis. Subcutaneous mycosis – Sporotrichosis, Chromoblastomycosis and Mycetoma.

UNIT – V

Protozoan infections - *Entamoeba histolytica, Plasmodium vivax, Plasmodium falciparum, Giardia intestinalis, Trichomonas vaginalis, Taenia solium*. Trematodes - *Fasciola hepatica*, *Schistosoma haematobium*, Nematodes - *Trichuris trichiura, Ascaris lumbricoides*, and *Wuchereria Bancrofti*.

REFERENCES

1. Ananthanarayanan, R. and C.K.J. Panicker, 2005. Text Book of Microbiology 7th Edition. Orient Longman, New Delhi.
2. Brook,G.F., J. S. Butel, A. Stephen and Morse, 2003. Medical Microbiology, 22nd Edition. Mc Graw Hill.
3. Chakraborty, P., 2003. A Text book of Microbiology. 2nd Edition. New Central Book Agency (P) Ltd., Calcutta.
4. Chander, J., 2002. A Text book of Medical Mycology. Interprint Mehta Publishers, New Delhi.
5. Chatterjee, K.D., 1980. Parasitology in relation to medicine. 12th Edition, Chatterjee Medical Publishers, Calcutta.
6. Chunin, J., 2000. Parasitology. New York Publishers, London.
7. Dismukes, W.E., P.G. Pappas and D. Sobel, 2003. Clinical Mycology. Oxford University Press, UK.
8. Jawetz, E., J.L. Melnic and E.A. Adelberg, 2001. Review of Medical Microbiology. 22nd Edition. Lange Medical Publishers. New York.
9. Mehrotra, R.S. and K.R. Aneja, 2007. Introduction to Mycology. New Age International Ltd. New Delhi.
10. Panjarathinam, R., 2007. Text book of Medical Parasitology, 2nd Edition. Orient Longman Publishers. New Delhi.
11. Parija, S.C., 2000. A Text book of Medical Parasitology .All India Publishers and Distributors, New Delhi.

M.Phil. / Ph.D. Physics

SYLLABUS
(Effective from the Academic year 2019 – 2020 and onwards)

DEPARTMENT OF PHYSICS

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act, 1956)
Eachanari Post, Coimbatore – 641 021, INDIA.
Phone: 0422-6453777, 6471113-5, 2980011-2980018;
Fax No: 0422 – 2980022, 2980023
Email: info@karpagam.com
Web: www.kahedu.edu.in

DEPARTMENT OF PHYSICS
FACULTY OF ARTS, SCIENCE & HUMANITIES
RESEARCH PROGRAM – M.Phil / PhD in PHYSICS
(2019–2020 Batch and onwards)

Course code	Name of the course	Instruction hours / week	credits	Maximum Marks (100)
19RPHY101	Research Methodology and Pedagogy	4	4	100
19RPHY201	Advanced Physics	4	4	100
19RPHY301	Solar Energy and Utilization	4	4	100
19RPHY302	Molecular Spectroscopy			
19RPHY303	Thin Film Physics			
19RPHY304	Crystal Growth			
19RPHY305	Solid state Ionics			
19RPHY306	Concepts of Nanophysics and Nanotechnology			
19RPHY307	Laser Physics			
19RPHY308	Fluorescence Spectroscopy			
19RPHY309	Experimental Techniques In Materials Science			
Program Total		12	12	300

19RPHY101 PAPER – I: RESEARCH METHODOLOGY & PEDAGOGY

Course Objectives

- To develop a research orientation among the scholars and to acquaint them with fundamentals of research methods.
- To develop understanding of the basic framework of research process.
- To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- To develop an understanding of the ethical dimensions of conducting applied research.
- Appreciate the components of scholarly writing and evaluate its quality.
- To show the scholars roadmaps of research from the beginning to the end and their intricacies;
- To inform and equip the scholars with essential knowledgebase and infrastructures for conducting research before landing up in the field.
- To understand the Research Pedagogy include article readings, discussions, etc.,

Course Outcomes

Upon completing this course, each scholar will be able to:

1. demonstrate knowledge of research processes (reading, evaluating, and developing);
2. perform literature reviews using print and online databases;
3. identify, explain, compare, and prepare the key elements of a research proposal/report;
4. define and develop a possible higher education research interest area using specific research designs;
5. compare and contrast quantitative and qualitative research paradigms, and explain the use of each in higher education research;
6. describe sampling methods, measurement scales and instruments, and appropriate uses of each; 7. explain the rationale for research ethics, and the importance of and local processes for Institutional Review Board review; and
7. demonstrate how educational research contributes to the objectives of your doctoral program and to your specific career aspirations in higher education.

Unit – I INTRODUCTION

Ethics of Research – Objectives of Research – Historical Background of Physics Research – Research Works of Sir C.V. Raman, S.Chandrasekhar and Venkaraman Ramakrishnan (Nobel prize works only) (Nobel Lectures) – Experimental Research in Physics – Design of the experiment, Apparatus to be used, Results and Interpretation – Theoretical Research in Physics – Theory, Models, Methods to solve the problems, results and Interpretation – Literature Survey on Thesis Writing – Online literature survey – Science Citation Index – Impact factor of a journal – Thesis writing.

UNIT II -PROBABILITY DISTRIBUTIONS

Mean, Median peak value, and Standard Deviation – Binomial Distribution – Poisson Distribution – Gaussian or Normal Error Distribution – Modes of distributions.

Error Analysis

Instrumental and Statistical uncertainties – Propagation of errors – Estimation of means and errors – Method of least squares – Statistical fluctuations – Chi square test of a distribution

UNIT III - NUMERICAL INTEGRATION

Trapezoidal and Simpson's 1/3 rule for single integrals - Error estimates - Trapezoidal and Simpson's rule for double integrals

Interpolation: Two points Gaussian quadrature - Three points Gaussian quadrature - Cubic spline interpolation

Eigen values: Power method - Jacobi method (Only 2 x 2 and 3 x 3 matrices)

Simulation techniques: Monte Carlo simulation – Fuzzy logic.

UNIT IV- COMPUTER APPLICATIONS IN PHYSICS RESEARCH

Programming in C: Constants - Variables - Data types - Operators and Expressions - Input/Output Statements - Control statements - Functions - Arrays - One, two, multidimensional array declarations and initializations

Simple applications using C - Program: Program to integrate tabulated function using Trapezoidal rule - Program to integrate tabulated function using Simpson's 1/3 rule - Program to compute the solution of first order differential equation of the type y' = f(x,y) using RK4 method - Program to compute first order differential equation y' = f (x,y) using Milne's method - Program to compute the interpolation value at a specified value from a set of table points using natural cubic spline interpolation.

UNIT V-PEDAGOGICAL METHODS IN HIGHER LEARNING

Historical perspectives: Objectives and role of higher education – Learning and learning hierarchy – Information processing – Learning and outcomes – Motivation.

Education evaluation: A conceptual framework – Methods of evaluation – Self evaluation and student evaluation in higher education – Question banking – Diagnostic testing and remedial teaching.

SUGGESTED READINGS

1. E.Balagurusamy - Numerical methods , Tata McGraw Hill Publishing company Limited
2. Nye, J.F. (1985). Physical Properties of Crystals: Their Representation by Tensors and Matrices. Oxford University Press, New York.
3. P.Kandasamy - Numerical methods, K.Thilgavathy and K.Gunavathi, S.Chand and company limited
4. Numerical Mathematical Analysis by Scarborough J B, Oxford & Ibh, ISBN-10: 9788120417595

5. Bevington Philip, Robinson D. Keith – Data Reduction and Error Analysis for Physical Sciences, Mc Graw Hill Higher Education.
6. https://nptel.ac.in/courses/121/106/121106007/
7. https://nptel.ac.in/courses/109/105/109105115/
8. https://nptel.ac.in/courses/109/103/109103153/
9. https://nptel.ac.in/courses/107/108/107108011/

19RPHY201 PAPER – II: SUBJECT PAPER : ADVANCED PHYSICS

Course Objectives

- To convey the scholars some of the concepts of higher levels of physics
- To prepare them for research in advanced physical fields.
- To introduce the concept of advanced concepts of quantum mechanics
- To teach scholars some of the basic concepts of experimental methods of physics in research
- To prepare them for research in advanced fields of experimental physics.
- To specialize and equip them with some mathematical tools ready to plan and confront challenges in advanced physical fields of research.
- To prepare and specialize them in the relevant areas of research, development and applications.
- To introduce the basic theoretical background of condensed matter physics.
- To study some of the basic properties of the condensed phase of matter especially solids.

Course Outcomes

After attending the course the scholars will understand the

1. some of the advanced concepts of Electrodynamics, quantum mechanics, condensed matter physics, Spectroscopy and mathematical physics, likely to be useful in forefront areas of research.
2. conversant with the concepts of scattering theory, relativistic quantum mechanics and the idea of quantum field theory.
3. some of the fundamental and higher level concepts of measurement and characterization techniques likely to be useful especially in forefront areas of experimental research.
4. acquainted with the basic theoretical knowledge that explains various phenomena of condensed matter such as superconductivity, fractional Hall effect etc.
5. Explain various types of magnetic phenomenon, physics behind them, their properties and applications.
6. Apply integral transform (Fourier and Laplace) to solve mathematical problems of Fourier transforms as an aid for analyzing experimental data.

UNIT I - MAXWELL'S EQUATIONS:

Magnetic field of a spherically symmetric current - A traveling field - The speed of light - Solving Maxwell's equations; the potentials and wave equation - Maxwell's equations for waves in free space, plane waves - Three dimensional waves - Spherical waves - Maxwell's equations for light and electromagnetic waves - Spherical waves from a point source - The fields of an oscillating dipole - The potentials of a moving charge - The potentials for a moving charge with constant velocity

UNIT II -QUANTUM BEHAVIOR

Atomic Collision and Backscattering Spectrometry: – Energy loss of Light Ions and Backscattering Depth Profiles – Sputter Depth Profile and Secondary Ion Mass Spectroscopy – Channeling: Basics and its application in Thin Film analysis - X-ray Photoelectron Spectroscopy – Electron Microprobe analysis of surface – Non-radiative Transitions and Auger Electron Spectroscopy.

UNIT III - SPECTROSCOPIC TECHNIQUES

Spectrophotometer – UV –VIS Near IR, - Basic concepts of FTIR and Raman and its applications to various materials - NMR and ESR and its applications – Thermal analysis (TG/DTA, DSC) of different Materials.

The Bragg Law – X-ray Spectroscopy – Diffraction Directions – Diffraction Methods – Powder Method – Particle size Calculation – X-ray scattering by electrons, atomic and unit cells.

UNIT IV- CRYSTAL PHYSICS AND PHYSICAL PROPERTIES OF CRYSTALS

Representation of physical quantities by scalars, vectors and tensors – Tensors of second rank- Transformations of components of a second-rank tensor – Representation quadric – Simplification of equations referred to principal axes – Effect of crystal symmetry on crystal properties: Neumann’s principle – Magnitude of a property in a given direction – Geometrical properties of the representation quadric – Equilibrium properties represented by second-rank tensor:

Properties of metallic and semiconducting Nanoparticles – various physical and chemical methods of preparation - synthesis of carbon nanostructures and their applications

UNIT V - DIFFERENTIAL EQUATIONS

Runge-kutta IVth order method for first order differential equation – RK4 for simultaneous first order differential equations – RK4 method for second order differential equations – Milne’s Predictor – Corrector method

Partial differential equations

Difference quotients – Graphical representation of partial quotients – Classification of PDE of the second order – Elliptic equations – Standard five point formula – Diagonal five-point formula – Solution of Laplace’s equation by Liebmann’s iteration.

SUGGESTED READINGS

1. Amnon Yariv (1975). Quantum Electronics (Chapter-14). John Wiley & Sons, Inc., New York.
2. Banwell. Fundamentals of Molecular Spectroscopy.
3. Chang Raymond. Basic Principles of Spectroscopy. McGraw Hill International book company
4. Cullity, B.D. Elements of X-Ray Diffraction (Second Edition)

5. Guozhong Cao. Nanostructures & Nanomaterials Synthesis, Properties and Applications. World Scientific Publishing.
6. Laud , B.B. (1985). Lasers and Non-Linear Optics (Chapter-13). Wiley Eastern Ltd.
7. Leonard C. Feldman and James W. Mayer. Fundamentals of surface and thin film analysis
8. Nye,J.F. (1985), Physical Properties of Crystals: Their Representation by Tensors and Matrices, Oxford University Press, New York.
9. Pool, C.P. Jr. and Owens, F.J. Introduction to Nanotechnology. John Wiley & Sons.
10. https://nptel.ac.in/courses/115/101/115101004/
11. https://nptel.ac.in/courses/115/106/115106065/
12. https://nptel.ac.in/courses/115/103/115103102/
13. https://nptel.ac.in/courses/115/106/115106086/
14. https://nptel.ac.in/courses/113/106/113106069/

19RPHY301 PAPER – III : SPECIAL PAPER I : SOLAR ENERGY AND ITS UTILIZATION

Course Objectives

- Solar energy harvesting and utilizing for day to day purposes has become order of the day.
- The scarcity and increasing need of the fossil fuel has made man to think about alternate sources, the easiest and best being Solar energy. Hence the course introduced to get knowledge of solar energy and its utilization.
- To introduce the students to the world of solar energy, its different uses, the different methods of harvesting solar energy.
- To understand the basic concepts of energies produced from various energy sources, advantages and disadvantages
- To learn the present energy scenario and the need for energy conservation
- To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of Solar Power Development and Management.
- To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Solar Power Development and Management.
- To develop a comprehensive technological understanding in solar PV system components
- To Analyse the environmental aspects of renewable energy resources.

Course Outcomes (COs)

At the end of the course, Students will / can be able to

1. Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
2. Know the need of renewable energy resources, historical and latest developments
3. explain the principles that underlie the ability of various natural phenomena to deliver solar energy
4. outline the technologies that are used to harness the power of solar energy
5. Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc
6. Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
7. Gain the knowledge about the energy produced from biomass and biogas.
8. Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications
9. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.
10. Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

UNIT 1- RADIATION GEOMETRY

Basis earth sun angles - Determination of Solar time - Derived Solar angles - Day length - Solar Radiation measurements - selective surfaces - Heat balance energy lost by radiation, convection and conduction - Physical characteristics of selective surfaces - Anti reflection coatings - Solar reflector materials - production methods of coatings.

UNIT II - FUNDAMENTALS OF HEAT TRANSFER

Transfer of Heat by Conduction: Study heat flow in a slab-steady heat flow in a cylindrical shell- Heat transfer through fins – Transient heat conduction. Thermal Radiation: Basic laws of radiation – Radiant heat transfer between two black bodies- Radiant heat transfer between grey bodies. Convention heat loss Evaluation of convective heat transfer co-efficient –Free convection from vertical planes and cylinders – Forced convection – Heat transfer for fully established flow in tubes.

UNITIII - SOLAR THERMAL SYSTEMS

General description of plate collector – thermal losses and efficiency of FPC –Energy balance equation – Evaluation of overall loss coefficient – Thermal analysis of flat plate collector and useful heat gained by the fluid performance of solar air heaters – Heating and drying of agricultural products Types of drier in use.

Solar concentrators and Receiver geometries – General characteristics of focusing collector systems Evaluation of optical losses – Thermal performance of focusing collectors.

UNITIV-PHOTOVOLTAICS

Description of the photovoltaic effect – Electrical characteristics calibration and efficiency measurement – silicon solar energy converters – Thermal generation of recombination centers silicon. Role of thin films in solar cells Properties of thin films for solar ells CdSe, CdTe, In P, Ga As, Cd Cu2, Cu In SnO2, Cd2SnO4 ZnO)- Transport properties of metal films – poly crystalline film silicon solar cells (Photovoltaic characteristics, junction analysis loss mechanisms) Amorphous silicon solar cells (Structural compositional optical and electrical properties)

UNIT V- ENERGY STORAGE AND SOLAR APPLICATIONS

Types of energy storage Thermal storage Latent heat storage – Electrical storage principle of operation of solar ponds-Non convective solar ponds – Theoretical analysis of solar pond – solar distillation – solar cooking –solar pumping.

SUGGESTED READINGS

1. Charles E. Backus (1976). Solar cells. IEEE Press
2. Garg, H.P. (1982). Treatise on solar energy volume I fundamentals of Solar Energy.
3. Kasturi Lal Chopra and Suhit Ranjan Das (1983). Thin film solar cells.
4. Rai, G.D. (1996). Solar energy utilization.
5. Rai, G.D.Thermal performances testing of FPC and CPC.

6. https://nptel.ac.in/courses/115/107/115107116/
7. https://nptel.ac.in/courses/115/103/115103123/
8. https://onlinecourses.nptel.ac.in/noc19_ph13/preview
9. https://onlinecourses.nptel.ac.in/noc20_mm05/preview

19RPHY302 PAPER – III: SPECIAL PAPER II: MOLECULAR SPECTROSCOPY

Course Objectives

- This paper gives an insight into the theoretical and practical aspects of spectroscopy. it is used as a tool for non-destructive testing of samples. It is important to know the physical aspects of spectroscopy.
- The major objectives of this course are to integrate theory and practice and to bring together different branches of both Academic studies and Industrial Research through the presentation of critical aspects of modern Spectroscopy.
- The course will provide a valuable theoretical introduction and an overview of modern topics in spectroscopy, which are of current interest and importance in Semiconductor Industry and Biomedicine.
- To give an understanding of wide range of techniques including optical Nearfield spectroscopy, Raman, and FTIR spectroscopy.
- To introduce electronic spectroscopy methods that are widely used in physics, chemistry and biological sciences.
- To recognize the symmetry of molecole
- To identify the active molecular motion
- To undestand rotational, vibrationa, Raman and electronic spectra.

Course Outcomes (COs)

After completing the course the students will / can able to

1. Understand the basic physical chemistry law that govern molecular spectroscopy
2. Describe the basic concepts of crystal field theory.
3. According to crystal field theory examines simple molecules.
4. Defines the basic concepts of molecular orbital theory.
5. According to molecular orbital theory examines simple molecules.
6. Identify the types of radiation in the atomic and molecular electronics.
7. Gain knowledge of the most common atomic and molecular spectroscopic methods and the atomic and molecular properties derived from those.

UNIT I- MOLECULAR SYMMETRY

Symmetry operation – symmetry elements – Different type of symmetry operations – symmetry point groups – Linear and non linear molecules – Representations of groups - Irreducible Representations and character – and character tables.

UNIT II- MOLECULAR ORBITAL THEORY

General principles – the LACO approximation – the Huckel approximation – Bonding character of orbitals - symmetry factoring of secular equations – Transformation properties of Atomic orbitals – Hybridization schemes of and orbitals Hybrid orbitals as linear combinations of Atomic orbitals – Valence Bond and Molecular orbital theory - Brief description of Hartree-Fock theory and Density functional theory

UNIT III- MOLECULAR VIBRATIONS

The symmetry of Normal vibrations – Determining the symmetry types of the Normal mode – Internal coordinates – symmetry coordinates - Normal coordinates – potential and kinetic energies in terms of symmetry coordinates – removal of redundant coordinates – application of group theory of Raman and IR activity.

UNIT IV- INFRARED AND RAMAN SPECTROSCOPY

IR spectroscopy: Practical aspects – Theory of I.R rotation vibration spectra of gaseous diatomic molecules – applications of I.R spectroscopy – Principles of F.T.I.R spectroscopy – FTIR instrumentation – Interpretation of data.

Classical and Quantum theory of Raman effect - Rotation vibration Raman spectra of diatomic and polyatomic molecules – Applications - Laser Raman spectroscopy – Sample handling techniques – Polarized Raman spectra of single crystals – Fundamentals of Surface Enhanced Raman Scattering (SERS)

UNIT V - ELECTRONIC SPECTRA

Electronic excitation of diatomic species - Resonance and Normal Fluorescence – Intensities of transitions - Phosphorescence population of triplet state and intensity- Experimental methods - Applications of Fluorescence and phosphorescence – UV spectrophotometry.

SUGGESTED READINGS

1. Chandra, A.K. Quantum chemistry.
2. Aruldhas, G. (2008). Molecular Structure and Spectroscopy. Pergamon Press, New Delhi.
3. Cotton, F.A. Chemical applications of group theory. Wiley Inter science.
4. Herzberg. Infra red Raman spectroscopy.
5. Puranik, P.G. Group theory application to molecular vibrations.
6. People, J.A. and Segai, G.A. (1965). Approximate self–consistent molecular orbital theory I. Calculations with complete neglect of Differential over lap. J . Che . Phy . Vol.43.
7. People, J.A. and Segai, G.A. (1965). Approximate self–consistent molecular orbital theory II. Calculations with complete Neglect of Differential over lap. J Che. Phy .Vol. 43 No .10.
8. People, J.A. and Segai, G.A. (1965). Approximate self–consistent molecular orbital theory III CNDD Results for AB-2 and AB,3 Systems .
9. Santry, D.P. and Segai, G.A. (1967). Approximate self – consistent molecular orbital theory IV. Calculations on Molecules including the Elements sodium through chlorine. J. Chem. . phys . vol. 47 – 158 – 174.

10. Segai, G.A. (1967) Calculation of Equilibrium bond lengths by the CNDO method. J.Chem.Phys . vol. 47 . 1876 – 1877.
11. Wioson, E.B. Cross. Molecular vibrations.
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13. https://nptel.ac.in/courses/104/106/104106122/
14. https://nptel.ac.in/courses/104/101/104101126/
15. https://onlinecourses.nptel.ac.in/noc20_cy08/preview

19RPHY303 PAPER – III: SPECIAL PAPER III. THIN FILM PHYSICS

Course Objectives

- Introduce physical concepts and mathematical tools used to describe surfaces, interfaces and thin films.
- To develop an intuition for surface and thin film physical principles through plotting of functions using Maple
- To relate the mathematical results to practical applications and experiments in thin film techniques.
- Develop an appreciation of the mathematical basis for experimental techniques for deposition and analysis of thin films
- Understand physical phenomena that can be exploited for the deposition of thin films
- To demonstrate knowledge of different thin film deposition strategies

Course Outcomes (COs)

At the end of the course, the students can/will be able to

1. Discuss the differences and similarities between different vacuum based deposition techniques
2. Evaluate and use models for nucleating and growth of thin films
3. Examine the relation between deposition technique, film structure, and film properties, discuss typical thin film applications,
4. Select proper deposition techniques for various applications.
5. Understand the basic concepts about the thin film technology
6. The importance of use of thin films in application and research.
7. The students gain experience in handling high vacuum equipment and using thin film growth techniques which to enables them to work at production units related to optical, mechanical, electronic coatings etc.

UNIT I- PREPARATION OF THIN FILMS

Spray pyrolytic process – characteristic feature of the spray pyrolytic process – ion plating – Vacuum evaporation – Evaporation theory – The construction and use of vapour sources – sputtering Methods of sputtering – Reactive sputtering – RF sputtering - DC planar magnetron sputtering.

UNIT II- THICKNESS MEASUREMENT AND NUCLEATION AND GROWTH IN THIN FILM

Thickness measurement: electrical methods – optical interference methods – multiple beam interferometry – Fizeau – FECO methods – Quartz crystal thickness monitor.

Theories of thin film nucleation – Four stages of film growth incorporation of defects during growth.

UNIT III- ELECTRICAL PROPERTIES OF METALLIC THIN FILMS

Sources of resistivity in metallic conductors – sheet resistance - Temperature coefficient of resistance (TCR) – influence of thickness on resistivity – Hall effect and magneto resistance – Annealing – Agglomeration and oxidation.

UNIT IV- TRANSPORT PROPERTIES OF SEMICONDUCTING AND INSULATING FILMS

Semiconducting films; Theoretical considerations - Experimental results – Photoconduction – Field effect thin films – transistors, Insulation films Dielectric properties – dielectric losses – Ohmic contracts – Metal – Insulator and Metal – metal contacts – DC and AC conduction mechanism .

UNIT V - OPTICAL PROPERTIES OF THIN FILMS AND THIN FILMS SOLAR CELLS

Thin films optics –Theory – Optical constants of thin films – Experimental techniques – Multilayer optical system – interference filers – Antireflection coating, thin films solar cells: Role, Progress, and production of thin solar cells – Photovoltaic parameter, thin film silicon (Poly crystalline) solar cells : current status of bulk silicon solar cells – Fabrication technology – Photo voltaic performance: Emerging solar cells: GaAs and $CulnSe_2$.

SUGGESTED READINGS:

1. Anderson, J.C. The use of thin films in physical investigation.
2. Berry, Koil and Harris. Thin films technology.
3. Chopra, K.L. Thin film Phenomena.
4. Chopra, K.L. and Das, S.R. Thin films solar cells.
5. George Hass and others (Ed). Physics of thin films, vol. 12.
6. Holland, L. Vacuum deposition of thin films.
7. Maissel, L.I. and Clang, R. Hand book of Thin films Technology.
8. Vilsan, J.L. Thin films processes.
9. https://nptel.ac.in/content/storage2/courses/112108092/module2/lec08.pdf
10. http://www.infocobuild.com/education/audio-video-courses/materials-science/FundamentalsOfMaterialProcessing2-IIT-Kanpur/lecture-37.html
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19RPHY304 PAPER – III: SPECIAL PAPER IV: CRYSTAL GROWTH

Course Objectives

- To strengthen the students with crystallographic and crystal growth techniques
- To provide the general characteristics of crystals, methods of preparation etc.
- Various thin films deposition techniques and thin film characterization techniques are also covered in the course.
- To give an idea about historical importance of crystals, methods of preparation and characterization of crystals etc.
- To explore the knowledge in fundamentals of materials syntheses, crystal growth techniques, zone refining, properties etc.,
- To provide the basic knowledge on crystal structure.

Course Outcomes (COs)

After completing the course the students will / can able to

1. The student will learn about the crystal growth mechanisms and techniques.
2. Understand different crystals having a lot applications in electronics, energetics etc.
3. Acquire the theoretical concept behind electrical and thermal properties of metals
4. Understand the fundamental theories to describe the energy bands in metals
5. Gain the knowledge about Semiconductor Crystals and their properties
6. Gain the knowledge about phonons and its importance in thermal physics

UNIT I- FUNDAMENTALS OF CRYSTAL GROWTH

Importance of crystal growth – Classification of crystal growth methods – Basic steps: Generation, transport and adsorption of growth reactants – Nucleation: Kinds of nucleation – Classical theory of nucleation: Gibbs Thomson equations for vapour and solution – Kinetic theory of nucleation – Becker and Doring concept on nucleation rate – Energy of formation of a spherical nucleus – Statistical theory on nucleation: Equilibrium concentration of critical nuclei, Free energy of formation.

UNIT II- THEORIES OF CRYSTAL GROWTH

An introductory note to Surface energy theory, Diffusion theory and Adsorption layer theory – Concepts of Volmer theory, Bravais theory, Kossel theory and Stranski’s treatment – Two-dimensional nucleation theory: Free energy of formation, Possible shapes and Rate of nucleation – Mononuclear, Polynuclear and Birth and Spread models – Modified Birth and Spread model – Crystal growth by mass transfer processes: Burton, Cabrera and Frank (BCF) bulk diffusion model, Surface diffusion growth theory.

UNIT III - EXPERIMENTAL CRYSTAL GROWTH-PART-I: MELT GROWTH TECHNIQUES.

Basics of melt growth – Heat and mass transfer – Conservative growth processes: Bridgman-Stockbarger method – Czochralski pulling method – Kyropolous method – Nonconservative processes: Zone-refining – Vertical and horizontal float zone methods – Skull melting method – Vernueil flame fusion method.

UNIT IV- EXPERIMENTAL CRYSTAL GROWTH-PART-II: SOLUTION GROWTH TECHNIQUES.

Growth from low temperature solutions: Selection of solvents and solubility – Meir's solubility diagram – Saturation and supersaturation – Metastable zone width – Growth by restricted evaporation of solvent, slow cooling of solution and temperature gradient methods– Crystal growth in Gel media: Chemical reaction and solubility reduction methods – Growth from high temperature solutions: Flux growth Principles of flux method – Choice of flux – Growth by slow evaporation and slow cooling methods – Hydrothermal growth method.

UNIT V -EXPERIMENTAL CRYSTAL GROWTH-PART-III: VAPOUR GROWTH TECHNIQUES

Basic principles – Physical Vapour Deposition (PVD): Vapour phase crystallization in a closed system – Gas flow crystallization – Chemical Vapour Deposition (CVD): Advantageous and disadvantageous – Growth by chemical vapour transport reaction: Transporting agents, Sealed capsule method, Open flow systems – Temperature variation method: Stationary temperature profile, Linearly time varying temperature profile and Oscillatory temperature profile.

SUGGESTED READINGS

1. Brice, J.C. (1986). Crystal Growth Processes. John Wiley and Sons, New York.
2. Mullin, J.W. (2004), Crystallization. Elsevier Butterworth-Heinemann, London.
3. Pamplin, B.R. (1975). Crystal Growth. Pergamon Press, Oxford.
4. Sunagawa Ichiro. (2005). Crystals: Growth, Morphology and Perfection. Cambridge University Press, Cambridge.
5. Vere, A.W. (1987). Crystal Growth: Principles and Progress. Plenum Press, New York.
6. https://nptel.ac.in/content/storage2/courses/103104045/pdf_version/lecture19.pdf
7. https://www.youtube.com/watch?v=G76H7A6_iyo
8. https://www.youtube.com/watch?v=8GsyipwtCIA
9. https://www.youtube.com/watch?v=db5nZCipJh8

19RPHY305 PAPER – III: SPECIAL PAPER V: SOLID STATE IONICS

Course Objectives

- To provide an introduction to the concepts underlying solid state Ionics
- To illustrate the wide range of materials and physical properties that currently available for ionic conductors
- To introduce the superionic conductors and their applications
- To establish the ionic conductors for energy applications
- To introduce the different mechanism of electrochemical energy storage materials and their applications
- To understand the ion transport mechanism via gas, liquid and solid phase materials.

Course Outcomes

Students will be able to:

1. calculate point defect concentrations using formation energies, develop Brouwer diagrams, describe several means of tailoring point defect concentrations through independent variables, and apply equilibrium thermodynamics to the case of defective solids
2. write point defect reactions in Kroger-Vink notation to describe defect processes, and apply a non-equilibrium thermodynamics and chemical kinetics framework to describe defect reactions and kinetic behavior
3. describe operation of various solid state ionics applications (including open circuit cells, cells using current, and cells generating current)
4. select measurement techniques appropriate for investigating solid state electrochemical material/device behavior and select materials appropriate for different functions within the devices.
5. use appropriate resources for finding up-to-date information on solid state ionics for continued learning.
6. Learn the superionic conductors and their real life applications.
7. Learn synthesis design and planning, different processing technoques and their chemical-physical fundamentals as well as basic method of characterisation of solids.

UNIT I Introduction

Crystalline solids – space lattice – the basis and crystal structure; crystal translational vectors, symmetry operation primitive lattice cell and unit cell symmetry elements, Fundamental type of lattice, atomic packing, atomic radius, lattice constants and density, crystal structure other cubic structure – type of bonding – Ionic bonding – Energy of formation of NaCl molecules, Madelung constants – potential energy of diagram of ionic molecules – calculation of repulsive exponent – Born Haber cycle characteristics of ionic bond.

UNIT II Transport Properties of Ionic Conductors

Ionic conductivity – Normal and super ionic conductors – Mass transport in crystals – Diffusion – Atomic diffusion theory – Experimental determination of the diffusion constant – Ionic conduction – Experimental results – for ionic conduction – The Einstein relation – Dielectric loss in ionic crystals – Electronic conduction in ionic crystals – Excess conductors – Deficit conductors – Amphoteric semiconductor.

UNIT III

Phenomenological Models – Huberman's Theory – Ries Strassler Toom's Theory – Weleh and Diene Theory – Lattice Gas theory – Free ion model – Domain Model – Rica and Roth Theory – The Path Probability Method – The static variables – the Path variables – The path Probability – Stationary state condition – Classification of Superionic solids – Crystalline and Amorphous – Glasses – Dispersed solid Electrolytes – polymers – Ion exchange resins – biological basis resins – Classification over conducting ion species – mode and mechanism of conduction in each case and their corresponding criteria to be superionic conductors.

UNIT IV: Experimental Techniques and Methods

Structural characterization – XRD surface Analysis, EXAFS, IPS and Quasi neutron scattering – Thermo dynamical characterization – Differential scanning calorimetry, Differential Thermal Analysis, Thermo Gravimetric Analysis and Thermo electric power – Ion transport properties – Electrical conductivity – Two probe method – four probe method – Immitance spectroscopy – Dynamical conductivity – state conductivity – polarisation characteristic – determination of small electronic transport numbers.

UNIT V Electrochemical Techniques and Applications

Fundamentals of electrochemistry, Linear Sweep Voltammetry, Cyclic Voltammetry, Chronoamperometry, Linear polarization, Electrochemical Impedance spectroscopy. Batteries: Primary and secondary batteries, Li-ion batteries, Supercapacitors: Electric double layer capacitor, Pseudocapacitor, Fuel Cells: Solid oxide Fuel cells, Direct Methanol Fuel Cells, Proton Exchange Membrane Fuel cells, Sensors: Oxygen sensors and electrochemical sensors, Electrochromic displays.

SUGGESTED READINGS

1. Superionic solid – Principles and applications (Ed. S.Chandra) North Holland 1981.
2. Solid state ionics (Eds. T Kudo and Fueki) VCH Publishers, Kodansha 1990.
3. Lectures on solid state physics (Eds. G Bush and H Schade), international series on Natural Philosophy Vol. 79 Pergamon, press 1976.
4. "Solid Electrolytes" (Eds. S Geller) Springer Verlag New York 1977.
5. Impedance Spectroscopy Theory, Experiment, and Applications, (Eds) Evgenij Barsoukov and J. Ross Macdonald, Wiley interscience (2005).
6. Physics of Electrolytes – Transport Processes solid Electrolytes and in Electrodes (Eds. J Hladik) Academic press, New york 1972.

7. Fundamentals of Electrochemistry, 2nd Edition, V.S.Bagotsky, Wiley Interscience. (2006).
8. Electrochemical Methods: Fundamental and Application, Allen J.Bard Wiley and Sons Publications (2001).
9. https://nptel.ac.in/content/storage2/courses/113104005/lecture_pdf/module3.pdf
10. https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_14_m.pdf
11. https://nptel.ac.in/content/storage2/courses/122101002/downloads/lec-8.pdf
12. https://nptel.ac.in/content/storage2/courses/103108100/module6/module6.pdf

19RPHY306 PAPER – III: SPECIAL PAPER VI :
CONCEPTS OF NANOPHYSICS AND NANOTECHNOLOGY

Course Objectives

- To foundational knowledge of the Nanoscience and related fields.
- To make the students acquire an understanding the Nanoscience and Applications
- To help them understand in broad outline of Nanoscience and Nanotechnology.
- To familiarize with the on-going merge of the top-down approach of microelectronics and micromechanics with the bottom-up approach of chemistry/biochemistry.
- To demonstrate the potential of nanoscience and industrial applications of nanotechnology.
- To give you an insight into complete systems where nanotechnology can be used to improve our everyday life.

Course Outcomes

Scholars will be able to:

1. understand the fundamental physical principles, which govern properties of the condense matter and in particular the role of dimensionality on the mechanical, thermal, optical, electricaland magnetic properties of materials
2. understand the physical basis of new phenomena that appear when the linear dimension of an object or device shrinks below a micrometer
3. be familiar with the methods for fabrications of nanostructures
4. understand and be able to explain the principles of newly characterization techniques for imaging and analysis of nanostructures and nanomaterials
5. understand and be able to explain the principles of operation of nanoelectronic and nanophotonic devices
6. became familiar with the whole concept of nanoscale science and technology and be able to apply their knowledge for understanding further developments in this rapidly emerging area.
7. Learn about the background on Nanoscience
8. acquire the basic knowledge of the physical phenomena, theoretical concepts and experimental techniques behind the recent vastly improved ability to observe, fabricate and manipulate individual structures on the nanometer scale.
9. Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment
10. Apply their learned knowledge to develop Nanomaterial's
11. Introduce a recent advancements in nano medicine.
12. Understand need of nanotechnology in Medical field.
13. learn developments in nanostructured materials used for medical implants.

UNIT I- INTRODUCTION TO NANOTECHNOLOGY

Defining nanotechnology, Historical development – Beyond Moore's law, Comparison of bulk and nano materials – change in band gap and large surface to volume ratio, Classification of nanostructured materials – one, two and three-dimensional confinement, quantum dots, quantum wires and quantum wells, scope of applications.

UNIT II- SYNTHESIS AND CHARACTERIZATION

Classification of fabrication methods – Top to bottom approach – Ball milling, etching etc bottom to top approach – Physical and chemical methods – Molecular Beam Epitaxy, optical and electron beam lithography, Ion implantation, sputtering, thermal evaporation, pulsed laser deposition, chemical vapor deposition, controlled precipitation, sol gel methods. Grain size determination – XRD (Debye Scherer equation), TEM, AFM, STM and Light scattering techniques. Composition analysis – ICP – AES, EDAX, SIMS.

UNIT III- OPTICAL AND VIBRATIONAL PROPERTIES OF NANOPARTICLES

Basic concepts – Band structure of solids, excitons, effective mass, reciprocal lattice, Brillouin zone, phonons etc. Size and dimensionality effects – Bulk to nano transition –Density of states, potential well - quantum confinement effect – weak and strong confinement regime. Blue shift of band gap - Effective mass approximation (Rigorous mathematical treatment not necessary). Phonon confinement effect and presence of surface modes. Characterization tools - UV – Visible absorption and Photoluminescence techniques, Raman and IR spectroscopy

UNIT IV -CARBON NANOSTRUCTURES

Carbon nanostructures – carbon molecules – carbon clusters. Fullerene - structure of C_{60} and its crystal – larger and smaller fullerenes – other bucky balls. Carbon nanotubes – fabrication – structure – electrical properties – vibrational properties – mechanical properties. Applications of carbon nanotubes – Field emission and Shielding – computers – Fuel cells – Chemical sensors – Catalysis – Mechanical reinforcement.

UNIT V -NANOMACHINES AND NANODEVICES

Extension of conventional devices by nanotechniques – Bipolar and MOS transisitors – structure and technology, electrical characteristics, limitations, low temperature behavior. Microelectromechanical systems (MEMSs), Nanoelectromechanical systems (NEMSs), Resonant Tunneling Diode, Quantum Cascade lasers, Single Electron Transistors – Operating principles and applications.

SUGGESTED READINGS

1. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse “Nanotechnology”, Overseas Press New Delhi 2005
2. W. R. Fahrner (Ed.) “Nanotechnology and Nanoelectronics”, Springer 2006.
3. Charles P Poole Jr and Frank J Owens “Introduction to Nanotechnology”, Wiley student edition 2003.

4. https://nptel.ac.in/courses/118/104/118104008/
5. https://nptel.ac.in/courses/115/101/115101007/
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7. https://nptel.ac.in/courses/118/106/118106021/

19RPHY307 PAPER – III: SPECIAL PAPER VII : LASER PHYSICS

Course Objectives

- Laser is a versatile tool with applications in almost all fields from medical to astronomy, communications, welding, cutting etc.
- This paper explains the characteristics of lasers, different types of lasers and their construction to apply for industircal use. Applications of lasers in different fields are also explained.
- To provide up-to-date guidance of modern types of lasers and will give sufficient theoretical and, importantly, practical knowledge for designing and building actual lasers.
- To give exposure to students about the characteristics of different lasers, their fabrication techniques, applications etc.
- To make the student understand the principles of Lasers
- To enable the student to explore the field of Nonlinear optics
- To be able to apply the fundamental concepts of optics in lasers, optical fiber communications and optoelectronics

Course Outcomes (COs)

After completing the course the scholars can/will able to

1. Acquire fundamentals and principles of Laser action and Understand the basic conceptsof different types of lasers
2. Understand the absorption and spontaneous and stimulated emission in two level system,
3. Learn the basics & different parameters required to fabricate the lasers and their advantages and disadvantages in various fields.
4. The effects of homogeneous and inhomogeneous line broadening, and the conditions for laser amplification.
5. Classify fibers as single-mode, multimode step index and multi-mode graded index.
6. Describe modes in multimode fibers and mode field parameter in single-mode fibers
7. explain operational principles and construction of lasers
8. give an account of technological issues behind laser construction
9. describe optical components that can be used to tailor the properties of the laser
10. relate the laser operation principles to atom and molecular physics, solid state physics, quantum mechanics and physical optics.

UNIT --I

Radiative transitions and emission line widths. Radiative decay of excited states, homogeneous and inhomogeneous broadenings. Absorption, spontaneous and stimulated emissions. Einstein's A and B Coefficients. Absorption and gain of homogeneously broadened radiative transitions, gain coefficient and stimulated emission cross section for homogeneous and inhomogeneous broadening.

UNIT II

Necessary and sufficient conditions for laser action (population inversion and saturation intensity), threshold requirements for laser with and without cavity, laser amplifiers, rate equations for three and four level systems, pumping mechanisms. Laser cavity modes-longitudinal and transverse modes in rectangular cavity. FP cavity modes, Spectral and spatial hole burning, stability of laser resonator and stability diagram, unstable and ring resonators.

UNIT III

Q-switching and Mode locking, active and passive techniques, generation of giant pulses and pico second optical pulses, Properties of laser beam and techniques to characterize laser beam.

UNIT IV

Scattering: Scattering cross-section – Scattering amplitude – Partial waves – Scattering by a central potential: partial wave analysis – Significant number of partial waves – Scattering by an attractive square-well potential – Briet-Wigner formula – Scattering length – Expression for phase shift – Integral equation – The Born approximation – Scattering by screened coulomb potential – Validity of Born approximation - Laboratory and center of mass co-ordinate systems.

UNIT V

Introduction - Driving problems in biomedical imaging - Sources of imaging data: acquisition and noise - Elementary image processing - Grenander's Pattern Theory, Biomedical image analysis using MATLAB – Image registration – unaided and Interactive – Segmentation – Edge detection – Real time imaging applications.

SUGGESTED READINGS:

1. Laser Fundamentals - W T Silfvast, Cambridge University Press (1996)(Text)
2. Laser Electronics - J T Vardeyan. PHI, 2nd Ed (1989)
3. Lasers-Theory and Applications- Ghatak and Thyagarajan, McMillan (2002) (Text)
4. Principles of lasers - Svelto, Plenum Press (1948)
5. Solidstate laser engineering - Koechner, Springer Verlag (1993)
6. Laser Physics- Tarasov. Mir Publishers (1985)
7. John.L.Semmlow, Biomedical signal and Biomedical Image Processing – MATLAB based applications, Marcel Dekker Inc., 2004.
8. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC press.
9. https://nptel.ac.in/courses/104/104/104104085/
10. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20&%20Comm%20Engg/Optical%20Communication-backup/Course_home-M7.html
11. https://www.digimat.in/nptel/courses/video/104104085/L01.html
12. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-974-fundamentals-of-photonics-quantum-electronics-spring-2006/lecture-notes/chapter7.pdf

19RPHY308 PAPER – III: SPECIAL PAPER VIII : FLUORESCENCE SPECTROSCOPY

Course Objectives

- To know the modern optical spectroscopic and imaging techniques and their applications to biology and chemistry.
- To get the knowledge an introduction to fundamental concepts of light-matter interaction, lasers and laser systems, detectors and other relevant aspects of instrumentation necessary for spectroscopy and imaging.
- To discuss various modern surface spectroscopic techniques and examples from classic and contemporary literature.
- To get an in-depth introduction to the principles of fluorescence spectroscopy and its applications to the Life Sciences.
- To gain the knowledge in the advanced X-ray diffraction techniques for opto-electronic materials characterisation.
- To understand the crystal growth and their interactive nature with light.

Course Outcomes

After this course the scholars are expected to be able to:

1. explain the fundamental physical mechanisms involved in the generation of fluorescence light.
2. explain how interactions between biomolecules and electromagnetic radiation and environmental effects can generate changes in the measured fluorescence parameters, and how these changes can be exploited for monitoring of biomolecules and their interactions.
3. Mention the most important fluorescence techniques in the biomedical research field, and explain what type of questions these techniques can address.
4. Describe the physical principles of these fluorescence techniques,.
5. Based on knowledge on these techniques and their physical principles, describe and motivate what the factors are that limit their performance, and how the obtained measurements data are evaluated.
6. Follow, report on, and discuss relevant parts of the latest development in the field of fluorescence spectroscopy, and judge their applicability for different biomolecular studies.
7. more in detail estimate the usefulness of fluorescence methods within the students own area of research, and to provide well motivated, solid suggestions of how they can be applied in the area.

UNIT - 1: Solvent and Environmental Effects on Fluorescence spectra

Stokes' shifts and solvent relaxation, general and specific solvent effects, other mechanisms for spectral shifts. Lippert equation, Derivation of Lippert equation, Applications of Lippert equation, Specific solvent effects. Temperature effects, Additional factors that affects the emission spectra - locally excited and internal charge transfer states, excites state intramolecular proton transfer, effects of viscosity, probe-probe interaction and effect of solvent mixtures.

UNIT - 2: Fluorescence Quenching

Introduction, quenchers of fluorescence, Theory of colloidal quenching, Derivation of SternVolmer equation, Interpretation of bimolecular quenching constants, theory of static quenching, Comparison between static and dynamic quenching. Combined dynamic and static quenching with examples. Deviation from the Stern-Volmer equation - Quenching sphere of action. Derivation of the quenching sphere of action, Origin of the Smoluchowski equation.

Mechanisms and Dynamics of Fluorescence Quenching

Introduction, comparison of quenching and resonance energy transfer, distance dependence of resonance energy transfer and quenching, encounter complexes and quenching efficiency, mechanisms of quenching: Intersystem crossing or heavy atomic effect, electron exchange, photoinduced electron transfer. Transient effects in quenching,

Fluorescence Sensing

Optical Clinical Chemistry and spectral observable, spectral observable for fluorescence sensing, Mechanism of sensing, sensing collisional quenching - oxygen sensing, chloride sensors, energy transfer sensing - pH and pCO2 sensing by energy transfer, glucose sensing by energy transfer, ion sensing by energy transfer, theory of energy transfer sensing.

UNIT-3: X-RAY CRYSTALLOGRAPHY

Crystal and Symmetry: Growth of single crystals, different methods, Optical properties, ferroelectric, piezoelectric, thermal properties of crystal, Crystal system- Bravais lattices- point group and space group, symmetry elements.

Quasicrystals: definition, preparation, symmetry orientation order in quasicrystals, Quasi-periodic space tiling procedure. Macromolecules: definition, examples of macromolecules or Bio-molecules-symmetry.

X-rays: Production, white radiation characteristics, radiation - absorption edge, filters - absorption by crystals.

UNIT-4: DIFFRACTION OF X-RAYS

Direct and reciprocal lattice, Ewald's sphere and Bragg's law, Spacing formula,Transformation equations, Interpretation of rotation photograph.

Scattering of X-rays by a distribution of electron, structure factor, calculation of electron density function, Fourier synthesis, the crystal symmetry and x-ray diffraction pattern, Friedel's law and its break down.

Electron and neutron diffraction, comparison with X-ray diffraction, significance of electron and neutron diffraction, characterization of quasicrystalline sample using electron diffraction.

The Laue method, The Powder method, rotation and Weissenberg methods, The Burger precession method.

UNIT-5: INTENSITY DATA COLLECTION, STRUCTURE SOLUTION AND REFINEMENT

The single crystal diffractometer method, intensity data collection, corrections to intensity data- Lorentz, polarization, spot shape and absorption effects, primary and secondary extinction effects, absolute scaling and temperature factors.

Fourier techniques, Phase problem, Patterson function and its significance, Heavy atom methods, Isomorphous replacement method, anomalous scattering method, direct methods.

Cyclic Fourier refinement, the difference Fourier refinement, correction for series termination effects, temperature correction, Least squares refinement.

Derived results- bond lengths, bond angles, standard deviations in bond lengths and angles, comparison and averaging of bond lengths and angles, least square planes, absolute configuration and thermal motion.

SUGGESTED READINGS

1. Fundamentals of Photochemistry, Rohtagi - Mukherjee K K, Wiley Eastern Ltd., 1992.
2. Principles of Fluorescence Spectroscopy, Joseph R Lakowicz, Plenum Press, New York, 1986
3. Photophysics of Aromatic Molecules, Birks J B, Wiley - Interscience, London 1970.
4. Azaroff. L.V.: Introduction to Solids, McGraw-Hill, New York, 1960.
5. Phillips. F.C. : Introduction to Crystallography, Longmans, London, 1966.
6. Cullity. B. D.: Elements of X-ray crystallography, prentice hall, 2001.
7. Ponerger. J. J.: X-ray Crystallography, John Wiley, New York, 1942.
8. Burger. M. J.: Crystal Structure Analysis, John Wiley, New York, 1960.
9. 9 Stout. H & Jensen. L. H.: X-ray Structure determination, McGraw Hill, London, 1973.
10. Duncan Mc Kie & Christins Mc Kie: Crystalline Solids, Nelson, London, 1973.
11. Azaroff. L.V. Elements of X-ray crystallography, McGraw-Hill , New York, 1968.
12. Woolfson, M. M.: X-ray Crystallography, Cambridge University Press, 1978.
13. Glusker, J. P. & True blood. K.N.: Crystal Structure Analysis, Oxford Univ. Press, 1985.
14. Bacon. G. E.: Neutron Diffraction, Oxford Univ. Press, 1962.
15. Methods of Experimental Physics, Vol. 6: Part A, Associate Press.
16. Janot. C, Quasicrystals, Oxford Science Publications, Clarendon press, Oxford, 1992.
17. https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-cy01/
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19. http://web.iitd.ac.in/~sdeep/Fluorescence.pdf

19RPHY309 PAPER – III: SPECIAL PAPER IX :
EXPERIMENTAL TECHNIQUES IN MATERIALS SCIENCE

Course Objectives

- To learn how to operate a number of important materials processing and characterization instruments as well as to analyze and interpret the resultant data.
- To learn the strengths and weaknesses of different materials processing and characterization techniques.
- To gain a better understanding of the important processing-structure-property relationships.
- To provide concepts on the several materials characterization techniques at the morphological, structural and chemical level, the acquisition of skills in the use and selection of advanced experimental techniques for characterization of materials.
- To solving problems in materials science and engineering. Several characterization techniques are discussed, from the most conventional to the most recent.
- To enable the knowledge that in the future so that the students can prioritize choices of materials characterization meet the needs and resources available.

Course Outcomes

At the end of the course, the students can/will be able to

1. Know the proper selection of material based on the performance of the system under study and development of new materials.
2. Know depending on the requests that the equipment or system shall be subjected, the characterization may include the evaluation of mechanical, electrical, magnetic, optical, chemical or thermal.
3. Know the advanced techniques for materials characterization, particularly of the most widely used materials as thin films, nanomaterials and advanced materials.
4. Understand samples preparation and the applicability of these techniques in order to provide the essential groundwork for select and ranking them.
5. Know the main techniques in the study include characterization methods based on microscopy, microanalysis and diffraction techniques, and surface and spectroscopy analysis.
6. Understand the solving problems in materials science and engineering.

UNIT -1 METHODS OF MATERIALS BULK SYNTHESIS

Solid state reaction - ceramic technique - microwave synthesis - sol-gel method - wet-chemical methods - Hydrothermal method.

Growth of Single Crystals - Introduction to Methods of Growth of Crystals –BCF theory-Czochralski Method - Bridgman, Zone Melting and Zone Refining Methods.

UNIT-2 PREPARATION OF THIN FILMS

Types of thin Film Growth process - Spin coating - vacuum evaporation - sputtering - Pulsed laser deposition - Vapor Methods – CVD – PVD - Fundamental aspects of Epitaxial Growth methods.

UNIT – 3 STRUCTURAL CHARACTERIZATIONS AND IMAGING TECHNIQUES

X-ray diffraction ((XRD) - Electron and neutron diffraction - elementary ideas of photoelectron spectroscopy (PES) - Basic principle of atomic resolution electron microscopy - Scanning and Transmission electron microscopy (SEM, TEM) - Scanning tunneling and atomic force microscopy (STM, AFM) techniques.

UNIT – 4 OPTICAL CHARACTERIZATIONS AND SPECTROSCOPIC TECHNIQUES

Ultraviolet / visible (UV/Vis) absorption spectroscopy - Raman and Infrared Spectroscopy - Fluorescence spectroscopy - Elementary idea of laser based non-linear techniques. Room temperature as well as low temperature Photoluminescence - Cathode Luminescence - Mössbauer spectroscopy - Impedance spectroscopy

UNIT-5 PHYSICAL PROPERTY MEASUREMENTS

Intensive and extensive properties - Physical property measurements (DSC, DTA, TGA,) - Transport properties (R-T) – Photoconductivity study (C-V, I-V) - Low conductivity measurement (Dielectric Spectroscopy) - P-E loops for ferroelectrics - magnetic properties of bulk and nano phases of material (VSM & SQUID).

Suggested Readings:

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12. https://nptel.ac.in/courses/113/101/113101096/
13. https://nptel.ac.in/content/storage2/courses/112104039/pdf_version/lecture1.pdf.

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DEPARTMENT OF TAMIL

M.Phil & Ph.D CURRICULUM (2019-2020)

S.No	Subject Code	Name of the Course	Credits	Exam duration (Hrs)	Max Marks
1	19RTAM101	**Paper-I:** Research Methodology and Pedagogy	**4**	**3**	**100**
2	19RTAM201	**Paper-II:**History of Tamil Literature	**4**	**3**	**100**
	Paper III: Special Paper				
3	19RTAM301	Sanga Ilakkiyam	**4**	**3**	**100**
4	19RTAM302	Ara Ilakkiyam			
5	19RTAM303	Bhakthi Ilakkiyam			
6	19RTAM304	Ikkaala Ilakkiyam			
7	19RTAM305	Naattuppuraviyal			
		Total	**12**		**300**

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DEPARTMENT OF TAMIL

SYLLABUS

M.Phil, / Ph.D., Programs (2019-2020)

தாள்:1 ஆய்வியல் நெறிமுறைகள் மற்றும் கற்பித்தல்

தாள்:2 ஆய்வுசார் வெளியீடுகளுக்கான நெறிமுறைகள்

தாள்:3ஆய்வுக்களம் சார்ந்த சிறப்புப் பாடம்

3.1 சங்க இலக்கியம்

3. 2. அற இலக்கியம்

3. 3.பக்தி இலக்கியம்

3. 4. இக்கால இலக்கியம்

3. 5. நாட்டுப்புறவியல்

தாள்:1 ஆய்வியல் நெறிமுறைகள் மற்றும் கற்பித்தல்

தாள்:1 ஆய்வியல் நெறிமுறைகள் மற்றும் கற்பித்தல்

பாடத்திட்டப் பொதுநோக்கம்

- ஆய்விற்கான அடிப்படைக் கருத்துக்களையும்,அதற்கான உத்திகளையும் ஆய்வாளர் புரிந்து கொள்ளுதல்
- கருதுகோளை உருவாக்குதல்
- பொருத்தமான தலைப்பைத் தேர்வு செய்தல்
- ஆய்வுச்சிக்கலைத் தேர்வுசெய்து உரியகாலத்தில் அதற்கான தீர்வு காலத்தை வரையறுத்தல்.
- ஆய்வு முன்மொழிவைத் தயாரித்தல்.
- தேர்வு செய்த தலைப்பின் அடிப்படையில் ஆய்வறிக்கை எழுதத் தயாராதல்.

அலகு– 1 ஆய்வும் ஆய்வுப் பொருளும் தேர்வும்

ஆய்வு என்பதன் விளக்கம் - ஆய்வாளனுக்குரிய தகுதிகளும் உளப்பாங்கும் - ஆய்வுக்குரிய களம் - ஆய்வு நோக்கினைச் சுட்டல் - ஆய்வுச்சிக்கல் - ஆராயும் பொருள் பற்றித் தெளிதல் - ஆய்வுப் பொருள் பற்றி அதுவரை செய்யப்பட்ட ஆய்வுகள் பற்றிய தொகுப்புரையும் மதிப்பீடும்.

அலகு – 2 ஆய்வுப் பகுப்பும் தொகுப்பும் - களஆய்வும்

முதன்மைக்கூறுகள் (சீசஐஅயசல ளுழரசஉநள) துணை நிலைக்கூறுகள் (ளுநஉழனெயசல ளுழரசஉநள)இவற்றைத் தொகுத்தலும் பகுத்தலும் - பல்வேறு தொகுப்பு முறைகள் - நேர்காணல் - வினாத்தொகுதி(ளுரநளவழைளெ) மாதிரிகள் (ளுயஅிடநள) முதலியவை பற்றிய விளக்கம். கள ஆய்வு வகைகள் - மக்கள் இன,பண்பாட்டு ஆய்வு – கள ஆய்வுக்குத் தேவையானபொருட்கள் - களஆய்வில் ஈடுபடுவோர் தகுதிகள் - களக் குறிப்புகள் - உள இயலும் கள ஆய்வும் -நேர்காணல், வினா நிரல் ஆகியவற்றின் விளக்கம் - நேர்காணலின் வகைகள் - உற்று நோக்கல் உற்றுநோக்குவோரின் அணுகு முறைகள் - எழுத்து, பட ஆதாரம் - புகைப்படம், திரைப்படம், நாடா ஒலிப்பதிவு,ஓவியம், அரும்பொருள்கள் ஆகியவற்றைப் பணன்படுத்தும் முறைகள்.

அலகு – 3 ஆய்வு நெறிமுறைகள்

ஆய்வு நெறிமுறைகளின் வகைகள் -அளவையியல் முறை (டுழபைஉயட ஆநவாழன), அறிவியல் முறை (ளுஉநைவெகைஉ ஆநவாழன),அமைப்பு முறை (ளுலளவநஅள ஆநவாழன), வரலாற்று முறை (ர்ளைவழசஉையட ஆநவாழன),
ஒவ்வொரு குறிப்பிட்ட துறை, பொருளுக்கேற்ப ஆய்வு முறையை அமைத்தல்.

அலகு – 4 ஆய்வேட்டின் உருவாக்கம்

ஆய்வேட்டை உருவாக்கும் பல்வகை நிலைகள், மாதிரி வரைவு – பொறியாளர், அறிஞர்களின் கருத்தறிதல் - கலந்துரையாடல், மாதிரி வரைவு மறுபார்வை செய்தல் - திருத்தல் - செம்மையாக்கல் - ஆய்வேட்டின் அமைப்பு – பகுதிகள் - இயல் பிரிப்பு – சுருக்கக் குறியீடு, அடிக்குறிப்புகள், அட்டவணை, விளக்கப் படங்கள், பின்னிணைப்பு முதலியன – ஆய்வேட்டின் கட்டமைப்பும் புறத் தோற்றமும்.

அலகு – 5 தற்காலத் தமிழாய்வுப் போக்குகள்

உருவவியல் - அமைப்பியல் - குறியியல் - தொல் படிமவியல் - இலக்கிய வகை நிலையியல் -

தத்துவவியல் - நவீனத்துவம் - மார்க்சியம் - பெண்ணியம் - தலித்தியம் முதலான தற்காலத் தமிழாய்வுப் போக்குகள்.

பாட நூல்கள்:

1.ஆய்வியல் அறிமுகம் -டாக்டர்.தமிழண்ணல், டாக்டர்.எம்.எஸ்.இலக்குமணன்.

2.இலக்கிய ஆராய்ச்சி முறைகள் - டாக்டர். முத்துச் சண்முகம், டாக்டர்.சு.வேங்கடராமன்

பார்வை நூல்கள்:

1.ஆய்வுக் கட்டுரை எழுதும் முறை - டாக்டர். முத்துச் சண்முகம், டாக்டர்.சு.வேங்கடராமன்

2.நாட்டார் வழக்காற்றியல் களஆய்வு – தே.லூர்து

3.கள ஆய்வில் சில அனுபவங்கள் - டாக்டர். சரசுவதி வேணுகோபால்

4.ஆய்வு நெறிமுறைகள் - டாக்டர்.ஈ.சு.விசுவநாதன்

5.ஆராய்ச்சி நெறிமுறைகள் - டாக்டர். ச.வே.சுப்பிரமணியம்

6.திறனாய்வுக்கலை – தி.சு.நடராஜன் (என்.சி.பி.எச் வெளியீடு)

7.ஆராய்ச்சி முறைமைகள் - முனைவர்.எச்.சித்திரபுத்திரன்,முனைவர் ஆ.சண்முகம்

8..ஆய்வியல் நெறிமுறைகள் - கு.வெ.பாலசுப்பிரமணியன்

9.நாட்டுப்புறவியல் - களஆய்வு – முனைவர்.இரா.சந்திர சேகரன்

தாள் - 2 தமிழ் இலக்கியவரலாறு

தாள்:2 ஆய்வுசார் வெளியீடுகளுக்கான நெறிமுறைகள்

பாடத்திட்டப் பொதுநோக்கம்

- அகப் புறக் கொள்கைகளின் அடிப்படையில் எட்டுத்தொகை பத்துப்பாட்டின் கருத்தாக்கங்களை ஆராய்ச்சிக்கு உட்படுத்துதல்.
- சங்கம் மருவிய கால இலக்கியங்களின் வழி ஆதிக்கப் பண்பாட்டு மாற்றங்களைக் கட்டமைத்தலும், எடுத்துரைத்தலும்.
- சமண,பௌத்த மதங்களின் வளர்ச்சியும் ,மதங்களால் தமிழுக்கு ஏற்பட்ட வளர்ச்சி நிலைகளை ஆவணப்படுத்தலும், ஆராய்ச்சிக்குட்படுத்தலும்.
- ஐம்பெறும், ஐஞ்சிறுகாப்பியங்களின் வரவால் ஏற்பட்ட சமூகமாற்றங்களையும், பண்பாட்டு வளர் நிலைகளையும் ஆராய்ச்சிக்குட்படுத்தல்.
- தமிழ்ச் சிற்றிலக்கியங்களின் வகைகள், பாடுபொருள்,அதன் இலக்கணம் போன்றவற்றைக் கண்டறிலும், வகைப்படுத்தலும்.
- 15-16 ஆம் நூற்றாண்டில் சிற்றிலக்கியங்களின் வளர்ச்சியால் ஏற்பட்ட பண்பாட்டு மரபுகளையும், மாற்றங்களையும் ஆராய்தல்.

அலகு – 1 சங்க இலக்கியங்கள்
சங்க இலக்கியங்கள் - பத்துப்பாட்டு – எட்டுத்தொகை நூல்கள் - அக, புறக் கொள்கைகள் - சான்றோர் செய்யுள் - தன்னுணர்ச்சிப்பாடல்கள் - குறிக்கோள் சமூகம்.

அலகு – 2 நீதி இலக்கியங்கள்
சங்கம் மருவிய காலம் - களப்பிரர் - பல்லவர் ஆட்சி – சமண நூல்களின் ஆதிக்கம்- பண்பாட்டு மாற்றம், பாடு பொருள் மாற்றம் , வடிவ மாற்றம், வெண்பாவை ஒட்டிப் பதினெண்கீழ்கணக்கு – திருக்குறள் மனித குலத்தை மையப்படுத்திய நீதி இலக்கியம் - விழுமியங்களின் களஞ்சியம் - நீதி இலக்கியங்களில் காலந்தோறும் ஏற்பட்ட மாற்றம்.

அலகு – 3 பக்தி இலக்கியங்கள்
பக்தி இலக்கியத் தோற்றம் - சமண பௌத்த பண்பாட்டுத் தாக்கத்தின் அடிப்படையில் மொழி, வரலாறு, சமய வாழ்வு, மாறுதல் - இசை, நாடகம் பற்றிச் சமணர் பௌத்தர் கோட்பாடுகள் - ஆழ்வார்கள்,நாயன்மார்கள் பக்திக் கோட்பாடுகள்.

அலகு – 4 காப்பியங்கள்
காப்பியம் - இதிகாசம் - புராணம் - இவற்றின் தொன்மையும் தன்மைகளும் - காப்பியம் பற்றிய வடமொழி – தமிழ் மொழி இலக்கணங்கள் - ஐம்பெரும் காப்பியங்கள் - ஐஞ்சிறு காப்பியங்கள் - காப்பியங்கள் -வழிப்பெரும் சமுதாய விழுமியங்கள் - அறம்,பொருள்,இன்பம் வீடு – தமிழ்க் காப்பிய மரபு– சிலம்பும் மேகலையும் - பெரியபுராணம் காப்பியம் என்ற கொள்கை – மேல் நாட்டுக் காப்பியக் கொள்கைகள் - தமிழில் உள்ள பிற காப்பியங்கள்.

அலகு – 5 சிற்றிலக்கியங்கள் மற்றும் முக்கிய இலக்கியங்கள்
தமிழ்ச் சிற்றிலக்கியங்களின் வகைகள் - பாடுபொருள் - யாப்பு – ஒரு சிறு துறை

பிரபந்தமாதல் - பரணி , உலா,பிள்ளைத்தமிழ், அந்தாதி – குறவஞ்சி, பள்ளு, கலம்பகம் ஆகியவற்றின்இலக்கணம் - நாவல், சிறுகதைகளின் வரையறை – கதைக்கரு, கதைக் கோப்பு, பாத்திரங்கள் பற்றியஅறிமுகம்.

பார்வை நூல்கள்

1.சங்க இலக்கதி ஒப்பீடு (இரண்டு பாகங்கள்) – தமிழண்ணல்

2. தமிழ்க்காதல் - வ.சு.ப. மாணிக்கம்

3.திருக்குறள் நீதி இலக்கியம் - டாக்டர்.க.த. திருநாவுக்கரசு

4.பதிணென்கீழ்கணக்குச் சொற்பொழிவுகள் - சைவ சித்தாந்த நூற்பதிப்புக்கழக வெளியீடு

5.காவியகாலம் - எஸ்.வையாபுரிப்பிள்ளை

6.தமிழில் காப்பியக் கொள்கை – டாக்டர் துரை.சீனிச்சாமி

7.தமிழும் தத்துவமும் - டாக்டர்.சோ.ந.கந்தசாமி

8. சிற்றிலக்கியச் சொற்பொழிகள - டாக்டர் ப. அருணாச்சலம்

9.பெரியபுராணம்:ஓர் ஆய்வு – அ.ச ஞானசம்பந்தம்

தாள்:3 ஆய்வுக்களம் சார்ந்த சிறப்புப் பாடம் - சங்க இலக்கியம்

பாடத்திட்டப் பொதுநோக்கம்

- எட்டுத்தொகை, பத்துப்பாட்டு நூல்களின் வழி பழந்தமிழரின் பண்பாடு சார்ந்த வாழ்க்கை முறைகளை ஆசாய்ச்சிக்குட்படுத்துதல்.
- சங்கம் இருந்தது என்பதற்கான சான்றுகள்,முற்சங்க வரலாறு, முச்சங்கங்களால் இயற்றப்பட்ட முத்தமிழ் நூல்கள் பற்றிய ஆராய்ச்சி செய்தல்.
- எட்டுத்தொகை, பத்துப்பாட்டு தொகுப்பு முறைகள், திணைத்,துறை அமைப்பு பற்றிய ஆவணங்களைத் தொகுத்தல்.
- முதல் கரு,உரிப்பொருள் அமைப்பு யாப்புவகைகள், உள்ளுறை, இறைச்சி பொருள் அமைப்பு முறைகளைக்கொண்டு மேலாய்வு செய்தல்.
- சங்ககாலத்து மக்கள் வாழ்வியல் முறைகள், பண்பாடு, தொழில்,வாணிபம், உணவு,உடை ஒழுக்கம் , இல்லறமுறை போன்றவற்றை ஆய்வுக்குட்படுத்தல்.
- சங்க இலக்கியங்களின் மெய்ப்பொருளியல், நிலையாமை உணர்வு, அறக்கோட்பாடுகள், ஒரேபொருள் பல கடவுள்கள் என்ற அமைப்புமுறைகளைக் கண்டறிதல்.

அலகு– 1சங்கமும் சங்க நூல்களும்

சங்கம் - சொற்பொருள், துணையான சொற்கள் - சங்கம் இருந்தது என்பதற்குச் சான்றுகள் - கடல் கோள் - முற்சங்கம். முதல், இடை, கடைச் சங்கங்களின் காலவரையறை – சங்கம் பற்றிய பழமை உரையாசிரியர்களின் கருத்து, இக்காலத்து ஆய்வாளர்களின் கருத்துக்கள் - சங்கம் பற்றிய புராணக் கதைகள் செவிவழிச் செய்திகள் - பிற்காலத்துச் சமண சங்கம் - சமண சங்கத்துச் செய்திகளைப் பழந்தமிழ்ச் சங்கத்திற்கு ஏற்றிச் சொல்லுதல் - மூன்று சங்கங்களிலும் தோன்றிய இயல், இசை, நாடகத் தமிழ் நூல்களைப் பற்றிய பொதுக்குறிப்பு.

அலகு– 2 கடைச்சங்க நூல்களின் யாப்பு மரபும் பொருள் மரபும்

எட்டுத்தொகை – பத்துப்பாட்டு – தொகுப்புமுறை – புறப்பாடல்கள் - திணை, துறை அமைப்பு – அகப்பாடல்கள் - முதல், கரு, உரிப்பொருள் அமைப்பு – யாப்பு வகைகள் 0 அறநெறிக் கோட்பாடுகள் - குறிப்புப் பொருள் - உள்ளறை, இறைச்சி.

அலகு– 3 சங்க காலத்து மக்கள் வாழ்வியல்

நிலப்பாகுபாடு –மக்கட் பாகுபாடு, நிலவழிப் பகுப்பு, தொழில் வழிப் பகுப்பு, தகுதி வழிப் பகுப்பு, மேலோர், கீழோர் - வருணப் பகுப்பு - இல்வாழ்க்கை குடும்பம், குழு உறுப்பினர். துலைவன், தலைவி, ஏவலர் - இல்லறத்தார் கடமை –களவு, கற்பு ஒழுக்கங்கள், திருமணம் - பின்முறை வதுவையர், காமக்கிழத்தி, பரத்தை போன்றோரின் நிலைகள் - கைத்தொழில், உழவு– உணவு, உடை, அணிகலன் - கல்வி, கலை, இசை, நாகம்,ஓவியம், சிற்பம், கட்டடங்கள், குடியிருப்பு, வீடு, அரண்மனை, கோவில்கள் - பொழுது போக்குகள், பயணங்கள் - சமூக வாழ்வு– அறநெறிக் கொள்கைகள், தனிமனித அறம், சமூக அறம்,ஈகை, ஒப்புரவு – நம்பிக்கைகள்.

அலகு– 4 சங்க காலத்து அரசியல்

முடியாட்சி – தந்தை வழி மகன் அரசுரிமை - இளவரசன் - குறுநில மன்னர்கள், அரசாங்கம், அரசவை, அரசியலாயம், ஐம்பெருங்குO> எண்பேராயம், புலவர், கலைஞர் - அமைச்சு, நாடு, நாட்டுப் பிரிவுகள், பெருநகரம், நகரமைப்பு, சிற்றூர்கள், ஊரமைப்பு, ஆட்சியமைப்பு – நாட்டாச்சி, நகராட்சி, சிற்றூராட்சிகளின் தொடர்பு – ஆட்சிக் குழுக்கள் தேர்தல்கள் - நிதி, பொருளாதாரம், வரிப்பொருள், சுங்கம், பிறபொருள்கள், நாணயம், நிதி, அறங்கூறவையம் - வணிகம் - தரைவழி, கடல்வழி வாணிகங்கள் - நெடுஞ்சாலை சாலைப்

பாதுகாப்பு, வேளாண்மை – பாசன வசதிகள் - படை, நால்வகைப்படை, படைத் தலைவன், போர் வீரன், போர் அறம், போர் முறைகள் - அரண், மதில், அகழி, காடு, வெளிநாட்டுத் தொடர்பு, வல்லாண்மை, புலவர், புரவலர் தொடர்புக்கல்வி – சுகாதாரம்.

அலகு– 5 சங்க காலத்து மெய்ப்பொருளியல்

தத்துவ ஆராய்ச்சி – மண்முதல் மூலப்பகுதி ஈறாக உள்ள பொருள்கள், நிலையாமை உணர்வு, அறக்கோட்பாடுகள், கடவுள் கொள்கைகள், ஒரே பொருள் பல கடவுளர்கள் - உயிர்கொள்கை, உயிர் வகைகள், பல பிறப்புக் கோட்பாடுகள் - இம்மை, மறுமை, எழுமை – fd;kf; NfhI;ghLfs; - Co;tpid – சமயச் சடங்குகள், பிறப்பு, இறப்ப, திருமணம், தெய்வ வழிபாடு, திருக்கோவில்கள், தெய்வத்திரு உருவங்கள்,சிறுதெய்வ வழிபாடுகள் - திருவிழாக்கள் - துறவுக் கொள்கை – அறவோர், அறிவர், துறவி, தாபதர் ஒழுக்க நெறிகள்- சங்க காலத்திலும் சங்கம் சார்ந்த காலத்திலும் சமண – பௌத்த, வைதீக மெய்பபொருளியல் கொள்கையின் வளர்ச்சி.

பார்வை நூல்கள்

1. தொல்காப்பியர் - டாக்டர் பா. அருணாச்சலம்
2. தொல்காப்பியப் பொருளதிகார ஆராய்ச்சி – மு. இராகவையங்கார்
3. தொல்காப்பியரின் இலக்கியக் கொள்கைகள் : நோக்கு, இறைச்சி, மெய்ப்பாடு, உள்ளுறை – டாக்டர் தமிழண்ணல்
4. சங்க இலக்கிய ஒப்பீடு பாகம் :1 – டாக்டர் தமிழண்ணல்
5. சங்க இலக்கிய ஒப்பீடு பாகம் :2 – டாக்டர் தமிழண்ணல்
6. நெடுநெல்வாடை : திறனாய்ந்து தெளிதல் - கு. கோதண்டபாணிப்பிள்ளை
7. பண்டைத் தமிழர் வாழ்வும் வழிபாடும் - கைலாசபதி
8. அகப்பொருட் பாடல்களில் தோழி – டாக்டர் நா. செயராமன்
9. அகப்பொருட் பாடல்களில் தலைவி – டாக்டர் கோ. பாசுகரதாஸ்
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15. பத்துப்பாட்டு ஆராய்ச்சி– மா. இராசமாணிக்கனார்
16. தமிழ் நூல்களில் குறிப்புப் பொருள் - முனைவர் மா.ரா.போ. குருசாமி.

குறிப்பு : பாடத்திட்டம் ஐந்து அலகுகளாகத் தரப்பட்டுள்ளது. ஒவ்வொரு அலகிலிருந்தும் இரண்டு வினாக்கள் அளிக்கப்பட்டு ஏதேனும் ஒன்றிற்கு விடை எழுதக் கோரும் வகையில் வினாத்தாள் அமையும். ஆக ஐந்து அலகுகளிலிருந்தும் ஐந்து வினாக்களுக்கு விடைகள் எழுதப்படவேண்டும்.மொத்தமதிப்பெண்கள்-100.

தாள்:3 ஆய்வுக்களம் சார்ந்த சிறப்புப் பாடம் – அற இலக்கியம்

பாடத்திட்டப் பொதுநோக்கம்

- சங்கம் மருவியகதல நூற்களான பதினெண் மேற்கணக்கு நூற்கள் தமிழ்ச் சமூகத்திற்கு அளித்த அறச்சிந்தனைகளைப், பட்டியலிடுதல், ஆராய்ச்சிக்குட்படுத்துதல்.
- திருக்குறள் –நாலடியார் உட்பட்ட அறஇலக்கியங்களின் பாடுபொருள்களின் பகுப்முறைகள், மக்கள் வாழ்வில் அவ்விலக்கியங்களினால் ஏற்பட்ட மாற்றங்களைக் கண்டறிதல்.
- அறஇலக்கியங்கள் தோன்றிய காலச்சூழல், சமண பௌத்தர்களின் வருகை,களப்பிரர் ஆட்சி, ஒழுக்க நெறிகளுக்கு முக்கியத்துவம் தந்த சூழல்.
- திருக்குறள்,நாலடியார் பொன்ற அறஇலக்கியங்களின் தனித்தன்மைகள், பாடுபொருள் பகுப்புமுறைகள் , காலம் ஆகியவற்றைக் கண்டறிதல்.
- சிறுபஞ்சமூலம், ஏலாதி, திரிகடும், ஆசாரக்கோவை போன்ற அற இலக்கியங்களின் அமைப்புமுறை,இவ்விலக்கியங்களால் ஏற்பட்ட மாற்றங்களை ஆய்வு செய்தல்.
- பிற்கால அறஇலக்கியங்களான ஆத்திச்சூடி,நல்வழி, மூதுரை,கொன்றைவேந்தன், நீதிநெறிவிளக்கம் ஆகிய நூல்களின் அமைப்புமுறைகளைக் கண்டறிதல்.

அலகு - 1

அறம் (நீதி) - விளக்கம் : பொது அறம், சமயச்சார்பு அறம்- விளக்கம் - நீதி இலக்கியங்கள் ∴ அற நூல்கள் மற்றும் சமயச் சார்பு அற இலக்கியங்கள்- விளக்கம் - அற இலக்கியங்களுக்கும் ஏனைய இலக்கியங்களுக்கும் உள்ள பொதுவியல்புகளும்- சிறப்பியல்புகளும் அற நூல்களின் வடிவம் (யாப்பு)

அலகு - 2

அற இலக்கியங்கள் தோன்றிய காலச்சூழல் - சமண பௌத்தர்களின்வருகை - களப்பிரர் ஆட்சி - அற இலக்கியங்களின் தோற்றம் - அற இலக்கியங்களின் முக்கியத்துவம் -அற இலக்கியக் கோட்பாடுகள் - வாழ்வியல் / ஒழுக்க நெறிகளுக்கு முக்கியத்துவம் தந்தவை.

அலகு - 3

திருக்குறள் - நாலடியார் தனித்தன்மைகள் பாடுபொருள்களிலும் பகுப்புமுறையிலும் சங்க இலக்கியத்தினின்றும் வேறுபட்டுள்ள திறம் - வேறுபாட்டிற்கான காரணங்கள் -திருக்குறளின் நோக்கம் - வாழ்வியல் நெறிமுறைகள்.

அலகு - 4

சிறுபஞ்சமூலம் - ஏலாதி - முதுமொழிக்காஞ்சி - நான்மணிக்கடிகை - திரிகடுகம் - ஆசாரக்கோவை- இன்னா நாற்பது - இனியவை நாற்பது - பழமொழி - இவற்றின் அமைப்புமுறை - அறம் புகட்டும் உத்திகள் - சமயக் கோட்பாடுகள் - வாழ்வியல் நெறிமுறைகள் -இவ்விலக்கியங்களின் தனித்தன்மைகள் - பா வடிவம் ஒற்றுமை - வேற்றுமைகள்.

அலகு - 5

பிற்கால அற இலக்கியங்கள் - ஔவையாரின் ஆத்திசூடி நல்வழி - மூதுரை - கொன்றை வேந்தன் - நீதி நெறி விளக்கம் அமைப்பு முறை - அறம் புகட்டும் உத்திகள் - காலத்தின் வெளிப்பாடு சங்க மருவிய அற இலக்கியங்களுக்கும் இக்கால அற இலக்கியங்களுக்குமுள்ள ஒற்றுமை -வேற்றுமை - பாரதியின் ஆத்திசூடி முதல் டாக்டர் சொ. பரமசிவத்தின் அறநூல் வரையிலான இருபதாம்நூற்றாண்டு அற நூல்களின் அமைப்பு முறை - உத்திகள் - வெளிப்பாட்டுத்திறன் - தனித்தன்மைகள்.

ஒவ்வொரு அலகிலிருந்தும் பொதுவான வினாக்களே அமைதல் வேண்டும்.

பார்வை நூல்கள் :

1) திருக்குறள் : பதின்மர் உரை தொடங்கி, தற்கால உரை மற்றும் திறனாய்வு விளக்க நூல்கள் அனைத்தும்.
2) "நாலடியார் : உரைவளம்" பாகம் 1 ரூ 2 - தஞ்சை சரசுவதிமகால் நூல்நிலைய வெளியீடு, தஞ்சை.
3) ஏனைய பதினெண்கீழ்க்கணக்கு அறநூல்களும், அவற்றின் உரை மற்றும் திறனாய்வு விளக்க நூல்களும்.
4) பதினென்கீழ்க்கணக்குச் சொற்பொழிவுகள், கழக வெளியிடு, சென்னை.
5) நீதி நெறி விளக்கம் - குமரகுருபரர்
6) நீதி நூல் - முனிசீப் வேதநாயகம் பிள்ளை, கழகம், சென்னை.
7) விவேக சிந்தாமணி, கழக வெளியீடு, சென்னை.
8) நீதிக் களஞ்சியம், நியூ செஞ்சுரி புத்தக நிலையம்
9) அறநூல் - டாக்டர். சொ. பரமசிவம், பட்டுப்பதிப்பகம், 1269, 32 ஆவது தெரு, 'ஐ' பிரிவு, அண்ணாநகர், சென்னை - 40.
10) தமிழின் பழமொழி இலக்கியம் - எஸ். சவுந்திரபாண்டியன், ஸ்டார் பிரசுரம், சென்னை.
11) பாரதியார் ஆத்திசூடி : உரையுடன் - பூம்புகார் பதிப்பகம், சென்னை.
12) திரு. வி. க. வின் திருக்குறள் பாயிரம் - பூம்புகார் பதிப்பகம், சென்னை.
13) திரு. வி. க. வின் திருக்குறள் பாயிரம் : 2 - பூம்புகார் பதிப்பகம், சென்னை.
14) நீதி நூல்கள் - முல்லை முத்தையா : பாகம் 1 - பூம்புகார் பதிப்பகம், சென்னை.
15) ஔவை அமுதம் (ஆத்திசூடி விளக்க உரை) - பூம்புகார் பதிப்பகம், சென்னை.
16) வெற்றிவேற்கை - அதிவீரராமபாண்டியன்
17) ஆத்திசூடி - பாரதிதாசன்.

தாள்:3 ஆய்வுக்களம் சார்ந்த சிறப்புப் பாடம் –பக்தி இலக்கியம்

பாடத்திட்டப் பொதுநோக்கம்

- பக்திக் காலத்திற்கு முன்பிருந்த தமிழக நிலை. பன்னிரு ஆழ்வார்களின் பக்தி நெறி,
- வைணவத் தத்துவங்கள்,பிற்கால சைவ – வைணவ சமய வளர்ச்சியை ஆய்வுக்படுத்துதல்.
- இயற்கைவழிபாடு, ஆவிவழிபாடு, இறைநம்பிக்கை,அறுவகைச் சமயங்கள் பற்றிய ஆய்விற்கு உட்படுத்தல்.
- நாலாயிரத்திவ்ய பிரபந்தம், பன்னிரு ஆழ்வார்களின் பக்திநெறி, வைணவத்தத்துவங்கள் போன்றவற்றை மேலாய்வுக்களங்களில் உட்படுத்துதல்.
- கிறித்துவ, இசுலாமிய இலக்கியங்கள் போன்றவற்றின் சமயக்கோட்பாடுகளின் சிறப்புக்கள்.
- பிற்கால சைவ வைணவ இலக்கியங்களின் வளர்ச்சி,கோயில் அமைப்பு, வழிபாட்டு முறைகளைக் கண்டறிதல்.

அலகு : 1
பக்தி விளக்கம் - அச்சம், நம்பிக்கையால் பக்தி பிறந்த முறை - பக்தியின் பிரிவுகள் -இயற்கை வழிபாடு - ஆவி வழிபாடு - நடுகல் வழிபாடு - இறை நம்பிக்கை - இறைவழிபாடு - அறிவாராய்ச்சியில் எழுந்த கடவுள் நம்பிக்கை - அன்பு நெறியில் எழுந்த வழிபாட்டுநிலை - அறுவகைச் சமயங்கள்.

அலகு : 2
பக்திக் காலத்திற்கு முன்பிருந்த தமிழக நிலை - பக்தி இயக்கம் தோற்றமும்வளர்ச்சியும் - பன்னிரு திருமுறைகள் - சைவத் தத்துவம் - சமயக் குரவர்களின் பக்தித் திறன் -பன்னிரு திருமுறைகள் காட்டும் சமுதாயம் - பண்பாடு - சிவனின் அருளிச்செயல்கள் - புராணக் கதைகள்.

அலகு : 3
நாலாயிர திவ்யப் பிரபந்தம் - பன்னிரு ஆழ்வார்கள் ஆழ்வார்களின் பக்தி நெறி - வைணவத்தத்துவங்கள் - நாயக, நாயகி பாவம் - சரணாகதித் தத்துவம் - பரபத்தி, பரமஞானம், பிற பக்தித்திறன்கள் - திருமாலின் அருளிச் செயல்கள், புராணக் கூறுகள்.

அலகு : 4
கிறித்துவ இலக்கியங்கள் - இசுலாமிய இலக்கியங்கள் - கிறித்துவ சமயக் கோட்பாடுகள் -இசுலாமிய சமயக் கோட்பாடுகள் - பிற்கால சைவ - வைணவ சமய வளர்ச்சி.

அலகு : 5
இந்துத் திருக்கோயில் அமைப்பு - வழிபாட்டு நெறிமுறைகள் - கோயில் கலைகள் -ஏனைய ஆலய அமைப்பும் - வழிபாட்டு நெறிமுறைகளும், கலைகளும்.

பார்வை நூல்கள் :
1) பக்தி இலக்கியம் - ப. அருணாச்சலம்,பாரி புத்தக நிலையம், 1970, சென்னை.
2) மதமும் பண்பாடும் - எஸ். இராதாகிருஷ்ணன் (மொழிபெயர்ப்பாளர் - வி. எஸ். வி. ராகவன்), வள்ளுவர் பண்னை, 1977, சென்னை.
3) பெரிய புராணம் : ஓர் ஆய்வு - அ. ச. ஞானசம்பந்தம், தமிழ்ப் பல்கலைக்கழகத் தத்துவ மையம், 1987, காஞ்சிபுரம்.
4) பக்தி இலக்கிய உருவாக்கம் - வ. ஜெயா, முத்துப் பதிப்பகம், 1994, விழுப்புரம்
5) சைவ இலக்கியச் சேவை - மு. சாய்பு மரைக்காயர், வானதி பதிப்பகம், 1986, சென்னை

6) இந்திய சமுதாய வரலாறு - ந. க. மங்கல முருகேசன், தமிழ்நாட்டுப் பாட நூல் நிறுவனம், 1975, சென்னை.
7) தமிழர் சமய வரலாறு - அ. வேலுப்பிள்ளை, பாரி புத்தகப் பண்னை, 1985, சென்னை
8) தமிழும் தத்துவமும் - சோ. ந. கந்தசாமி, மணிவாசகர் பதிப்பகம், 1980, சிதம்பரம்.
9) தம்பிரான் தோழர் - ந. சுப்புரெட்டியார், பாரி நிலையம், 1985, சென்னை
10) வைணவ உரைவளம் - ந. சுப்புரெட்டியார், பாரி நிலையம், 1985, சென்னை
11) வைணவச் செல்வம் - ந. சுப்புரெட்டியார், தமிழ்ப் பல்கலைக்கழகம், 1995, தஞ்சாவூர்.
12) ஆழ்வார்களின் ஆரா அமுது - ந. சுப்புரெட்டியார், ஐந்திணைப் பதிப்பகம், 1987, சென்னை.
13) விட்டுசித்தன் விரித்த அமுது - ந. சுப்புரெட்டியார், ஐந்திணைப் பதிப்பகம், 1987, சென்னை.
14) தமிழர் சமுதாய வரலாறு - க. ப. அறவாணன், மொழிக்கோட்டம், 1992, பாண்டிச்சேரி.
15) நாலாயிர திவ்ய பிரபந்தம் - மதி. ஸ்ரீநிவாசன், ஆழ்வார்கள் அமுத நிலையம், 1987, சென்னை.
16) சைவ சமய வளர்ச்சி வரலாறு - மா. இராச மாணிக்கனார்
17) கிறித்துவமும் தமிழும் - மயிலை சீனி. வேங்கடசாமி
18) இசுலாம் வளர்த்த தமிழ் - மு. மு. உவைசு, உலகத்தமிழாராய்ச்சி நிறுவனம், சென்னை.
19) தமிழகக் கோயிற்கலைகள் - இரா. நாகசாமி, ம. சத்திய மூர்த்தி தமிழ்நாடு அரசு தொல்பொருள் ஆய்வுத்துறை, 1976, சென்னை.
20) தமிழர் வளர்த்த அழகுக் கலைகள் - மயிலை சீனி. வேங்கடசாமி.

குறிப்பு : பாடத்திட்டம் ஐந்து அலகுகளாகத் தரப்பட்டுள்ளது. ஒவ்வொரு அலகிலிருந்தும் இரண்டு வினாக்கள் அளிக்கப்பட்டு ஏதேனும் ஒன்றிற்கு விடை எழுதக் கோரும் வகையில் வினாத்தாள் அமையும். ஆக ஐந்து அலகுகளிலிருந்தும் ஐந்து வினாக்களுக்கு விடைகள் எழுதப்பட வேண்டும். மொத்த மதிப்பெண்கள் - 100.

தாள்:3 ஆய்வுக்களம் சார்ந்த சிறப்புப் பாடம் –இக்கால இலக்கியம்

பாடத்திட்டப் பொதுநோக்கம்

- உரைநடை தோற்றத்திற்கான சூழல், புதுக்கவிதையின் வளர்ச்சி,
- தமிழில் நாடக ,சிறுகதை, நாவல் இலக்கியங்களின் வளர்நிலை போன்றவற்றை ஆய்வுக்குட்படுத்துதல்.
- திரு.வி.க,மறைமலை அடிகள், உ.வேஇசா, சி.என் அண்ணாதுரை போன்றோர் உரைநடைக்கு அளித்த பங்கு.
- புதுக்கவிதை தோற்றம் வளர்ச்சி, விடுதலைகுப்பின் மரபுக்கவிதையின் போக்கு, இருபதுகளில் தமிழ்க்கவிதையின் நிலைபற்றி ஆராய்தல்.
- தமிழ் நாடக இலக்கியங்களின் தனித்தன்மைகள்,நாடகமறுமலர்ச்சி, நாடகத்தில் கதைக்கரு,நாடகத்தில் பாத்திர அமைப்பு.
- சிறுகதை தோற்றம் வளர்ச்சி,சிறுகதையின் அமைப்புமுறைகள், மணிக்கொடியின் காலம். கல்கிமுதல் செயகாந்தன் வரையிலான படைப்புக்களை ஆய்வு செய்தல்.

அலகு : 1 - தமிழில் உரைநடை இலக்கியம் :
உரைநடையின் தோற்றத்திற்கான சூழல் - உரைநடையின் தோற்றமும் வளர்ச்சியும் -உரைநடையின் வகைகள் - தமிழில் மொழிபெயர்ப்பு, பயண இலக்கியம், அறிவியல்கட்டுரைகள் ஆகியவற்றில் உரைநடையின் பங்கு - உரைநடைக்கு திரு.வி.க., மறைமலை அடிகளார்,உ.வே.சா., சி. என். அண்ணாதுரை, மு.வ. ஆகியோரின் பணிகள் - பாரதிக்குப்பின் தமிழ்உரைநடை - குறிப்பாகக் கல்கி, வ.சுப. மாணிக்கனார் ஆகியோர்தம் பங்களிப்புப் பற்றிய செய்திகள்.

அலகு : 2 - தமிழில் கவிதை இலக்கியம் :
கவிதையின் விளக்கம் - கூறுகள் - கவிதை வரலாற்றில் பாரதி, பாரதிதாசன்பெறுமிடம் - விடுதலைக்குப்பின் மரபுக் கவிதையின் நோக்கும் போக்கும் - புதுக்கவிதையின்தோற்றமும் வளர்ச்சியும் - இருபதுகளில் தமிழ்க் கவிதை - எழுத்து, கசடதபற, வானம்பாடிக் காலம்- தற்கால புதுக்கவிதை வளர்ச்சி- நாமக்கல் கவிஞர், கவிமணி, பாவேந்தர், கண்ணதாசன், ந.பிச்சமூர்த்தி, மு. மேத்தா, நா. காமராசன், அப்துல் ரகுமான், சிற்பி ஆகியோர் தம் கவிதைகள்தமிழில் ஏற்படுத்திய மாற்றம் - வசன கவிதை பற்றிய செய்திகள்.

அலகு : 3 - தமிழில் நாடக இலக்கியம் :
நாடகத்தோற்றம் - நாடகக்கூறுகள் - தமிழ் நாடக வரலாற்றில் பரிதிமாற் கலைஞர், பம்மல்சம்பந்த முதலியார் - செய்யுள் நாடகங்கள் - நாடக மறுமலர்ச்சிக் காலம் - சுதந்திரப் போராட்டக்காலத்தில் தமிழ் நாடகங்கள், சமூக நாடகங்கள் மற்றும் வரலாற்று நாடகங்கள் பற்றிய பார்வைகள் -நாடகக் கதைத்திட்டம் - நாடகத்தில் பாத்திரம், உரையாடல், தனிமொழி, பின்புலம் பற்றிய செய்திகள்- நாடக அமைப்பு, தொடக்கம், வளர்ச்சி, உச்சநிலை, வீழ்ச்சி பற்றிய கருத்துக்கள் - இணைக்கதை,எதிர்க்கதை, நாடகக்கதை, நாடக முரண் பற்றிய செய்திகள் - தமிழ் நாடகங்களில் மேலைநாட்டு நாடகங்களின் தாக்கம் - ஓரங்க நாடகம் - வானொலி நாடகம் பற்றிய கருத்துக்கள்.

அலகு : 4 - தமிழில் சிறுகதை இலக்கியம் :
சிறுகதையின் விளக்கம் - சிறுகதையின் இலக்கணம் - அமைப்பு - சிறுகதையின்தோற்றமும் வளர்ச்சியும் - சிறுகதை வரலாற்றில் வ. வே. சு. ஐயர் மற்றும் பாரதி பெறுமிடம் -தமிழ்ச் சிறுகதைகளில் மணிக்கொடியின் காலம் - கல்கி, புதுமைப்பித்தன், கு. ப.ரா., விந்தன், ஜெயகாந்தன் ஆகியோர் சிறுகதைகள் பற்றிய மதிப்பீடு - தமிழ்ச் சிறுகதையின்உருவம், உள்ளடக்கம், பாடு பொருள், உத்தி - இருபதாம் நூற்றாண்டின் சிறுகதைப் போக்குகள் -இன்றைய சிறுகதைகள்.

அலகு : 5 - தமிழில் புதின இலக்கியம்

புதின இலக்கியத்தின் தோற்றமும் வளர்ச்சியும் - தமிழில் முன்னோடி நாவல்கள் -நாவலின் வகைகளும் கூறுகளும் - நாவலின் கதைத்திட்டம், பாத்திரம், உரையாடல்ஆகியவை பெறுமிடம் - விடுதலைக்கு முன்னும் பின்னும் எழுந்த தமிழ் நாவல்கள்.

பார்வை நூல்கள் :

1) தமிழ் இலக்கிய வரலாறு - டாக்டர். மு. வரதராசன்
2) தமிழ் இலக்கிய வரலாறு - டாக்டர். சி. பாலசுப்பிரமணியம்
3) பாரதிக்குப்பின் தமிழ் உரைநடை - வல்லிக்கண்ணன்
4) புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு - தமிழண்ணல்
5) திறனாய்வும் தமிழ் இலக்கியக் கொள்கைகளும் - டாக்டர். ந. பிச்சமுத்து
6) புதுக் கவிதையின் தோற்றமும் வளர்ச்சியும் - வல்லிக்கண்ணன்
7) இருபதாம் நூற்றாண்டுத் தமிழ் இலக்கியம் - மா. இராமலிங்கம் (என்ற) எழில் முதல்வன்
8) தமிழ் நாடகத்தின் தோற்றமும் வளர்ச்சியும் - சக்தி பெருமாள்
9) சிறுகதையின் தோற்றமும் வளர்ச்சியும் - கா. சிவத்தம்பி
10) உரைநடையின் தோற்றமும் வளர்ச்சியும் - அ. மு. பரம சிவானந்தம்.
11) தமிழ் நாடக வரலாறு - ஏ. என். பெருமாள்
12) தமிழ் நாவல் இலக்கியம் - க. கைலாசபதி

குறிப்பு : பாடத்திட்டம் ஐந்து அலகுகளாகத் தரப்பட்டுள்ளது. ஒவ்வொரு அலகிலிருந்தும் இரண்டு வினாக்கள் அளிக்கப்பட்டு ஏதேனும் ஒன்றிற்கு விடை எழுதக் கோரும் வகையில் வினாத்தாள் அமையும். ஆக ஐந்து அலகுகளிலிருந்தும் ஐந்து வினாக்களுக்கு விடைகள் எழுதப்பட வேண்டும். மொத்த மதிப்பெண்கள் - 100.

தாள்:3 ஆய்வுக்களம் சார்ந்த சிறப்புப் பாடம் – நாட்டுப்புறவியல்

பாடத்திட்டப் பொதுநோக்கம்

- தமிழ் நாட்டுப்புறவியல் வரலாறு,நாட்டடப்புற வழக்காறுகளைச் சேகரித்தல், நாட்டுப்பறக் கள ஆய்வில் அறிவியல் அணுகுமுறைகளை உட்படுத்தி ஆய்வை மேற்கொள்ளுதல்.
- தமிழ் நாட்டுப்புற வழக்காறுகளைச் சேகரித்தலும்,பட்டியலிடுதலும்.
- நாட்டுப்புறவியல் களஆய்வில் மேற்கொள்ளும் அணுகுமுறைகள்.
- வரலாற்று நிலவியல்கோட்பாடு, வரலாற்று மீட்டுருவாக்கக் கோட்பாடு,செயல்திறன் கோட்பாடுகளின் அடிப்படையில் ஆய்வை மேற்கொள்ளுதல்.
- நாட்டுப்புற இலக்கியவகைகளான தாலாட்டு, காதல்பாடல்கள்,,விளையாட்டுப் பாடல்கள் போன்றவற்றை ஆவணம் செய்தல்.
- நாட்டுப்புறக் கலைகளான தெருக்கூத்து, பொம்மலாட்டம், கரகம், சிறுதெய்வ வழிபாடு விழாக்கள் ஆகியவற்றை ஆராய்ச்சிக்குட்படுத்துதல்.

அலகு : 1 - நாட்டுப்புறவியலின் விளக்கம் :
நாட்டுப்புறவியலின் விளக்கம் - பல்வேறு அறிஞர்களின் கருத்துக்கள் - நாட்டுப்புறவியல்மற்றும் வழக்காறுகளை வரையறுப்பதில் சிக்கல்கள் - சூழல், பாடம், இழைவு அடிப்படையில்(Text, Context, Texture) வழக்காறுகள் நிர்ணயம் செய்வதின் தேவை - தமிழ் நாட்டுப்புறவியல் வரலாறு- இந்தியாவில் குறிப்பாகத் தென்னிந்தியாவில் நாட்டுப்புறவியல் வளர்ச்சி.

அலகு : 2 - கள ஆய்வும் வழக்காறுகளும் :
தமிழ் நாட்டில் நாட்டுப்புற வழக்காற்றுச் சேகரிப்பும் மதிப்பீடும் - நாட்டுப்புறவியல் கள ஆய்வில்அறிவியல் அணுகுமுறையின் இன்றியமையாமை - அறிவியல் அணுகுமுறையில் சில படிநிலைகள் - ஆய்வுச் சிக்கலைத் தீர்மானித்தல் - பொதுவான கள ஆய்வின்பயனின்மை - கருதுகோளை உருவாக்குதல் - ஆய்வுச் சிக்கலைப் பகுத்தாய்தல் -சேகரித்தலும் சேகரிப்பு முறையும் - கள ஆய்வாளன் தகுதிகள்.

அலகு : 3 - கோட்பாடுகள் :
1) வரலாற்று நிலவியல் கோட்பாடு (Historical Geographical Theory)
2) வரலாற்று மீட்டுருவாக்கக் கோட்பாடு (Historical Reconstruction Theory)
3) செயல்திறன் கோட்பாடு (Functional Theory)
4) உளவியல் ஆய்வுக் கோட்பாடு (Psycho – Analytical Theory)
5) சூழ்நிலைக் கோட்பாடு (Contextual Theory)
6) அமைப்பியல் கோட்பாடு (Structural Theory)

அலகு : 4 - நாட்டுப்புற இலக்கியங்கள் :
நாட்டுப்புற இலக்கிய வகைகள் - நாட்டுப்புறப் பாடல்கள் - தாலாட்டு - காதல் பாடல்கள் -விளையாட்டுப் பாடல்கள் - ஒப்பாரிப் பாடல்கள் - கதைப் பாடல்கள் - கதைகள் - விடுகதைகள் -பழமொழிகள் முதலியன.

அலகு : 5 - நாட்டுப்புறக் கலைகள் :
நாட்டுப்புறக் கலைகள் - தெருக்கூத்து, பொம்மலாட்டம், கரகம், காவடி போன்றன - சிறு தெய்வவழிபாடும் விழாக்களும் - விளையாட்டுக்கள் - கைவினைப் பொருட்கள்

பார்வை நூல்கள் :
1) நாட்டுப்புறப்பாடல்கள் சமூக ஒப்பாய்வு - வி. சரசுவதி, பதிப்புத்துறை, மதுரை காமராசர் பல்கலைக்கழகம், 1982, மதுரை.
2) கள ஆய்வில் சில அனுபவங்கள் - வி. சரசுவதி, மு. இராமசாமி, வெற்றிவேல் பிரசுரம்,

1976, மதுரை.
3) நாட்டார் வழக்காற்றியல் கள ஆய்வு - தே. லூர்து, பாரிவேல் பதிப்கம், 1986, பெருமாள்புரம், திருநெல்வேலி.
4) நாட்டுப்புறவியல் ஆய்வு - சு. சக்திவேல், மணிவாசகர் பதிப்பகம், 1983, சிதம்பரம்.
5) நாட்டுப்புற இலக்கிய வரலாறு - சு. சண்முகசுந்தரம், மணிவாசகர் பதிப்பகம், 1980, சிதம்பரம்.
6) நாட்டுப்புற இயல் ஆய்வுகள் - ஆறு. இராமநாதன், 1978, சென்னை.
7) தமிழர் நாட்டுப்பாடல்கள் - நா. வானமாமலை, நியூ செஞ்சுரி புக் ஹவுஸ், 1977, சென்னை.
8) நாட்டார் வழக்காற்றியல் : சில அடிப்படைகள் - தே. லூர்து, நாட்டார் வழக்காற்றியல் ஆய்வு மையம், 1977, பாளையங்கோட்டை.
9) நாட்டுப்புறக் கலைகள் - ஆறு. இராமநாதன், மணிவாசகர் நூலகம், சென்னை.
10) கள ஆய்வு, பாரதியார் பல்கலைக்கழகம்,கோவை.

குறிப்பு : பாடத்திட்டம் ஐந்து அலகுகளாகத் தரப்பட்டுள்ளது. ஒவ்வொரு அலகிலிருந்தும் இரண்டு வினாக்கள் அளிக்கப்பட்டு ஏதேனும் ஒன்றிற்கு விடை எழுதக் கோரும் வகையில் வினாத்தாள் அமையும். ஆக ஐந்து அலகுகளிலிருந்தும் ஐந்து வினாக்களுக்கு விடைகள் எழுதப்பட வேண்டும். மொத்த மதிப்பெண்கள் - 100.

FACULTY OF ENGINEERING

Ph.D CIVIL ENGINEERING
CURRICULUM & SYLLABI
2019 -2020

Department of Civil Engineering
Faculty of Engineering

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act 1956)

COIMBATORE 641 021. INDIA.

DEPARTMENT OF CIVIL ENGINEERING
FACULTY OF ENGINEERING
RESEARCH PROGRAM – M.Phil / Ph.D in Civil Engineering
2019-2020 Batch and onwards

Subject Code	Paper I	Instruction Hours / week	Credits	Maximum Marks (100)
19RCE101	Paper- I: Research Methodology and Pedagogy	4	4	100
19RCE201	Paper- II: Advance Structural Engineering	4	4	100
19RCE202	Paper- II: Advanced Environmental Engineering			
19RCE203	Paper- II: Slope Stability And Land Slides			
19RCE204	Paper- II: Structural Dynamics and Earthquake Engineering			
19RCE205	Paper- II: Theoretical Soil Mechanics			
19RCE206	Paper- II: Soil Dynamics And Machine Foundations			
19RCE207	Paper- II: Soil Structure Interaction			
19RCE208	Paper- II: Rock Mechanics In Engineering Practice			
19RCE209	Paper- II: Reinforced Soil Structures			
19RCE210	Paper- II: Earthquake Analysis And Design of Structures			
19RCE211	Paper- II: Experimental Stress Analysis			
19RCE212	Paper- II: Rehabilitation & Modernization of Irrigation Structures			
19RCE301	Paper- III: Advanced Concrete Technology	4	4	100
19RCE302	Paper- III: Prefabricated Structures			
19RCE303	Paper- III: High Performance Concrete			
19RCE304	Paper- III: Ground Improvement Techniques			
19RCE305	Paper- III: Geopolymer Cement and Concrete			
19RCE306	Paper- III: Pavement Engineering			
19RCE307	Paper- III: Solid and Hazardous Waste Management			
19RCE308	Paper- III: Remote Sensing and GIS applications in Environmental Engineering			
19RCE309	Paper- III: Groundwater modeling and Management			
19RCE310	Paper- III: Industrial Waste water pollution – Prevention and Control			
19RCE311	Paper- III: Environmental Policies and Legislations			
Program Total		12	12	300

19RCE101	**Research Methodology and Pedagogy**	**4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart knowledge in the concept of problem identification and research methodology
2. To familiarize with basic of research and the research process
3. To demonstrate the different types of research and its applicability
4. To comprehend the knowledge of social research
5. To exhibit in sampling design and sampling techniques
6. To enrich the knowledge in writing a good research report.

COURSE OUTCOMES

1. Read, interpret, and critically evaluate social research.
2. Identify, explain, and apply the basic concepts of research, such as variables, operationalization, sampling, reliability, and validity.
3. Recognize the ethical issues involved in research, and practice ethical research standards.
4. Identify and explain the difference between quantitative, qualitative, and mixed methods research and what types of research questions can be answered with each method.
5. Use theory and previous research to create research questions and hypotheses and to identify and analyze the appropriate method and variables needed for research questions.
6. Use a variety of research methods through hands-on experience.

UNIT I - HIGHER EDUCATION AN INTRODUCTION

Historical perspectives, the objectives of higher education, role of higher education-social focus, curricular focus, administrative focus, drivers of change in higher education-globalization, changing demographics, structuring of employment, technological change, demand of accountability, consumerism,. Expectations by employers, rate of knowledge growth, campus demographics, concern for community. Restructuring and new patterns of decision making.

UNIT II - RESEARCH PROCESSES AND METHODOLOGY

Introduction to Research – Research strategies – Ethics – Code of conduct for Research – Health and Safety – IPR – Research Events – Networks – Outreach Activities – Best Research practices – Quality assurance for Research – Career Management for Researchers – Research seminars – Journal critiques -.

UNIT III - EFFECTIVE RESEARCH SKILLS

Data collection – Modeling – Simulation – Analysis – Prototyping – Presentation Skills – Data Presentation Skills – Research Writing skills (For Articles, Reports, Journals and Thesis) – Creative Skills – Effective Interview Skills – Team Building Skills – Communication and Interpersonal Skills – knowledge Transfer skills – Vivo voce – Teaching and Information Skills – Effective use of Library – Survey Skills – Planning and Control Methods – Statistical Tools – Patents and Copyrights – Advanced Research Techniques and Tools.

UNIT IV - TECHNIQUES OF TEACHING AND EVALUATION

Large group techniques – lecture, seminar, symposium, panel discussion-project approaches and workshop.Small Group techniques-group discussion simulation, role playing-Buzz techniques, brain storming, case discussion and assignment…system approach in education. Individualized techniques-CAI Keller plan – PSI and programmed learning-methods of evaluation-self evaluation and student evaluation in higher education, question banking, diagnostic testing and remedial teaching.

UNIT V - ESSENTIALS FOR EFFECTIVE COMMUNICATION IN ENGLISH

Improving Vocabulary stock-general and technical vocabulary-British and American vocabulary-homophones & homonyms, idioms and phrases-Different grammatical functions of the same word-Grammar-Tenses, Voice, reported speech, Modals, spoken English structures, formal and informal-letters, project reports, descriptions, circulars, synopsis and summary writing. Listening skills for competitive exams-Reading skills-skimming and scanning – Reading journals, magazines and newspapers for comprehension.Practical use of English – conversation, seminars, individual speeches and group discussions. Reference skills-Using dictionary, thesaurus and encyclopedia effectively. Error shooting for better use of English.

Suggested Readings

1. Alley, Michael, (1996), 'The Craft of Scientific Writing', 3rd Edition, Springer.
2. Alley, Michael, (2003), 'The Craft of Scientific Presentations", Springer.

Reference Books

1. Hubbuch, Susan M.,(2005), Writing Research Papers Across the Curriculum, 5th Edition, Thompson.
2. Vedanayagam.E.G (1989),Teaching technology for college teachers New Delhi - Sterling publishers (Pvt) Ltd.
3. Kumar.K.H.(1997), Educational technology, New Delhi- New age international (Pvt) Ltd.
4. Tony Bates.A.N,(2005), Technology e-learning and distance education, New York, Rout ledge. .
5. Aggarwal. J.C. (1995), Essential of educational technology; Teaching Learning innovations in education-New Delhi- Vikas publishing house (p) Ltd.,.
6. Crow & Crow. (1998),Educational Psychology", Erusia Publishing House New Delhi.
7. M. Ashraf Rizvi.(2005),Effective technical communication, TataMcGraw Hill Co.Ltd.

Websites:

www.english4engineer.com

www.learn4good.com/language/engineer

19RCE201 **Advance Structural Engineering** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

1. To understand the concepts of advanced concrete materials and their techniques.
2. To know about the analysis of structure by Finite element method.
3. To study about the design of yield line theory of slab and grid floors
4. To study about structural action of shell
5. To know about the model material and their testing
6. To design the large-scale structure

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Understand the concepts of advanced concrete materials and their techniques.
2. Analysis the structure by Finite element method
3. Design the yield line theory of slab and grid floors
4. Design the structural action of shell
5. Understand about the model materials and testing.
6. Will gain the knowledge about the design the large-scale structure

UNIT I- MATERIAL SCIENCE FOR CIVIL ENGINEERING
Modern concrete and concreting techniques, advanced concrete materials, composites, laminates and its applications.Reinforced Concrete and Pre-stressed concretes, Concepts and design, Codal provisions system, optical networking, satellite communication system.

UNIT II - FINITE ELEMENT METHOD
Finite Element Method, 2D and 3D applications in plane and three dimensional elasticity problems. Analysis of plate and shell structures.Applications using proper software.Nonlinear analysis of structural elements.Material and geometric nonlinearity.Applications for beam, plates and shells.

UNIT III - DESIGN OF FLAT SLAB AND GRID FLOORS :
Yield line theory of slabs – Hillerberg's method of design of slab – Design of Flat- Slab Equivalent frame method of design - Approximate analysis and Design of grid floors.

UNIT IV - MEMBRANE THRORY OF SHELLS
Classification of shells - Types of shells - Structural action - Membrane theory – Shells of revolution and shells of translation - Examples - Limitations of membrane theory.

UNIT V - MODEL ANALYSIS
Laws of similitude - model materials – model testing – testing large scale structures – holographic techniques

Suggested Readings

1. S.P.Timoshenko and Goodier (2011), 3rd ed., international student edition,Theory of Elasticity, McGraw – Hill Publications.
2. Devdas Menon,(2009), Advance Structural Engineering, Alpha Science Intl Ltd .
3. Anil K Chopra, (2011), Dynamics of Structures Theory and Applications to Earthquake Engineering, 4th Edition, Prentice – Hall Publications
4. R.W. Clough and J Penzin – Dynamics of Structures , McGraw Hill Publications
5. R.C. Roy – Structural Dynamics an Introduction to computer methods, John wiley& Sons Publications
6. S. Timoshenko and W. Krieger, Theory of plates and shells, McGraw Hill
7. Ansel C. Ugural, Stresses in plates and shells, McGraw Hill
8. Chadrashekhara K. Analysis of Plates , New Age International Edition
9. J.N. Reddy – An Introduction to the finite element method – Tata McGraw Hill Publishing Co. Lt

19RCE202 **Advance EnvironmentalEngineering** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

1. To provide the engineering graduates with technical expertise in Environmental Engineering which will enable them to have a career and professional accomplishment in the public or private sector.
2. To address the complexities of real-life environmental engineering problems related to water supply, sewerage, sewage treatment, waste management industrial pollution prevention and control.
3. To Identify and develop processes and technologies to meet desired environmental protection needs of society
4. To formulate solutions that are technically sound, economically feasible, and socially acceptable.
5. To design systems, processes, and equipment for control and remediation of water, air, and soil quality environment within realistic constraints of economic affordability and social acceptability
6. Have a knowledge of contemporary environmental issues and an ability to engage in life-long learning

Course Outcomes:

1. The students are expected to be able to identify, formulate, and solve environmental engineering problems using the techniques, skills, and modern engineering tools necessary for environmental engineering practice.
2. Assess the potential environmental impacts of development projects and design mitigation measures.
3. Have basic knowledge about environment protection and operation of pollution control devices.
4. Design and conduct experiments, as well as interpret data and communicate effectively.
5. Function in multi-disciplinary teams and understand the ethical and professional responsibility.
6. Find professional level employment as Environmental Engineers or pursue higher studies

UNIT I - SOLID WASTE TREATMENT AND DISPOSAL

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – closure of landfills – landfill remediation.

UNIT II - INDUSTRIAL WASTEWATER TREATMENT

Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors -

Chemical oxidation – Ozonation – carbon adsorption – Photo-catalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal.- Treatability studies.

UNIT III - AIR QUALITY MONITORING AND CONTROL TECHNIQUES:

Air pollutants: Sources, classification, Combustion Processes, pollutant emission, Effectson Health, vegetation, materials, atmosphere, Reactions of pollutants Scales of APstudies, effects as per scales, Air sampling, pollution measurement methods, Ambient airquality and emission standards, Air pollution indices, Air Act, legislation and regulations,Removal of gaseous pollutants. Particulate emission control; bioscrubers, biofilters,Indoor air quality.

UNIT IV- SURFACE WATER HYDROLOGY
HYDROLOGIC PROCESSES

Rainfall – Rain gauges – Adequacy of network – Spatial and temporal distribution – frequency and intensity / duration analysis – Consistency – missing data – Abstractions – Infiltration – Evaporation – Interception – Process, estimation and measurement – Depression and detention storages.

RUNOFF ESTIMATION

Components – Factors affecting runoff – Catchment characteristics – Flow measurements – Stream gauging – Floats, current meters – Venturi, Cut-throat and Parshall flumes – Rating curves – Aquastic Doppler velocity meter – Estimation – SCS and strange table methods – Empirical equations – Rainfall – Runoff models – TANK model – Tank clustered catchments.

UNIT V - REMOTE SENSING

Remote Sensing, GIS and GPS Techniques and their applications in Environmental Studies.Softwares in Environmental Engineering.Pollutant Transport Mechanisms and Modelling, Hazardous Waste Management, Waste Minimization Techniques, Environmental Risk Management

Suggested Readings

1. Manual on water supply and Treatment ",(1999) CPHEEO, Ministry of Urban Development, GOI, New Delhi.
2. Manual on Sewerage and Sewage Development ",(1993), CPHEEO, Ministry of UrbanDevelopment, GOI, New Delhi.
3. B.A. Hauser,(1991) " Practical Hydraulics Hand Book ", Lewis Publishers, New York.
4. M.J. Hammer, " Water and Wastewater Technology ", Regents/Prentice Hall, New Jersey.
5. Franzini, J., Freyberg, D., Linsley, R., and G. Tchobanoglous, (1991), “WaterResources Engineering”. McGraw Hill.
6. Reed, S.C. and Crites, R.W.,(1996) “Natural Systems for Waste Management and Treatment” .McGraw Hill.
7. Guyer, H.H., (1998), “Industrial Processes and Waste Stream Management”.WileyInterscience.
8. Bishop, P.,(2000), “ Pollution Prevention: Fundamentals and Practice”. McGraw Hill.
9. American Water Works Association, (1997) “Water Treatment Plant Design”, (3rd Ed.).McGraw-Hill.
10. Kawamura, S., (2000),“Integrated Design and Operation of Water Treatment Facilities”.Wiley and Sons.

19RCE203 **Slope Stability and Land Slides** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

1. Understand the engineering properties soil and rock to estimate their strength characteristics for slope stability analysis
2. Describe the different methods of slope stability analysis
3. Evaluate the infinite slopes based on the stability analysis
4. Describe the nature of landslides on various soils for stability analysis
5. Evaluate the behavior of slopes using instrumentation techniques
6. Applications of field observation techniques for understanding the landslides formation on soils

Course Outcomes:

1. Understand the various slope failures and causes of Failures
2. Describe the different methods of slope stability analysis
3. Analysis of non-uniform slopes with various methods
4. Analysis and design of the landslide detection and the stability of slopes on various soils
5. Understand the basic concepts and analysis of field observations and slope stabilization
6. Applications of various techniques in landslide detection and monitoring techniques and understand the role of landslides in the earth system

UNIT I - Stability of Slopes

Introduction – Importance – General characteristics - Types of failures – Causes of failures – Purpose of stability computation – Investigation of failures – Procedure – Case studies.

UNIT II - Stability Analysis

Stability analysis – Method of slices – Friction circle method – Soils with cohesion – Soils with cohesion and angle of internal friction. Critical states for design for embankments – Stability computations – Evaluation of pore water pressure.

UNIT III - Irregular Slopes

Non-uniform soils – Janbu’s analysis – Taylor’s analysis – Bishop’s analysis – Total stress and effective stress approaches – composite surfaces of sliding – Block sliding.

UNIT IV - Land Slides

General Characteristics -sources – Stability of Hill side slopes – Open cuts – Engineering problems involving the stability of slopes – Cuts in sand – Cuts in loess – Homogeneous and soft clay slopes – Sudden spreading of clay slopes – Clay flows - Clays containing pockets and sand masses – Slides in stiff clay slopes on shale – Slopes on weathered rock; talus slopes, slopes on over consolidated clays – Slides along coastal areas and tropically weathered residual soils – long term stability of clay slopes.

UNIT V - Field Observations and Slope Stabilization

Field instrumentation – Observation studies during construction – Post construction, piezometers – Settlement plates – Inclinometer – Case histories.

Compaction of new embankments – Compaction of natural masses of soil and existing fills – Compaction of deep deposits of sand – Vibroflotation – Compaction of compressible soils – Drainage as a means of stabilization – Use of Geotextiles – Soil nailing.

Suggested Readings

1. Chowdhury, D.F., (1988), "Slope analysis", Prentice Hall.
2. Winterkorn, H.F. and Fang, H.Y.,(1994), "Foundation Engineering" Handbook, Von Nostrand Reinhol.
3. Bramhead, E.N.,(1986), "The Stability of Slopes", Blacky Academic and Professionals Publications, Glasgow .
4. Anderson, M.G., and Richards, K.S.,(1987), " Slope Stability", John Wiley.

19RCE204 **Structural Dynamics and Earthquake Engineering** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

1. To introduce the basics of Earthquake Engineering
2. To introduce the engineering seismology, building geometrics & characteristics, structural irregularities,
3. To introduce tips on earthquake engineering - do's and don'ts
4. To introduce cyclic loading behaviour of RC, steel and pre-stressed concrete elements
5. To discuss code provisions and their application on different types of structures
6. To apply codal provisions on different types of structures

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Apply the basics of Earthquake Engineering
2. Demonstrate the dynamics of structural system under earthquake load
3. Analyze the influence of the structural / geometrical design in building characteristics
4. Demonstrate the cyclic loading behaviour of RC steel and pre-stressed concrete elements
5. Apply codal provisions on different types of structures.
6. Cyclic loading behaviour of RC, steel and pre-stressed concrete elements

UNIT I Theory of Vibrations

Difference between static loading and dynamic loading – Degree of freedom – idealisation of structure as single degree of freedom system – Formulation of Equations of motion of SDOF system – D"Alemberts principles – effect of damping – free and forced vibration of damped and undamped structures – Response to harmonic and periodic forces.

UNIT II Multiple Degree of Freedom System

Two degree of freedom system – modes of vibrations – formulation of equations of motion of multi degree of freedom (MDOF) system – Eigen values and Eigen vectors – Response to free and forced vibrations – damped and undamped MDOF system – Modal superposition methods.

UNIT III Elements of Seismology

Elements of Engineering Seismology – Causes of Earthquake – Plate Tectonic theory – Elastic rebound Theory – Characteristic of earthquake – Estimation of earthquake parameters – Magnitude and intensity of earthquakes – Spectral Acceleration.

UNIT IV Response of Structures to Earthquake

Effect of earthquake on different type of structures – Behaviour of Reinforced Cement Concrete, Steel and Prestressed Concrete Structure under earthquake loading – Pinching effect – Bouchinger Effects – Evaluation of earthquake forces as per IS:1893 – 2002 – Response Spectra – Lessons learnt from past earthquakes.

UNIT V Design Methodology

Causes of damage – Planning considerations / Architectural concepts as per IS:4326 – 1993 – Guidelines for Earthquake resistant design – Earthquake resistant design for masonry and Reinforced Cement Concrete buildings – Later load analysis – Design and detailing as per IS:13920 – 1993.

Suggested Readings

1. Chopra, A.K.,(2002), "Dynamics of Structures – Theory and Applications to Earthquake Engineering", 4th Edition, Pearson Education.
2. Agarwal. P and Shrikhande. M., (2007) "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt. Ltd.
3. Biggs, J.M. (1964), "Introduction to Structural Dynamics", McGraw Hill Book Co., New York.
4. Dowrick, D.J.,(2009) "Earthquake Resistant Design", John Wiley & Sons, London,
5. Paz, M. and Leigh., (2006), "Structural Dynamics – Theory & Computation", 4th Edition, CBS Publishers & Distributors, Shahdara, Delhi.

Part II :Ph.D in Civil Engineering 2019-20

19RCE205 Theoretical Soil Mechanics 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

Course Objectives:

1. Describe the engineering behaviour of soil and rock for understanding the slope stability analysis
2. Acquire the basic knowledge on different methods of slope stability analysis
3. Describe the equilibrium analysis to understand the stress-stain behaviour in infinite slopes
4. Describe the various theories and mechanism for estimating the engineering behavior of soils
5. Evaluate the behavior of porous media in different soil conditions for slope stability analysis
6. Applications of basic concepts and field testing techniques to estimate the problems associated with geotechnical engineering structures

Course Outcomes:

1. Understand the theory of elasticity and equation of equilibrium and compatibility in soil mechanics
2. Describe the stresses and displacement in soil with fundamental solutions
3. Understand the stress – strain relationship using limit equilibrium analysis
4. Ability to apply theory of elasticity / plasticity / rheological modeling to analyse and obtain solution to challenges involving engineering behavior of soils
5. Analysis of flow through porous media in different soil conditions
6. Application of various principles and theories to analyze the problems related to soil mechanics

UNIT I - Theory of Elasticity

Introduction – Material behaviour – Idealistic behaviour – Elastic, viscous and plastic – Elasticity and stability problems, concept of stress and strain – Plane stress, plane strain and axisymmetric problems – Equation of equilibrium and compatibility – Stress functions.

UNIT II - Stresses and Displacements (Elastic Solutions)

Stresses in elastic half-space medium by external loads – Fundamental solutions – Boussinesq, Flamant, Kelvin and Mindlin solution – Applications of fundamental solutions – Anisotropic and non-homogeneous linear continuum – Influence charts – Elastic displacement.

UNIT III - Limit Equilibrium Analysis

Limit equilibrium analysis – Perfectly plastic material – Stress – strain relationship – Stress and displacement field calculations – Slip line solutions for undrained and drained loading.

UNIT IV - Limit Analysis

Limit analysis – Principles of virtual work – Theorems of plastic collapse – Mechanism for plane plastic collapse – Simple solutions for drained and undrained loading – Stability of slopes, cuts and retaining structures. Centrifuge model – Principles and scale effects, practical considerations.

UNIT V - Flow Through Porous Media

Flow through porous media – Darcy's law – General equation of flow – Steady state condition – Solution by flow net – Fully saturated conditions – Flownet in anisotropic soils – construction of flownet for different cases.

Suggested Readings

1. Aysen, A., (2002), "Soil Mechanics: Basic concepts and Engineering Application", A.A.Balkema Publishers.
2. Ulrich Smoltc, YK, (2002), "Geotechnical Engineering Handbook (Vol. 1)", Ernot&Sohn.
3. Aysen, A., (2003), "Problem Solving in Soil Mechanics", A.A.Balkema Publisher.
4. Davis, R.O., and Selvadurai, A.P.S.,(1996), Elasticity and Geomechanics, Cambridge University Press.
5. Taylor, R.N.,(1995), "Geotechnical Centrifuge Technology", Blackie Academic and Professional
6. Wai-Fah Chen, and Liu, X.L.,(1991), " Limit Analysis in Soil Mechanics, Elsevier Science Ltd.,
7. Muni Budhu, (2000.), "Soil Mechanics and Foundations", John Wiley and Sons, Inc, Network.
8. Atkinson, J.H., (1981), "Foundations and Slopes", McGraw Hill.
9. Harr, M.E., (1966), "Foundations of Theoretical Soil Mechanics, McGraw Hill.
10. Cedergren, H.R.,(1997), " Seepage Drainage and Flownets", John Wiley.

19RCE206 **Soil Dynamics and Machine Foundations** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

1. Acquire the basic knowledge on vibration theories for dynamic analysis of floundations
2. Understand the basic concepts on dynamic properties of soil using various field and laboratory testings
3. Describe the types of machine foundations to undersand the applicability of various vibration theories
4. "Describe the modes of vibration in foundation systems and to understand the importance of designing
5. machine foundation for reciprocating and impact machines."
6. Evaluate the vibration isolation techniques using springs and damping materials
7. Acquire the ability to design machine foundations with different vibration theories

Course Outcomes:

1. Understand the fundamental concepts of theory of vibration and the various terminology. encompassed to study the behavior of soils due to the effects of dynamic loads.
2. Describe the dynamic soil properties & their determination by field and laboratory tests.
3. Understand the general principles of analysis and design of machine foundation.
4. Analyze and design the foundations for machineries of reciprocating, impact and rotary type.

5. Analyze the active and passive isolation problems for machine foundation.
6. Application of various principles and analyze various problems related to machine foundation.

UNIT I - Theory of Vibration

Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems – Forced vibrations – Resonance – Viscous damping – Principles of vibrations measuring systems – Effect of transient and pulsating loads.

UNIT II - Dynamic Soil Properties

Dynamic stress – Strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Mechanism of liquefaction – Influencing factors – Evaluation of liquefaction potential – Analysis from SPT test – Dynamic bearing capacity – Dynamic earth pressure.

UNIT III - Machine Foundations

Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation – Vibration analysis – Elastic Half – Space theory – Mass-spring-dashpot model – Permissible amplitudes – Permissible bearing pressures.

UNIT IV - Design of Machine Foundation

Evaluation of design parameters – Types of Machines and foundations – General requirements – their importance - Analysis and design of block type and framed type machine foundations – Modes of vibration of a rigid foundation – Foundations for reciprocating machines, impact machines, Two – Cylinder vertical compressor, Double-acting steam hammer – Codal recommendations.

Emprical approach - Barken's method – Bulb of pressure concept – Pauw's analogy – Vibration table studies.

UNIT V - Vibration Isolation

Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – Properties of isolating materials – Vibration control of existing machine foundation.

Suggested Readings

1. KameswaraRao, N.S.V. (2000), "Dynamics soil tests and applications", Wheeler Publishing, New Delhi,
2. Prakash, S and Puri, V.K.,(1987), " Foundations for machines", McGraw Hill.
3. Moore, P.J., (1985), "Analysis and Design of Foundations for Vibrations", Oxford and IBH.
4. Vaidyanathan, C.V., and Srinivasalu, P.,(1995), Handbook of Machine Foundations, McGraw Hill.
5. KameswaraRao,(1998) "Vibration Analysis and Foundation Dynamics", Wheeler Publishing, New Delhi..
6. Swami Saran,(2010), "Soil Dynamics and Machine Foundation", Galgotia publications Pvt. Ltd. New Delhi.
7. Das B.M., (1992), "Principles of Soil Dynamics", McGraw Hill.
8. Krammer S.L., (2004), "Geotechnical Earthquake Engineering", Prentice Hall, International series, Pearson Education (Singapore) Pvt Ltd.

19RCE207 **Soil Structure Interaction** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

1. Explain the effects of soil flexibility in the response of the structure
2. Analyse the structure with soil structure interaction effects to obtain the realistic response
3. Describe the numerical analysis of plates on elastic medium
4. Analyse the structure with soil structure interaction effects to obtain the realistic response in pile and pile-raft system
5. Analyse the structure with soil structure interaction effects to obtain the realistic response in laterally pile and pile-raft system
6. "Acquire the ability to design the geotechnical engineering structures using the concept of soil structure interaction"

Course Outcomes:

1. Understand the various soil response models applicable to soil-foundation interaction analysis.
2. Analyze the beams on elastic foundation and its applications
3. Analyze the plates on elastic medium and its applications
4. Assess the elastic solutions for problems of pile and pile-raft system.
5. Assess the elastic solutions for problems of laterally pile and pile-raft system
6. Application of various principles and evaluate the soil stiffness and damping ratio

UNIT I - Soil - Foundation Interaction

Introduction to soil – Foundation interaction problems, Soil behaviour, Foundation behaviour, Interface, behaviour, Scope of soil-foundation interaction analysis, soil response models.Winkler, Elastic continuum, Two parameter elastic models, Elastic – plastic behaviour, Time dependent behaviour.

UNIT II - Beams on Elastic Foundation - Soil Models

Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness – Analysis through application packages.

UNIT III - Plate on Elastic Medium

Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions, Analysis of braced cuts – Application packages.

UNIT IV - Elastic Analysis of Pile

Elastic analysis of single pile, Theoretical solutions for settlement and load distribution, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap – Pile raft – Application packages.

UNIT V - Laterally Loaded Pile

Load deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Interaction analysis, pile raft system, solutions through influence charts - Application packages.

Suggested Readings

1. Saran, S., (2006), "Analysis and design of substructures:, Taylor & Francis Publishers.
2. Hemsley, J.A., (1998), "Elastic Analysis of Raft Foundations", Thomas Telford.
3. Poulos, H.G., and Davis, E.H., (2008), "Pile Foundation Analysis and Design", John Wiley.
4. Murthy, V.N.S., (2007), "Advanced Foundation Engineering", CBS Publishers, New Delhi.
5. McCarthy, D.F., (2002), "Essentials of Soil Mechanics and Foundations: Basic Geotechnics", Sixth Edition, Prentice Hall.
6. Scott, R.F.,(1981), " Foundation Analysis", Prentice Hall.
7. ACI 336, (1988), " Suggested Analysis and Design Procedures for Combined Footings and Mats", American Concrete Institute, Delhi.

19RCE208 Rock Mechanics In Engineering Practice 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

Course Objectives:

1. Describe the various properties and behaviour of various geological formation
2. Describe the various theories and concepts on strength criteria of rocks
3. Acquire the basic knowledge on the design of geotechnical engineering structures using case studies
4. Describe the slope stability analysis for critical slopes and apply the concept of factor of safety
5. Acquire the knowledge on the effect of reinforcements in the remedial measures of slope stability
6. Application of basic concepts of rock mechanics for designing the geotechnical engineering structures

Course Outcomes:

1. Understand the various distribution, geological characters and civil engineering significance of major rock formations of India
2. "Describe the strength criteria of rocks and behaviour of rock under hydrostatic and deviatoric loadings "
3. Analyze the design aspects and stress measurements in rocks

4. Assess the stability analysis of rock slopes and various remedial measures for critical slopes
5. Assess the reinforcement techniques in stability of rocks
6. Apply the geological knowledge in civil engineering planning and development based on the properties of rocks

UNIT I - Classification of Rocks

Rocks of peninsular India and the Himalayas – Index properties and classification of rock masses, competent and incompetent rock – Value of RMR and ratings in field estimations.

UNIT II - Strength Criteria of Rocks

Behaviour of rock under hydrostatic compression and deviatoric loading – Modes of rock failure – Planes of weakness and joint characteristics – Joint testing, Mohr – Coulomb failure criterion and tension cut-off, Hoek and Brown Strength criteria for rocks with discontinuity sets.

UNIT III - Design Aspects in Rocks

Insitu stresses and their measurements, flat jack - Over and under coring methods – stress around underground excavations – Design aspects of openings in rocks – Case studies.

UNIT IV - Slope Stability of Rocks

Rock slopes – Role of discontinuities in slope failure, slope analysis and factor of safety – Remedial measures for critical slopes – Case studies.

UNIT V - Reinforcement of Rocks

Reinforcement of fractured and jointed rocks – Shotcreting – Bolting – Anchoring – Installation methods – Case studies.

Suggested Readings

1. Goodman, R.E.,(1989), " Introduction to Rock Mechanics", John Wiley and Sons.
2. Hool, E and Bray, J., (1981), "Rock Slope Engineering, Institute of Mining and Metallurgy", U.K..
3. Hoek, E and Brown, E.T., (1981), "Underground Excavations in Rock, Institute of Mining and Metallurgy", U.K..
4. Bazant, Z.P.,(1985), " Mechanics of Geomaterials Rocks, Concrete and Soil", John Wiley and Sons, Chichester.
5. Wittke, W., (1990), "Rock Mechanics: Theroy and Applications with Case Histories", Springerverlag, Berlin.

19RCE209	**Reinforced Soil Structures**	**4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

1. Describe the behaviour and performance of soil - reinforcement interactions using various concepts and mechanisms of reinforced soil
2. Acquire the basic knowledge on the materials properties of different soil reinforcements
3. Describe the design concepts and applications of soil reinforcements
4. Describe the need for geosynthetics in the design of drainage and landfill program
5. Acquire the basic concepts from the case studies on the soil nailing techniques
6. Acquire the ability to analyze and design the geotechncial engineering structures using soil reinforcement techniques

Course Outcomes:

1. Understand the various principles and mechanisms of reinforced soil techniques in different soils
2. Describe the materials used in reinforced soil structures and its laboratory testing
3. Assess the design principles of reinforced soil of various structures
4. Assess the use of geosynthetics in drainage requirements and landfill designs program
5. Describe the soil nailing concepts and various case histories
6. Apply the principles of soil reinforcement in engineering constructions

UNIT I - Principles and Mechanisms

Historical background – Initial and recent developments – Principles – Concepts and mechanisms of reinforced soil – Factors affecting behaviour and performance of soil – Reinforcement interactions.

UNIT II - Materials and Material Properties

Materials used in reinforced soil structures- Fill materials, reinforcing materials, metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites, Geojutes, Geofoam, natural fibres, coir Geotextiles – Bamboo – Timber – Facing elements – Properties – Methods of testing – Advantages and disadvantages – Preservation methods.

UNIT III - Design Principles and Applications

Design aspects of reinforced soil – Soil reinforcement function – Separator, Filtration, Drainage, Barrier function – Design and applications of reinforced soil of various structures – Retaining walls – Foundations - Embankments and slopes.

UNIT IV - Geosynthetics and Applications

Introduction – Historical background – Applications - Design criteria – Geosynthetics in roads – Design – Giroud and Noiray approach – Geosynthetics in landfills – Geosynthetic clay liner – Design of landfills – Construction of landfills using geosynthetics-Barrier walls- Reinforced Soil retaining walls- Reinforced soil slopes.

UNIT V - Soil Nailing and Case Histories

Soil nailing – Introduction – Overview – Soil – Nail interaction – Behaviour – Design procedure – Behaviour in seismic conditions.

Performance studies of reinforced dams, embankments, Pavements, Railroads, Foundations - Case studies.

Suggested Readings

1. Jewell, R.A., (1996), " Soil Reinforcement with Geotextile", CIRIA, London.
2. John, N.W.M.,(1987), " Geotextiles", John Blackie and Sons Ltd., London.
3. Jones, C.J.F.P., (1982), "Earth Reinforcement and Soil Structures", Earthworks, London.
4. Koerner, R.M., (1997), " Designing with Geosynthetics", (Third Edition), Prentice Hall.
5. Proc. Conference on polymer and Reinforcement, Thomas Telford Co., London, 1984.
6. Gray, D.H., and Sotir, R.B., (1996), "Biotechnical and Soil Engineering Slope Stabilization", A Practical Guide for Erosion Control, John Wiley & Son Inc., New York,.
7. RamanathaAyyar, T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N., (2002), "Comprehensive reference book on Coir Geotextile", Centre for Development for Coir Technology.

Part II :Ph.D in Civil Engineering **2019-20**

19RCE210 **Earthquake Analysis and Design Of Structures** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

1. To develop the equation of motion for vibratory systems and solving for the free and forced response.
2. To Create simple models for engineering structures.
3. To understand the dynamic analysis result for design analysis and research purposes.
4. To understand Structural dynamics theory to Earthquake analysis response and design of structure.
5. To gain the Knowledge of mathematics science and engineering to create mathematical modeling

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Apply Knowledge of mathematics, science and engineering by developing the equation of motion for vibratory systems and solving for the free and forced response.

2. Create simple models for engineering structures using knowledge of structural dynamic
3. Intercept dynamic analysis result for design analysis and research purposes.
4. Apply Structural dynamics theory to Earthquake analysis response and design of structure.
5. Apply Knowledge of mathematics science and engineering to create mathematical modeling
6. Analyze the different system with distributed load

UNIT I - EARTHQUAKES AND GROUND MOTION

Engineering Seismology (Definitions, Introduction to Seismic hazard, Earthquake Phenomenon), Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation.

UNIT II - EFFECTS OF EARTHQUAKE ON STRUCTURES

Dynamics of Structures (SDOFS/ MDOFS), Response Spectra - Evaluation of Earthquake Forces as per codal provisions - Effect of Earthquake on Different Types of Structures - Lessons Learnt from Past Earthquakes

UNIT III - EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES

Structural Systems - Types of Buildings - Causes of damage - Planning Considerations - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Masonry Buildings - Design consideration – Guidelines.

UNIT IV - EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES

Earthquake Resistant Design of R.C.C. Buildings - Material properties - Lateral load analysis – Capacity based Design and detailing – Rigid Frames – Shear walls.

UNIT V - VIBRATION CONTROL TECHNIQUES

Vibration Control - Tuned Mass Dampers – Principles and application, Basic Concept of Seismic Base Isolation – various Systems- Case Studies, Important structures.

Suggested Readings

1. Bruce A Bolt,(2004), “Earthquakes” W H Freeman and Company, New York.
2. C. A. Brebbia,(2011), ”Earthquake Resistant Engineering Structures VIII”,WIT Press.
3. Mohiuddin Ali Khan, (2012), “Earthquake-Resistant Structures: Design, Build and Retrofit”, ElsevierScience& Technology.
4. Pankaj Agarwal and Manish Shrikhande, (2009), “Earthquake Resistant Design of Structures”, Prentice Hall of India.
5. Paulay,T and Priestley, M.J.N., (1992), “Seismic Design of Reinforced Concrete and Masonrybuildings”, John Wiley and Sons.
6. S K Duggal,(2007), “Earthquake Resistant Design of Structures”, Oxford University Press.

19RCE211 **Experimental Stress Analysis** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

1. To measure the strain under static and dynamic loads.
2. To describe the mechanical, optical, pneumatic and electrical strain gauges
3. To create awareness about the fixing of gauges and temperature effects.
4. To analysis of measuring circuits and strains of different strain gauge rosettes.
5. To describe the measurements by using transducers and exciters.

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Explain the measurement of strain under static and dynamic loads.
2. Describe the Mechanical, optical, pneumatic and electrical strain gauges for strain measurement.

3. Create awareness about the fixing of gauges and temperature effects in bonded gauges and measure of stress in stress gauges.
4. Analysis of measuring circuits and strains of different strain gauge rosettes.
5. Describe the measurements by using transducers and exciters

UNIT I - MEASUREMENTS & EXTENSOMETER
Principles of measurements, Accuracy, Sensitivity and range of measurements. Mechanical, Optical Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

UNIT II- ELECTRICAL RESISTANCE STRAIN GAUGES
Principle of operation and requirements, Types and their uses, Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheastone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT III- PHOTOELASTICITY
Two dimensional photo elasticity, Concept of light – photoelastic effects, stress optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photo elastic materials. Introduction to three dimensional photo elasticity.

UNIT IV - BRITTLE COATING AND MOIRE METHODS
Introduction to Moire techniques, brittle coating methods and holography.

UNIT V- NON – DESTRUCTIVE TESTING
Fundamentals of NDT, Radiography, ultrasonic, magnetic particle inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique.

Suggested Readings

1. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., andRamachandra, K., (1984), “Experimental Stress Analysis”, Tata McGraw-Hill, New Delhi.

References

1. Dally, J.W., and Riley, W.F.,(2005), “Experimental Stress Analysis”, McGraw-Hill Inc., NewYork, 2005, IV edition.
2. Hetyenyi, M.,(1972), “Hand book of Experimental Stress Analysis”, John Wiley and Sons Inc., New York.
3. Pollock A.A., (1993), “Acoustic Emission in Acoustics and Vibration Progress”, Ed. Stephens R.W.B., Chapman and Hall.

19RCE212 **Rehabilitation and Modernisation of Irrigation Systems** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To enable the students for a successful career as water management professionals.
2. To create a potential among students in the area of irrigation management with specific enrichment to synthesis of data and their analysis.
3. To expose the students the need for an interdisciplinary approach in irrigation water management and providing a platform to work in an interdisciplinary team.
4. To provide students an ability to understand the applications of mathematical and scientific concepts to analyse intricate technical, social and environmental problems in irrigation water management and finding solutions for them.
5. To promote student awareness for a life-long learning process and inculcate professional ethics and codes of professional practice in water management.

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Understand the concepts of soil-water-plant relationship as well as to expose them to the principles and practices of crop production.
2. Exposure to ground water, hydraulics of ground water related to drainage, drainage concepts, planning, design and management of drainage related irrigation system management
3. Understand the various principles of irrigation management and to analyse the different types of irrigation systems and their performances based on service-oriented approach.
4. To gain insight on local and global perceptions and approaches to participatory water resource management and to learn from successes and failures in the context of both rural and urban communities of water management.
5. Exposure on the use of economic concepts in irrigation development and to impart knowledge on economic planning so as to enable viable allocation of resources in the irrigation sector.

UNIT I - IRRIGATION SYSTEMS
Historical evolution of irrigation systems in India; its importance to agricultural production. Irrigation system classification – Nature of system modernization and rehabilitation. Distinction between rehabilitation and modernization; Rehabilitation and modernization objectives – Theory and Practice.

UNIT II - SYSTEM MAINTENANCE
Maintenance: essential, catch up, preventive and normal – Diagnostic analysis of flow, seepage and other parameters through Participatory Rural Appraisal, Rapid Rural Appraisal and Walkthrough Survey – Development and maintenance programme – Kudimaramath – Turnover – WUA.

UNIT III - DIAGNOSTIC ANALYSIS OF IRRIGATION SYSTEMS
System performance: history of inflow, cropping pattern, system alterations, distribution performance – Operational constraints – Management constraints – Resources constraints.

UNIT IV- REHABILITATION
Baseline survey – Deferred maintenance – Causes – Criteria used for taking rehabilitation programmes –Service Delivery Concepts- Software and hardware improvements – Prioritization – Role of water users' association – Monitoring and evaluation.

UNIT V - CASE STUDIES
Rehabilitation and modernization programmes – Periyar Vaigai Project – Walawe Project – Tank Modernization Project – Water Resources Consolidation Project. IAM WARM Project - DRIP - Case study of Rehabilitation using Water Delivery Concept.

Suggested Readings

1. CWR,(2000), Baseline Survey of Irrigation Commands, Centre for Water Resources, Anna University, Chennai.
2. IIMI and WALMI, (1994), "The Case of Mahi Kadana", WALMI, Gujarat, India.
3. CSU, (1984)"Diagnostic Analysis of Irrigation Systems Volume 2: Evaluation Techniques. Water Management Synthesis Project", Colorado State University, USA.

4. WAPCOS, Technical Report No. 19-A, (1989), "Handbook for Improving Irrigation System Maintenance Projects", WAPCOS, New Delhi.
5. CWR, (2000), "Tank Modernization Project EEC Assistance: Monitoring and Evaluation. Final Reports", Centre for Water Resources, Anna University, Chennai.
6. CWR, (1997), "Planning and Mobilization of Farmers Organization and Turnover", Tamil Nadu Water Resources Consolidation Project. CWR and OM, Anna University, Chennai.

Part III :Ph.D in Civil Engineering **2019-20**

19RCE301 **Advanced Concrete Technology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

1. To know about the constituent materials of concrete and mix design principles.
2. To understand the concept of special concrete.
3. To study about the tests for durability of concrete
4. To study about recommendations of IS 456-2000 for quality control of concrete
5. To know about the concreting under special circumstances
6. To know about the tests for hardened concrete.

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Identify the constituent materials of concrete and mix design principles.
2. Describe the concept of special concrete.

3. Demonstrate the tests for durability of concrete
4. Categorize the quality control of concrete as per IS 456-2000 code
5. Develop the concreting under special circumstances
6. Will gain the knowledge of tests for hardened concrete.

UNIT I- INTRODUCTION
Concrete: Past, Present and Future- Constituent Materials --Strength of Concrete -Dimensional Stability of Concrete- Chemical and Mineral Admixtures-Properties of Fresh and hardened Concrete - Principles of Concrete Mix Design-Methods of Concrete mix design.

UNIT II - SPECIAL CONCRETES
Lightweight and Heavy Weight Concrete-High Strength Concrete-High Performance Concrete-Polymers in Concrete-Steel fiber Reinforced Concrete-Ferrocement Concrete-Vaccum Concrete-Shotcrete-Ready Mixed Concrete-SIFCON.

UNIT III - DURABILITY OF CONCRETE
Permeability-chemical attack-sulphate attack-Quality of water-marine conditions-
Thermal properties of concrete-fire resistance-methods of making durable concrete **-**
Mass Concrete-Formwork-Structural Concrete Block Masonry -Quality Control of Concrete Construction.

UNIT IV - FORMWORK AND QUALITY CONTROL
Formwork Materials and Systems-Specifications-Design-Recommendations of IS 456-2000 on Quality- Statistical Parameters and Variability-Errors in Concrete Constructions-Quality Management.

UNIT V - CONCRETING UNDER SPECIAL CIRCUMSTANCES
Underground Construction-Concreting in Marine Environment-Under eater Construction-Hot weather and Cold weather concreting.

Tests on Concrete : Evaluation of Strength of existing structures-investigation Techniques-Tests on Hardened Concrete-Non Destructive Testing-Semi destructive testing techniques-Tests on fresh Concrete-Load Test on Structural Components.

Suggested Readings

1.Neville, A.M., Properties of Concrete, Pitman Publishing Limited, London.

2. Shetty M.S.(2003),Concrete Technology,S.Chand and Company Ltd,.New Delhi.
3. Gambir,M.L.(2004) “Concrete Technology”, Tata McGraw Hill,
   Publishing,Co,Ltd,NewDelhi.
4. Krishnaraju.N, “Design of Concrete mixes”, Sehgal Educational Consultants
   Pvt.Ltd.,Faridabad.
5. IS:456-2000,Indian Standards Code of Practice for Pa\lain and Reinforced Concrete
6. IS: 10262, “Recommended Guidelines for Concrete Mix Design”,1982.
7. Santhakumar,A.R., Concrete Technology, Oxford University Press, New Delhi.

19RCE302	**Prefabricated Structures**	**4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

1. To know about the modular coordination and production process of prefabricates
2. To understand the concept of Long wall and cross-wall large panel buildings.
3. To study about the design of large panels and stair cases
4. To study about the design of shear walls
5. To know about the design of industrial sheds and roof trusses.
6. To know about the hand book-based design of prefabricates.

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Identify the modular coordination and production process of prefabricates
2. Describe the long wall and cross-wall large panel buildings.
3. Design the large panels and stair cases
4. Design the shear walls

5. Design the industrial sheds and roof trusses.
6. Will gain the knowledge of hand book-based design of prefabricates.

UNIT I - DESIGN PRINCIPLES
General Civil Engineering requirements, specific requirements for planning and layout of prefabricates plant. IS Code specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT II - REINFORCED CONCRETE
Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, -Connections – Beam to column and column to column.

UNIT III - FLOORS , STAIRS AND ROOFS
Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

UNIT IV -WALLS
Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

UNIT V - INDUSTRIAL BUILDINGS AND SHELL ROOFS
Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing design. Cylindrical, Folded plate and hyper-prefabricated shells, Erection and jointing, joint design, hand book based design.

Suggested Readings

1. B.Lewicki, (2011) Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam, London,New York.
2. Koncz.T., (1971)Manual of Precast Concrete Construction, Vol.I II and III, Bauverlag, GMBH.
3. Structural Design Manual, (1978) Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete, Netherland BetorVerlag,.
4. LassloMokk, Prefabricated Concrete for Industrial and Public Sectors,(1964) AkademiaiKiado, Budapest.
5. Murashev.V.,Sigalov.E., and Bailov.V.,(2003) Design of Reinforced Concrete Structures, CBS publishers and distributors, New Delhi.
6. Gerostiza. C.Z., Hendrikson, C. and RehatD.R.,(1994) Knowledge Based Process Planning for Construction and Manufacturing, Academic Press, Inc.

19RCE303	**High Performance Concrete**	**4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

1. To know about the characteristics of concrete
2. To know about the design of concrete mixtures
3. To understand the concept micro & macroscopic behavior and theories of HPC
4. To study about the design of Fibre reinforced concrete as per ACI 318-99
5. To study about the design of shear walls
6. To know about the hand book-based design of prefabricates.

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Identify the modular coordination and production process of prefabricates
2. Show competency in design of advanced reinforced concrete structures.
3. Develop competence for applying of structures. Design the shear walls

4. Design the industrial sheds and roof trusses.
5. Will gain the knowledge of hand book-based design of prefabricates.

UNIT I – PERFORMANCE CHARACTERISTICS OF CONCRETE
General performance characteristics – cement effect on concrete strength – Portland cement and other hydraulic cement characteristics and content – performance comparison of various cements in concrete – water/cement ratio, aggregate and admixtures – permeability effects on performance of concrete – air voids and permeability – diffusion, sorptivity – freezing, thawing effect – concrete in cold weather –air entraining agents- ACI recommendations –hot weather concreting

UNIT II – ADMIXTURES AND DESIGN MIXTURES OF HPC
Mineral admixtures – chemical admixtures – strength requirements – selection of materials and proportions – flow chat for mixtures – mixture design – high performance light weight aggregates production, properties and proportioning – mixing and placement – creep, shrinkage and durability – thermal expansion ,conductivity and carbonation – offshore arctic environment – design of concrete mixtures – long term effects

UNIT III- CHARACTERISTICS, MICRO & MACRO MECHANICS
Concrete properties – mature elastic strength expressions – workability and cohesiveness, permeability, volumetric stability – ductility and energy absorption, constructability- bond to parent concrete – abrasion and fire resistance – micro & macroscopic behavior and theories – classical failure, crack propagation and failure mechanics theory – shear friction theory – confinement

UNIT IV – FRC & FRPC AND CODE OVER VIEW
FRC historical development, general characters and mixture proportioning – mechanical properties and mechanics of fiber reinforcement – plastic composites – GFRP & CFRP sheets –fire resistance – structural element designs as per ACI 318-99 – performance control for long term durability – constituent materials , corrosion inhibiters – water, mixture proportioning – constructability, serviceability, quality control and quality assurance

UNIT V – ECONOMICS OF HPC & HPC in 21st CENTURY
Construction needs – design and rehabilitation considerations – monitoring and cost evaluation – expectations and conclusions - principal factors affecting cost –advantages using HPC- cost studies and comparisons

Suggested Readings

1. Edward G. Nawy, Fundamentals of high performance concrete ,2nd edition John Wily & Sons, Australia.
2. Pierrie- Claude Aitcin E.& F.N Spon High performance concrete Technology and Engineering ,London.
3. Yves Malier –E & FN Spon High performance concrete from material to structure, London.
4. V.M.Malhotra(2002) High performance concrete performance and quality of concrete structures ,Proceedings of the 3rd international conference .

Part III :Ph.D in Civil Engineering **2019-20**

19RCE304	**Ground Improvement Techniques**	**4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

1. At the end of the course student is expected to identify the problematic soil and suitable suggest remedial measures
2. To understand the different problematic soils and effect of ground improvement techniques.
3. To describe the seepage analysis and suitable dewatering systems for the particular soil conditions.
4. To express the concept of compaction efforts on ground improvement and their installation and working principles.
5. Describe the load transfer mechanism and effect of geo textiles reinforcements in ground improvement.
6. Describe the various stabilization methods for the different types of problematic soils.

COURSE OUTCOMES:

1. Student will be in a position to identify and evaluate the deficiencies if any in the deposits of a project area.
2. Capable of providing alternate methods to improve its character suitable to the project, so that the structures built will be stable and serve.
3. Describe the dewatering systems for different soil conditions and their effect.
4. Express the working principles of different compaction methods on improving weak deposits.
5. Express the design of geo textiles reinforcements for ground improvement.
6. Express the soil stabilization methods for the problematic soils.

UNIT I - DEWATERING
Introduction - Scope and necessity of ground improvement in Geotechnical engineering basic concepts and philosophy. Drainage - Ground Water lowering by well points, deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques.

UNIT II - COMPACTION AND SAND DRAINS
Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods - sand piles – concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of above methods.

UNIT III - STONE COLUMN, LIME PILES AND SOIL NAILING
Stone column, lime piles – Functions – Methods of installation – design, estimation of load carrying capacity and settlement. Root piles and soil nailing - methods of installation – Design and Applications – case studies.

UNIT IV - EARTH REINFORCEMENT
Earth reinforcement – Principles and basic mechanism of reinforced earth, simple design, Synthetic and natural fibre based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.

UNIT V - GROUTING
Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods - jet grouting – grout monitoring – Electro – chemical stabilization – Stabilization with cement, lime etc. – Stabilization of expansive clays.

Suggested Readings

1. RamanathaAyyar, T.S., Ramachandran Nair, C.L. and Balakrishnan Nair, N., (2002.) Comprehensive Reference book on Coir Geotextiles, Centre for development of Coir Technology.
2. Koerner, R.M.,(1997) Designing with Geosynthetics, Third Edition, Prentice Hall.
3. Jewell, R.A.,(1996) Soil Reinforcement with Geotextiles, CIRIA, London.
4. Jones, J.E.P.,(1985) Earth Reinforcement and Soil Structure, Butterworths,.
5. Rowe, R.K.,(2001) Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers.
6. Moseley, M.D., (1998) Ground Treatment, Blackie Academic and Professional.
7. Das, B.M(1999), Principles of Foundation Engineering, Fourth Edition, PWS Publishing.

8. Koerner, R.M. and Welsh, J.P(1990), Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley.
9. Hehn, R.W(1996.), Practical Guide to Grouting of Underground Structures, ASCE.
10. Shroff, A.V(1999), Grouting Technology in Tunneling and Dam, Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

Part III :Ph.D in Civil Engineering **2019-20**

19RCE305 **Geopolymer Cement and Concrete** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

1. To familiarize with the basic chemistry, structure, and reactions of geopolymer formation and its reaction products
2. To understand the fundamentals of Geopolymer composites (resins, pastes, mortars, concretes) and their characterization using different advanced analytical tools
3. To study the characteristic properties of Geopolymer composites such as strength, durability, waste utilization, safe disposal of hazardous effluents and heavy metal encapsulations
4. To identify and evaluate various geopolymer systems for commercially viable practical applications in various fields such as infrastructure, nuclear, constructions, buildings, precast systems, strengthening/retrofitting operations, and thermal/fire resistances
5. To analyse the Geopolymer composites with reference to ecology, economy, sustainability and environmental friendliness

COURSE OUTCOMES:

On completion of the course, the students will be able to:

1. Understand the concepts of basic chemistry, structure, and reactions of geopolymer formation and its reaction products
2. Understand the fundamentals of Geopolymer composites and their characterization
3. characteristic properties of Geopolymer composites such as strength, durability, waste utilization, safe disposal of hazardous effluents and heavy metal encapsulations
4. Identify and evaluate various geopolymer systems for commercially viable practical applications.
5. Analyse the Geopolymer composites with reference to ecology, economy, sustainability and environmental friendliness
6. Will gain the knowledge about toxic waste management

UNIT I - POLYMERS AND GEOPOLYMERS
Introduction - The mineral polymer concept: silicones and geopolymers - Macromolecular structure of natural silicates and alumino silicates - Scientific Tools, X-rays, FTIR, NMR – Poly (siloxonate) and polysilicate, soluble silicate,Si:Al=1:0 - Chemistry of (Na,K)–oligo-sialates: hydrous alumino-silicate gels and zeolites - Kaolinite / Hydrosodalite based geopolymer, poly(sialate) with Si:Al=1:1 - MetakaolinMK-750 based geopolymer, poly(sialate-siloxo) with Si:Al=2:1- Chemical mechanism: formation of ortho-sialate (OH)3-Si-O-Al- (OH)3 –

UNIT II - GEOPOLYMERS AND TOXIC WASTE MANAGEMENT
Calcium based geopolymer, (Ca, K, Na)-sialate, Si:Al=1, 2, 3 - Silica-based geopolymer, sialate link and siloxo link in poly(siloxonate) Si:Al>5 - Fly ash-based geopolymer - Phosphate-based geopolymers - Organic-mineral geopolymer - Containment with barriers - Waste encapsulation requires MK-750-based geopolymers - Heavy metals in mine tailings - The use of geopolymers for paint sludge disposal - Treatment of arsenic-bearing wastes - Uranium mining waste treatment - Geopolymers in other toxic-radioactive waste management applications

UNIT III - PROPERTIES AND APPLICATIONS
Physical properties of condensed geopolymers - Chemical Properties of condensed geopolymers - Long-term durability, archaeological analogues, geological analogues - Quality control - Development of user-friendly systems – Castablegeopolymer, industrial and decorative applications - Geopolymer – fiber composites - Foamed geopolymer - Geopolymers in ceramic processing

UNIT IV - GEOPOLYMER CEMENT
The manufacture of geopolymer cements - Greenhouse CO2 mitigation fosters the development of geopolymer cements - Additional Raw-Materials from industrial wastes - Additional Raw-Materials from industrial wastes - Replacement of (Na,K) soluble silicates with synthetic lavas

UNIT V - GEOPOLYMER CONCRETE
Geopolymer concrete - Mixture proportions of fly ash-based geopolymer concrete - Mixing, casting, and compaction of fly ash-based geopolymer concrete - Curing of fly ash-based geopolymer concrete - Design of fly ash-based geopolymer concrete mixtures - Short-term properties of fly ash-based geopolymer concrete - Long-term properties of fly ash-based geopolymer concrete - Reinforced geopolymer concrete beams and columns - Better than Portland cement concrete

Suggested Readings

1. Joseph Davidovits(2011), Geopolymer Chemistry and Applications ,Institute Géopolymère , 16 rue Galilée , France.
2. Advanced concrete technology by Zongjinli , John – Wily & sons , New Jersey
3. Innovative Material for concrete construction – ACES workshop by Michael N.Fardis, Springer Publications, London, New York
4. Dr. P. PurushothamaRaj , "Ground Improvement Techniques",Laxmi Publications , New delhi.

Part III :Ph.D in Civil Engineering **2019-20**

19RCE306 **Pavement Engineering** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

1. To understand the importance of transportation and characteristics of road transport
2. To know about the history of highway development, surveys and classification of roads
3. To study about the geometric design of highways
4. To study about traffic characteristics and design of intersections
5. To know about the pavement materials and design
6. To design flexible and rigid pavements as per IRC.

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Carry out surveys involved in planning and highway alignment.
2. Design cross section elements, sight distance, horizontal and vertical alignment.

3. Implement traffic studies, traffic regulations and control, and intersection design.
4. Determine the characteristics of pavement materials.
5. Design flexible and rigid pavements as per IRC.
6. Will gain the knowledge of horizontal and vertical curves

UNIT I - BASIC CONCEPTS
Pavements types – Historical developments - Approaches to pavement design –vehicle and traffic considerations – behaviour of road materials under repeatedloading – Stresses and deflections in layered systems.

UNIT II - FLEXIBLE PAVEMENT
Factors affecting flexible pavements – material characterization for analyticalpavement design – CBR and stabilometer tests – Resilient modulus – Fatiguesubsystem – failure criteria for bituminous pavements – IRC design guidelines.

UNIT III - RIGID PAVEMENT
Factors affecting rigid pavements - Design procedures for rigid pavement – IRC guidelines – Airfield pavements.Highway pavements – CRC pavements.

UNIT IV - PAVEMENT EVALUATION AND REHABILITATION
Pavement evaluation and rehabilitation, condition and evaluation surveys causes and types of distress – in flexible and rigid pavements – PSI models – Serviceability indexof rural roads – Overlay design, pavements maintenance management and construction.

UNIT V - STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS
The need for a stabilized soil – Design criteria and choice of stabilizers – Testing and field control – Stabilisation in India for rural roads – Use of Geosynthetics in road construction - Case studies.

Suggested Readings

1. Wright, P.H(1996), Highway Engineers, John Wiley & Sons, Inc., New York.
2. Khanna S.K and Justo C.E.G(2001), Highway Engineering, Eighth Edition, New Chand and Brothers, Roorkee.
3. Yoder R.J and WitchakM.W(2000)., Principles of Pavement Design, John Wiley.
4. Croney, D(1979), Design and Performance of Road Pavements, HMO Stationary Office.
5. Design and Specification of Rural Roads (Manual),(2001), Ministry of rural roads, Government of India, New Delhi.
6. Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.
7. Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.
8. O' Flaherty, C.A (1978), Highway Engineering (Vol. 2), Edward Arnold Cp.
9. Bell. P.S(1978), Developments in Highway Engineering, Applied Sciences publishers.

19RCE307 **Solid and hazardous waste management** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**

End Semester Exam: 3 Hours

Course Objectives:

1. To gain a brief knowledge on different hazardous waste and its disposal methods.
2. To provide students with the necessary background and knowledge about the various sources.
3. To know the on-site/off-site processing of the Solid waste management and the disposal methods.
4. To characterize the waste and its sources with various test available for checking the quality.
5. To impart knowledge and skills in various components of Municipal Solid Waste Management.
6. To gain the knowledge of processing and conversion technologies.

Course Outcomes:

1. Brief knowledge on different hazardous waste and its disposal methods.
2. The necessary background and knowledge about the various sources.
3. The on-site/off-site processing of the Solid waste management and the disposal methods.

4. Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of materials and energy from waste.
5. Have an overview of the Indian and international waste management regulations and guidelines for the design, construction, operation and management of waste treatment facilities.
6. Ways of operation of collection, transfer, treatment, management and disposal of wastes as per Solid Waste Management Rules, 2016.

UNIT I- INTRODUCTION

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management – Elements of integrated waste management and roles of stakeholders - Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, plastics and fly ash.

UNIT II - WASTE CHARACTERISATION AND SOURCE REDUCTION

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes – Recycling and reuse – Waste exchange.

UNIT III - STORAGE, COLLECTION AND TRANSPORT OF WASTES

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport

UNIT IV- WASTE PROCESSING TECHNOLOGIES

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes

UNIT V - WASTE DISPOSAL

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – closure of landfills – landfill remediation.

Suggested Readings

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, (1993), “Integrated Solid Waste Management, McGraw- Hill International edition, New York.
2. CPHEEO (2000), “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi.

19RCE308 Remote Sensing and GIS Applications in Environmental Engineering 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

1. To gain a sound fundamental understanding of the GIS and remote sensing technologies
2. To understand the basic principles underlying the GIS/model-based management of water resources and environment.
3. To become familiar with the GIS-based analytical and problem-solving techniques for sustainable planning and management of water resources and environmental problems.
4. Different types of remotely sensed images and data available for water resource applications.
5. To apply the GIS-based analytical and problem-solving techniques for sustainable planning and management of water resources and environmental problems.
6. To develop a project report and can develop Water Resource Information Systems (WRIS) for regional and basin scale.

COURSE OUTCOMES

By the end of this course the students will be able to

1. Develop fundamental understanding of the GIS and remote sensing technologies
2. Understand the basic principles underlying the GIS based management of water resources and environment.

3. Apply the GIS-based analytical and problem-solving techniques for sustainable planning and management of water resources and environmental problems.
4. Understand the types of remotely sensed images and data available for water resource applications.
5. Develop a project report and can develop Water Resource Information Systems (WRIS) for regional and basin scale.
6. Understand the basic principles underlying the GIS/model-based management of water resources and environment.

UNIT I -FUNDAMENTALS OF REMOTE SENSING
Introduction to remote sensing – Principles of Electro – Magnetic Radiation – Energy / Matter interaction with Atmosphere and land surface – spectral reflectance of earth Materials and vegetation – Data products

UNIT II - AERIAL PHOTOGRAPHY AND SATELLITE REMOTE SENSING

Aerial Photography – photogrammetry And Visual Image Interpretation –Various Satellites in orbit and their sensors – Resolutions - Multispectral Remote Sensing System (MSS) and design – VISIBLE – NIR remote sensing – Thermal IR Radiation Properties, systems and application – Microwave and LIDAR remote sensing – Principles and applications

UNIT II - DATA ANALYSIS AND GIS

Data Analysis – Visual interpretation and digital image processing – Classification -Introduction to GIS, concepts and base structure , various GIS software.

UNIT IV - REMOTE SENSING AND GIS APPLICATIONS
Application of Remote sensing and GIS – Management and Monitoring of Land, air ,Water and pollution studies – conservation of resources – coastal zone management –
Limitations

UNIT V - LABORATORY PRACTIES

Data sources - Visual interpretation - digital image processing –Introduction to ENVI image processing software – GIS / Data Analysis in ARC GIS.

Suggested Readings

1. Anji Reddy ,(2001) "Remote Sensing and Geographical Information system ", B S Publications.
2. M.G. Srinivas (2001) "Remote sensing applications", Narosa publishing House .
3. A M. Chandra and S.k .Ghosh, (2006) "Remote Sensing and Geographical Information System", Narosa Publishing House.
4. Lintz, J. andSimonet,(1994.) Remote Sensing of Environment, Addison Wesle Publishing Company.

5. Burro ughs (1998) P.A, Principles of Geographical Information system , Oxford UniversityPress .
6. Thomas M Lille sand , Rupiah W.Kiefer& Jonathan W. Chip man (2004) “Remote sensing and Image Interpretation “ John Wiley Sons.

Part III :Ph.D in Civil Engineering **2019-20**

19RCE309 **Groundwater Modeling And Management** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

1. These courses are introduced to the students to understand the basic concept of mathematical modelling
2. To know about the process simulation techniques of environmental disturbances
3. To know about modeling concept and transport phenomena.
4. To understand ground water prospecting.
5. To understand the contaminant transport model in environment.
6. To gain the knowledge about the ground water flow model.

Course Outcomes:

At the end of this course students can

1. Understand the basic concept of mathematical modelling
2. Know about the process simulation techniques of environmental disturbances with groundwater domains.

3. Concept of modeling concept and transport phenomena.
4. Understand ground water flow model.
5. Understand the ground water prospecting understand the contaminant transport model in environment.
6. Know the importance of Subsurface mass transport through the vadose zone.

UNIT I - GROUNDWATER PROSPECTING

Investigation and evaluation – Geophysical methods- Electrical Resistivity methods – Interpretation of data – Seismic method – Subsurface investigation – Test drilling – Resistivity logging – Application of remote sensing techniques.

UNIT II - GROUNDWATER FLOW MODEL

Physical models – Analog models – Mathematical modeling – Unsaturated flow models Numerical modeling of groundwater flow – Finite Differential equations - Finite difference solution – Successive over Relaxation, Alternating direction implicit procedure – Crank Nicolson equation – Iterative methods -Direct methods - Inverse problem – Finite element method

UNIT III - CONTAMINANT TRANSPORT MODEL

Contaminant transport theory – Advection, dispersion equation – Longitudinal and transverse dispersivity – Hydrodynamic dispersion – Analytical models – Numerical simulation of solute transport – Solution methods - Sorption model – Subsurface mass transport through the vadose zone - Density driven flow - Heat transport.

UNIT IV - MODEL DEVELOPMENT

Data requirements – Conceptual model design : Conceptualization of aquifer system – Parameters, Input-output stresses, Initial and Boundary conditions - Model design and execution : Grid design, Setting boundaries, Time discretization and Transient simulation – Model calibration : steady state and unsteady state – sensitivity analysis – Model validation and prediction – Uncertainty in the model prediction

UNIT V - GROUNDWATER MANAGEMENT MODEL

Optimal groundwater development – Indian GEC norms – Conjunctive use models Modeling multilayer groundwater flow system -Modeling contaminant migration – Modeling fracture flow system – Artificial recharge feasibility through modeling – Simulation of movements of solutes in unsaturated zone – Stochastic modeling of groundwater flow - Groundwater contamination, restoration and management

Suggested Readings

1. Anderson M.P., and Woessner W.W (2000), Applied Groundwater Modelling : Simulation of flow and advective transport, Academic Press, Inc.
2. Fetter C.W (2008) Contaminant Hydrogeology, Prentice Hall.
3. Rushton K.R (2003),Groundwater Hydrology:Conceptual and Computational Models, Wiley.
4. Elango L. and Jayakumar, R. (2001), Modelling in Hydrology, Allied Publishers Ltd.
5. Remson I., Hornberger G.M. and MoltzF.J(2007), Numerical Methods in Subsurface Hydrology, Wiley, New York.
6. Robert Willis and William W.G.Yenth (1987), Groundwater System Planning and Management, Prentice Hall, Englewood Cliffs.
7. M. Thangarajan, Vijay P. Singh,(2016), Groundwater Assessment, Modeling, and Management, CRC Press Custom Publishing.

19RCE310 Industrial Wastewater Pollution -Prevention and Control 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

Course Objectives:

1. To learn various process engineering, unit operations of Mining, Metallurgical, Thermal Power, Cement and Petroleum Industries.
2. Provides a fundamental understanding of the design, operational principles and practical applications of modern instrumental methods employed in chemical analysis of environmental samples.
3. To have a basic knowledge about Source reduction techniques.
4. To understand the concept of wastewater reuse and residual management
5. To understand detailly about Disposal on water and land
6. To gain the knowledge about the pollution prevention of assessment.

Course Outcomes:

At the end of this course students can

1. Understanding the environmental aspects and impacts of each unit operations of the polluting industries.
2. The students will be able to understand and orient themselves with the industry before they undergo summer training, internship, interview or job.
3. The students will be able to conceive and prepare Environmental Management Plan of these industries.
4. Develop critical thinking skills in the areas of instrument selection, method development and data interpretation.
5. Knowledge in various case studies about various industries.
6. Able to get a detailed Regulatory requirement for treatment of industrial wastewater.

UNIT I - INTRODUCTION
Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management

UNIT II - INDUSTRIAL POLLUTION PREVENTION
Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Pollution Prevention of Assessment - Material balance - Evaluation of Pollution prevention options –Cost benefit analysis – pay back period - Waste minimization Circles

UNIT III - INDUSTRIAL WASTEWATER TREATMENT
Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – carbon adsorption – Photo-catalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal.- Treatability studies.

UNIT IV - WASTEWATER REUSE AND RESIDUAL MANAGEMENT
Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse, Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

UNIT V - CASE STUDIES
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries.

Suggested Readings

1. Eckenfelder, W.W (2000) Industrial Water Pollution Control, Mc-Graw Hill.
2. Nelson Leonard Nemerow (2007), Industrial waste treatment contemporary practice and vision for the future, Elsevier, Singapore.
3. Frank Woodard (2001), Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi.

4. Paul L. Bishop (2000) Pollution Prevention: - Fundamentals and Practice, Mc-Graw Hill International, Boston.
5. Dezotti, Márcia, Lippel, Geraldo, Bassin, João Paulo (2018) - Advanced Biological Processes for Wastewater Treatment, Springer International Publishing.
6. MogensHenze, PoulHarremoes, Erik Arvin, Jes LaCour Jansen (2017), "Wastewater Treatment" Springer-Verlag Berlin Heidelberg.

Part III :Ph.D in Civil Engineering **2019-20**

19RCE311 **Environmental Policies and Legislations** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

1. Understating the environmental laws, acts, standard for environmental compliance.
2. Understating the EIA and its methodologies for Industries and Regulators.
3. To learn methodologies of Environmental Management System through Appellate Authority – Penalties for violation of consent conditions
4. To learn the implementation of Environmental Management System through Environmental Audits.
5. Insight of regulatory framework related to hazardous waste management.
6. To have a knowledge about the air act, water act and environmental act.

Course Outcomes:

At the end of this course students can learn the

1. Concepts and applications of Environmental Laws and EIA in real world situations
2. Environmental management system and various auditing processes.
3. Prepare the statutory Environmental Statement for various industries.
4. Serve and guide the industrial sector as good corporate citizens.
5. Understanding the principles of regulatory framework for the treatment and disposal of hazardous wastes.
6. Knowledge about the Concept of absolute liability.

UNIT I - INTRODUCTION
Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration – Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework (SPCB/CPCB/MoEF)

UNIT II - WATER (P&CP) ACT, 1974
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

UNIT III - AIR (P&CP) ACT, 1981
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

UNIT IV- ENVIRONMENT (PROTECTION) ACT 1986
Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

UNIT V- OTHER TOPICS
Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

Suggested Readings

1. CPCB,(1997)"Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi.
2. Shyam Divan and Armin Roseneranz (2001) "Environmental law and policy in India "Oxford University Press, New Delhi.
3. Pollution control Legislations volume I &II issued by Tamil Nadu Pollution Control Board.

Ph.D. COMPUTER SCIENCE AND ENGINEERING

CURRICULUM AND SYLLABI 2019

Department of Computer Science and Engineering

FACULTY OF ENGINEERING

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 Of UGC Act 1956)
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FACULTY OF ENGINEERING

RESEARCH PROGRAM – PhD in Computer Science and Engineering
(2019–2020 Batch and onwards)

Course code	Name of the course	Instruction hours / week	credits	Maximum Marks (100)
19RCSE101	Research Methodology and pedagogy	4	4	100
19RCSE201	Soft Computing	4	4	100
19RCSE202	Digital Image Processing			
19RCSE203	Cryptography and Network Security			
19RCSE204	Data Warehousing and Data Mining			
19RCSE205	Agent Based Intelligent Systems			
19RCSE206	Network Routing Algorithms			
19RCSE207	Internet of Things			
19RCSE208	Natural Language Processing			
19RCSE209	Machine Learning			
19RCSE210	Virtual Reality			
19RCSE301	Ad hoc Networks	4	4	100
19RCSE302	Big Data			
19RCSE303	Performance Evaluation of Computer Systems and Networks			
19RCSE304	Distributed Computing			
19RCSE305	Component Based Technology			
19RCSE306	XML and Web Services			
19RCSE307	Fuzzy Logic, Neural Networks And Applications			
19RCSE308	Ontology and Semantic Networks			
19RCSE309	Visualization Techniques			
19RCSE310	Virtualization Techniques			
19RCSE311	Grid Computing			
19RCSE312	Advanced Database			
19RCSE313	Embedded Systems			
19RCSE314	Cloud Computing			
19RCSE315	Bio Informatics			
Program Total		12	12	300

19RCSE101RESEARCH METHODOLOGY AND PEDAGOGY4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100**
Total: **100**

Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce the research methodology concepts
- To discuss various steps for experimental design
- To categorize various testing methods used for research
- To discuss about various multivariate statistical techniques applied for research
- To explain about pedagogical methods in higher learning
- To discuss methods to implement research using research methodology and pedagogy

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Identify and understand the research methodology concepts
- Develop various steps for experimental design
- Categorize various testing methods used for research
- Implement various multivariate statistical techniques applied for research
- Understand about pedagogical methods in higher learning
- Explain various methods to implement research using research methodology and pedagogy

UNIT I-INTRODUCTION TO RESEARCH

Research methodology – definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modeling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data- internal sources of data, external sources of data.

UNIT II-EXPERIMENTAL DESIGN

Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales –Types of scale – Thurstone's Case V scale model, Osgood's Semantic Differential scale, Likert scale, Q- sort scale-Sampling methods- Probability sampling methods – simple random sampling with replacement, simple random sampling without replacement, stratified sampling, cluster sampling. Non- probability sampling method – convenience sampling, judgment sampling, quota sampling.

UNIT III-TESTING METHODS

Hypotheses testing – Testing of hypotheses concerning means (one mean anddifference between two means -one tailed and two tailed tests), Concerning variance – onetailed Chi-square test- Nonparametric tests- One sample tests – one sample sign test, Kolmogorov-Smirnovtest, run test for randomness, Two sample tests – Two sample sign test, Mann-Whitney U test,K-sample test – Kruskal Wallis test (H-Test)

UNIT IV-MULTIVARIATE STATISTICAL TECHNIQUES

Data Analysis – Factor Analysis – Cluster Analysis – Discriminant Analysis – Multiple Regression and Correlation – Canonical Correlation – Application of Statistical (SPSS) Software Package in Research.

UNIT V-PEDAGOGICAL METHODS IN HIGHER LEARNING

Objectives and roll of higher education- important characteristics of an effective lecture- Quality teaching and learning- Lecture preparation- Characteristics of instructional design- Methods of teaching and learning: Large group –Technique- Lecture, Seminar, Symposium, Team Teaching, Project, small group technique-Simulation, role playing demonstration, Brain storming, Case studies and assignment, methods of evaluation-self evaluation, student evaluation, diagnostics testing and remedial teaching –question banking-electronic media in education:-'e' learning researches-web based learning.

SUGGESTED READINGS

1. Donald R. Cooper and Ramela S. Schindler, (2000), Business Research Methods, TataMcGraw-

Hill Publishing Company Limited, New Delhi.

2. Uma Sekaran,(2000), Research Methods for Business, John Wiley and Sons Inc., New York.

3. C.R.Kothari, (2001),Research Methodology, WishvaPrakashan, New Delhi.

4. Donald H.McBurney,(2002), Research Methods, Thomson Asia Pvt. Ltd. Singapore.

5. G.W.Ticehurst and A.J.Veal,(1999), Business Research Methods, Longma.

6. Ranjit Kumar, (1999), Research Methodology, Sage Publications, London, New Delhi.

7. Raymond-Alain Thie'tart, et.al.,(1999), Doing Management Research, Sage Publications,

London.

8. Panneerselvam, R., (2004), Research Methodology, Prentice-Hall of India, New Delhi.

19RCSE201 **SOFT COMPUTING** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**

Exam: 3 Hours

Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce neurofuzzy and soft computing concepts
- To discuss various categories of optimization
- To compare supervised and unsupervised learning neural networks
- To discuss various neuro fuzzy modeling algorithms
- To discuss different applications of computational intelligence
- To explain various applications of soft computing to implement in research

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Understand neurofuzzy and soft computing concepts
- Differentiate various categories of optimization
- Understand and compare supervised and unsupervised learning neural networks
- Implement various neuro fuzzy modeling algorithms
- Develop different applications of computational intelligence
- Implement various applications of soft computing to implement in research

UNIT I-FUZZY SET THEORY

Introduction to Neuro – Fuzzy and soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic operations – Member Function Formulation and parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT II-OPTIMIZATION

Derivative-based Optimization – Descent Methods – The Method of steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT III-NEURAL NETWORKS

Supervised Learning Neural Networks – Perceptrons-Adaline – Backpropagation Multilayer perceptrons – Radial Basis Function Networks – Unsupervised Learning and Other Neural Networks – Competitive Learning Networks – Kohonen Self – Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT IV-NEURO FUZZY MODELING

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro-Fuzzy Modeling – Framework – Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT V-APPLICATION OF COMPUTATIONAL INTELLIGENCE

Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency prediction – Soft Computing for Color Recipe Prediction.

SUGGESTED READINGS

1. Soft Computing: Neural Networks, Fuzzy Logic and Genetic Algorithms, Sushil Kumar Singh**,**Galgotia (2012).
2. Soft Computing & Intelligent System: Theory, Tools and Applications, Fakhreddine O. Karray(2009)**,** Pearson Education; First edition .
3. Davis E.Goldberg, (2004),"Genetic Algorithms Search, Optimization and Machine Learning", 4th Edition, Addison Wesley, New York.
4. Rajasekaran S. and G.A.V.Pai, (2006),"Neural Networks, Fuzzy Logic and Genetic Algorithms", 5th Edition, PHI, New Delhi.
5. Eberhart R. P.simpson and R.Dobbins, (2003),"Computional Intelligence PC Tools", 3rd Edition, AP Professional, Boston.

19RCSE202 ADVANCED DIGITAL IMAGE PROCESSING 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**

Exam: 3 Hours

Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce various fundamentals of Digital Image Processing
- To discuss various concepts based on segmentation
- To explain different feature extraction techniques present for digital image processing
- To discuss about registration and image fusion for digital image processing
- To discuss various concepts of 3D image visualization
- To discuss about various research-oriented applications using advanced digital image processing

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Understand various fundamentals of Digital Image Processing
- Explain various concepts based on segmentation
- Compare different feature extraction techniques present for digital image processing
- Explain about registration and image fusion for digital image processing
- Explain various concepts of 3D image visualization
- Develop various research-oriented applications using advanced digital image processing

UNIT I-FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing

UNIT II-SEGMENTATION

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods

UNIT III-FEATURE EXTRACTION

First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV-REGISTRATION AND IMAGE FUSION

Registration- Preprocessing, Feature selection-points, lines, regions and templates Feature correspondence-Point pattern matching, Line matching, region matching Template matching. Transformation functions-Similarity transformationand Affine Transformation. Resampling- Nearest Neighbour and Cubic Splines Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusiondiscrete wavelet transform, Curvelet transform. Region based fusion.

UNIT V-3D IMAGE VISUALIZATION

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images

SUGGESTED READINGS

1. John C.Russ, (2011), "The Image Processing Handbook", CRC Press.
2. Mark Nixon, Alberto Aguado, (2012), "Feature Extraction and Image Processing", Academic Press, 3rd edition.
3. ArdeshirGoshtasby, (2005)," 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications",John Wiley and Sons.
4. Rafael C. Gonzalez, Richard E. Woods,(2007), Digital Image Processing', Pearson,Education, Inc., 3rd Edition.
5. Anil K. Jain, (2002), Fundamentals of Digital Image Processing', Pearson Education,Inc.,
6. Rick S.Blum, Zheng Liu,(2006), " Multisensor image fusion and its Applications",Taylor& Francis.

19RCSE203 CRYPTOGRAPHY AND NETWORK SECURITY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce various concepts of cryptography and network security
- To explain public key encryption
- To discuss message authentication
- To discuss about network security practices
- To illustrate various concepts of system security
- To explain various cryptography and network security applications for research and engineering

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Analyse various concepts of cryptography and network security
- Explain public key encryption
- Understand message authentication
- Discuss about network security practices
- Illustrate various concepts of system security
- Develop various cryptography and network security applications for research and engineering

UNIT I -INTRODUCTION

Attacks - Services - Mechanisms - Conventional Encryption - Classical And Modern Techniques – Encryption Algorithms - Confidentiality.

UNIT II- PUBLIC KEY ENCRYPTION

RSA - Elliptic Curve Cryptography - Number Theory Concepts

UNIT III- MESSAGE AUTHENTICATION

Hash Functions - Digest Functions - Digital Signatures - Authentication Protocols.

UNIT IV-NETWORK SECURITY PRACTICE

Authentication, Applications - Electronic Mail Security - IP Security - Web Security.

UNIT V-SYSTEM SECURITY

Intruders – Viruses – Worms – Firewalls Design Principles – Trusted Systems.

SUGGESTED READINGS

1. Stallings, (2012), Cryptography & Network Security - Principles & Practice, Prentice Hall, 6th Edition

2. Bruce, Schneier, (1996), Applied Cryptography, 2nd Edition, Toha Wiley & Sons,

3. Man Young Rhee, (2003), “Internet Security”, Wiley,

4. Pfleeger&Pfleeger, (2006), “Security in Computing”, Pearson Education, 4th Edition,

19RCSE204 DATA WAREHOUSING AND DATA MINING 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To Introduce the concepts of data warehousing and data mining
- To illustrate various data preprocessing and association rules
- To explain in detail about predictive modeling
- To discuss the concepts of data warehousing in detail
- To explain various applications for research
- To explain the concepts of various data warehousing and data mining functionalities for real life scenarios

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Understandthe concepts of data warehousing and data mining
- Analyse various data preprocessing and association rules
- Understand in detail about predictive modeling
- Interpret the concepts of data warehousing in detail
- Explain various applications for research
- Understand the concepts of various data warehousing and data mining functionalities for real life scenarios

UNIT I - INTRODUCTION

Relation To Statistics, Databases- Data Mining Functionalities-Steps In Data MiningProcess-Architecture Of A Typical Data Mining Systems- Classification Of Data MiningSystems - Overview Of Data Mining Techniques.

UNIT II- DATA PREPROCESSING AND ASSOCIATION RULES

Data Preprocessing-Data Cleaning, Integration, Transformation, Reduction,Discretization Concept Hierarchies-Concept Description: Data Generalization AndSummarization Based Characterization-Mining Association Rules In Large Databases.

UNIT III- PREDICTIVE MODELING

Classification And Prediction: Issues Regarding Classification And Prediction-Classification By Decision Tree Induction-Bayesian Classification-Other ClassificationMethods-Prediction-Clusters Analysis: Types Of Data In Cluster Analysis-Categorization Of Major Clustering Methods: Partitioning Methods – HierarchicalMethods

UNIT IV- DATA WAREHOUSING

Data Warehousing Components -Multi Dimensional Data Model- Data WarehouseArchitecture-Data Warehouse Implementation- -Mapping The Data Warehouse ToMultiprocessor Architecture- OLAP.-Need- Categorization Of OLAP Tools.

UNIT V- APPLICATIONS

Applications of Data Mining-Social Impacts Of Data Mining-Tools-An Introduction ToDB Miner-Case Studies-Mining WWW-Mining Text Database-Mining SpatialDatabases.

SUGGESTED READINGS

1. Jiawei Han, MichelineKamber,(2011), "Data Mining: Concepts and Techniques",Morgan Kaufmann Publishers,
2. Alex Berson,Stephen J. Smith, (2004), "Data Warehousing, Data Mining,& OLAP", TataMcgraw- Hill,
3. UsamaM.Fayyad, Gregory Piatetsky - Shapiro, Padhrai Smyth And Ramasamy, (1996).
4. Uthurusamy,(1996), "Advances In Knowledge Discovery And Data Mining", The M.I.TPress,
5. Ralph Kimball, (1998), "The Data Warehouse Life Cycle Toolkit", John Wiley &SonsInc.,
6. Sean Kelly,(1997), "Data Warehousing In Action", John Wiley & Sons Inc.,

19RCSE205 AGENT BASED INTELLIGENT SYSTEMS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce various concepts of agent based intelligent systems in detail
- To discuss concepts on knowledge representation and reasoning
- To explain about various planning agents
- To understand about agents and uncertainty in detail
- To explain about various higher level agents
- To illustrate various applications of agent based intelligent systems in detail

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Understand various concepts of agent based intelligent systems in detail
- Interpret various concepts on knowledge representation and reasoning
- Understand about various planning agents
- Explain about agents and uncertainty in detail
- Explain about various higher level agents
- Develop various applications of agent based intelligent systems in detail

UNIT I- INTRODUCTION

Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching -Heuristics - Constraint Satisfaction Problems - Game playing.

UNIT II- KNOWLEDGE REPRESENTATION AND REASONING

Logical Agents-First order logic-First Order Inference-Unification-Chaining- ResolutionStrategies-Knowledge Representation-Objects-Actions-Events

UNIT III- PLANNING AGENTS

Planning Problem-State Space Search-Partial Order Planning-Graphs-NondeterministicDomains-Conditional Planning-Continuous Planning-MultiAgent Planning.

UNIT IV -AGENTS AND UNCERTAINITY

Acting under uncertainty – Probability Notation-Bayes Rule and use –BayesianNetworks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory -Decision Network – Complex Decisions.

UNIT V-HIGHER LEVEL AGENTS

Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning-Communication-Formal Grammar-Augmented Grammars-Future of AI.

SUGGESTED READINGS

1. Stuart Russell and Peter Norvig, (2009), "Artificial Intelligence - A Modern Approach",2nd Edition, Prentice Hall,

2. Michael Wooldridge, (2009), "An Introduction to Multi Agent System", John Wiley, 3. Patrick Henry Winston, Artificial Intelligence, III Edition, AW, 1999.

4. Nils.J.Nilsson, (2014), Principles of Artificial Intelligence, Narosa Publishing House,

19RCSE206 **NETWORK ROUTING ALGORITHMS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To expose the students to the layered architecture for communication networks
- To explain about Internet Routingprotocols
- To discuss specific functionality of the network layer.
- To enable the student to understand the basic principles of routing and implementation in conventional networks and the evolving routing algorithms based on Internetworking requirements, optical backbone and the wireless access part of the network.
- Explain about mobile ad –hoc networks
- To enable the student to understand the different routing algorithms existing and their performance characteristics.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

- Understand layered architecture and its significance.
- Learn network layer and various routing techniques available.
- Apply knowledge for identifying a suitable routing algorithm ,implementing it and analyzing its performance for any given network and user requirements and the type of channel over which the network has to operate,
- Design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications.
- Compare Routing techniques and protocols.
- Acquire the knowledge of how data transfer happen in conventional networks.

UNIT I-INTRODUCTION

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Functions of Network layer, General Classification of routing, Routing in telephone networks, Dynamic Non hierarchical Routing (DNHR), Trunk status map routing (TSMR), real-time network routing (RTNR), Distance vector routing, Link state routing, Hierarchical routing.

UNIT II-INTERNET ROUTING

Interior protocol : Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: Exterior Gateway Protocol (EGP) and Border Gateway Protocol (BGP). Multicast Routing: Pros and cons of Multicast and Multiple Unicast Routing, Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing.

UNIT III-ROUTING IN OPTICAL WDM NETWORKS

Classification of RWA algorithms, RWA algorithms, Fairness and Admission Control, Distributed Control Protocols, Permanent Routing and Wavelength Requirements, Wavelength Rerouting- Benefits and Issues, Lightpath Migration, Rerouting Schemes, Algorithms- AG, MWPG.

UNIT IV-MOBILE - IP NETWORKS

Macro-mobility Protocols, Micro-mobility protocol:Tunnel based : Hierarchical Mobile IP, Intra domain Mobility Management, Routing based: Cellular IP, Handoff Wireless Access Internet Infrastructure (HAWAII).

UNIT V-MOBILE AD –HOC NETWORKS

Internet-based mobile ad-hoc networking communication strategies, Routing algorithms – Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).

SUGGESTED READINGS

1. William Stallings, (2009), "High speed networks and Internets Performance and Quality of Service", 2nd Edition, Pearson Education Asia. Reprint India.
2. M. Steen Strub,(1995), ' Routing in Communication network, Prentice –Hall International, Newyork.
3. S. Keshav,(1999), 'An engineering approach to computer networking' Addison Wesley.
4. William Stallings,(1995), 'High speed Networks TCP/IP and ATM Design Principles, Prentice- Hall, New York.
5. C.E Perkins, (2001), 'Ad Hoc Networking', Addison – Wesley.
6. Ian F. Akyildiz, Jiang Xie and ShantidevMohanty,(Aug.2004, pp 16-27) " A Survey of mobilityManagement in Next generation All IP- Based Wireless Systems", IEEE Wireless Communications.

19RCSE207 INTERNET OF THINGS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To understand the basics of Internet of Things
- To get an idea of some of the application areas where Internet of Things can be applied
- To understand the middleware for Internet of Things
- To understand the concepts of Web of Things
- To understand the concepts of Cloud of Things with emphasis on Mobile cloud computing
- To understand the IOT protocols

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

- Understand the concepts of Internet of Things
- Identify and design the new models for various applications using IoT
- Design business intelligence and information security for WoB (Web of Things)
- Analyse various protocols for IoT
- Design a middleware for IoT
- Analyse and design different models for network dynamics

UNIT I-INTRODUCTION

Definitions and Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT– Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT - The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview – Communication middleware for IoT –IoT Information Security

UNIT II-IOT PROTOCOLS

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security

UNIT III-WEB OF THINGS

Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture

UNIT IV-INTEGRATED

Integrated Billing Solutions in the Internet of Things Business Models for the Internet of Things - Network Dynamics: Population Models – Information Cascades - Network Effects - Network Dynamics: Structural Models - Cascading Behavior in Networks - The Small-World Phenomenon

UNIT V-APPLICATIONS

The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments – Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents. Applications - Smart Grid-Electrical Vehicle Charging

SUGGESTED READINGS

1. The Internet of Things in the Cloud: A Middleware Perspective - Honbo Zhou(2012), CRC Press.
2. Architecting the Internet of Things - Dieter Uckelmann; Mark Harrison; Florian Michahelles-(Eds.) (2011) – Springer.
3. Networks, Crowds, and Markets: Reasoning About a Highly Connected World - David Easley and Jon Kleinberg, (2010), Cambridge University Press.
4. The Internet of Things: Applications to the Smart Grid and Building Automation by - Olivier Hersent, Omar Elloumi and David Boswarthick - Wiley (2012).
5. Olivier Hersent, David Boswarthick, Omar Elloumi , (2012), “The Internet of Things – Key applications and Protocols”, Wiley.

19RCSE208 NATURAL LANGUAGE PROCESSING 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To understand the basics of Internet of Things
- To get an idea of some of the application areas where Internet of Things can be applied
- To understand the middleware for Internet of Things
- To understand the concepts of Web of Things
- To understand the concepts of Cloud of Things with emphasis on Mobile cloud computing
- To understand the IOT protocols

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

- Understand the concepts of Internet of Things
- Identify and design the new models for various applications using IoT
- Design business intelligence and information security for WoB (Web of Things)
- Analyse various protocols for IoT
- Design a middleware for IoT
- Analyse and design different models for network dynamics

UNIT I-Overview and Language Modeling

OVERVIEW**:** Origins and challenges of NLP- Language and Grammar- Processing Indian Languages- NLP Applications-Information Retrieval.

LANGUAGE MODELING: Introduction-Various Grammar-based Language Models-Statistical Language Model.

UNIT II-Word Level and Syntactic Analysis

WORD LEVEL ANALYSIS: Introduction- Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. SYNTACTIC ANALYSIS: Introduction-Context-free Grammar-Constituency-Parsing-Probabilistic Parsing.

UNIT III-Semantic Analysis and Discourse Processing

SEMANTIC ANALYSIS: Introduction- Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. DISCOURSE PROCESSING: Introduction- cohesion-Reference Resolution-Discourse Coherence and Structure.

UNIT IV-Natural Language Generation and Machine Translation

NATURAL LANGUAGE GENERATION**:** Introduction-Architecture of NLG Systems- Generation Tasks and Representations-Application of NLG.
MACHINE TRANSLATION: Introduction-Problems in Machine Translation- Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.

UNIT V-Information Retrieval and Lexical Resources
INFORMATION RETRIEVAL**:** Introduction -Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – Evaluation. LEXICAL RESOURCES**:** Introduction-WordNet-FrameNet-Stemmers-POS Tagger- Research Corpora.

SUGGESTED READINGS

1. TanveerSiddiqui, U.S. Tiwary, (2008), "Natural Language Processing and Information Retrieval", Oxford University Press.
2. Daniel Jurafsky and James H Martin, (2008), "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition.
3. James Allen, Bejamin/cummings, (1995), "Natural Language Understanding", 2nd edition.

19RCSE209 **MACHINE LEARNING** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES

- To introduce the basic concepts and techniques of Machine Learning, supervised and unsupervised learning techniques
- To have a complete understanding of linear models and tree models in machine learning
- To study the various probability based learning techniques
- To learn Dimensionality Reduction Techniques.
- To understand Evolutionary Models and Graphical models of machine learning algorithms
- To discuss the overall concepts of various models in Machine learning

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem based on linear and tree model
- Suggest probability learning algorithms for any given problem
- Understand various dimensionality reduction techniques
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification accuracy / efficiency

UNIT I-INTRODUCTION TO MACHINE LEARNING

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT II- MACHINE LEARNING LINEAR MODELS

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi layer Perceptron in Practice – Examples of using the MLP – Overview– Radial Basis Functions and splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT III- TREE AND PROBABILISTIC MODELS

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor

Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

UNIT IV- DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

UNIT V- MACHINE LEARNING GRAPHICAL MODELS

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

SUGGESTED READINGS

1. EthemAlpaydin, (2014) ―Introduction to Machine Learning 3e (Adaptive Computation and MachineLearningSeries),ThirdEdition,MITPress,
2. Jason Bell, (2014)―Machine learning – Hands on for Developers and Technical Professionals, FirstEdition,Wiley,
3. Peter Flach, (2012) ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data,FirstEdition,CambridgeUniversityPress,.
4. Stephen Marsland, (2014) ―Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,
5. Tom M Mitchell, (2013)―Machine Learning, First Edition, McGraw Hill Education,
6. Christopher Bishop,(2007) "Pattern Recognition and Machine Learning" Springer,
7. Kevin P. Murphy,(2012), "Machine Learning: A Probabilistic Perspective", MIT Press,
8. Trevor Hastie, Robert Tibshirani, Jerome Friedman,(2011), "The Elements of Statistical Learning"Springer, Second Edition,
9. https://www.coursera.org/learn/machine-learning

19RCSE210 **VIRTUAL REALITY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications
- To discuss about the futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality.
- Understand the elements, architecture, input and output devices of virtual and augmented reality systems.
- Be able to develop and evaluate 3D interactive applications involving stereoscopic output, virtual reality hardware and 3D user interfaces.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to,

- Demonstrate understanding and perspective on the VR/AR landscape; past, present and future
- Demonstrate understanding of fundamental computer vision, computer graphics and human-computer interaction techniques related to VR/AR
- Analyse and Design a system or process to meet given specifications with realistic engineering constraints.
- Identify problem statements and function as a member of an engineering design team.
- Utilize technical resources
- Propose technical documents and give technical oral presentations related to design mini project results.

Unit I-Introduction of Virtual Reality

Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality – Multiple Modals of Input and Output InterfaceInput -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input

Unit II- Visual Computation in VR

3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices – Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering

Unit III-Environment Modeling and Interactive Techniques

Modeling, Behavior Simulation, Physically Based Simulation:– Body Track, Hand Gesture, 3D Manus, ObjectGrasp – System Structure of Augmented Reality – Key Technology in AR.

Unit IV- Introduction of Augmented Reality (AR)

Frameworks of SoftwareDevelopment Tools in VR. X3D Standard; Vega, MultiGen, Augmented Reality , Mixed Reality, Large Scale Environment Management **Augmented Reality:** System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.

Unit V- Development Tools and Frameworks Application of VR
Virtools– Geometric Modeling, Behavior Simulation, Physically Based Simulation – Body Track, Hand Gesture, 3D Manus, ObjectGraspVR Technology in Film & TV Production – VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR

SUGGESTED READINGS

1. Burdea, G. C. and P. Coffet.(2003/2006), Virtual Reality Technology, Second Edition. Wiley-IEEEPress,.
2. Sherman, William R. and Alan B. Craig.(2002), Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann,
3. Fei GAO.(March 2012), Design and Development of Virtual Reality Application System, Tsinghua Press,
4. Guangran LIU. (Jan 2011), Virtual Reality Technology, Tsinghua Press,

19RCSE301 **AD HOC NETWORKS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To learn Ad-Hoc Wireless Networks, Issues, and Classification of MAC Protocols.
- To understand the different types of AdHoc Routing Protocols and TCP overAdHoc Protocol.
- To understand about Sensor Network Architecture, its Applications and MAC Protocols for sensor networks.
- To learn the Different Issues in Wireless Sensor Routing
- To discuss the Indoor and outdoor Localization and Quality of Service in WSN.
- To learn Mesh Networks , IEEE 802.11s Architecture and different types of Mesh Networks.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Gain the knowledge of Ad-Hoc Network and its issues.
- Identify the basic problems, limitations, strengths and current trends of mobile computing
- Analyse the current wireless networking mechanisms for mobile computing
- Analyseand critique the performance of different networks and algorithms for mobile Computing
- Develop an attitude to propose solutions with comparisons for problems related to mobile computing
- Investigation of different protocols and mobile/wireless networks

UNIT I -INTRODUCTION

Introduction-Fundamentals of Wireless Communication Technology –TheElectromagnetic Spectrum - Radio Propagation Mechanisms - Characteristics of theWireless Channel - IEEE 802.11a,b Standard – Origin Of Ad hoc: Packet RadioNetworks - Technical Challenges - Architecture of PRNETs - Components of PacketRadios – Ad hoc Wireless Networks -What Is an Ad Hoc Network? Heterogeneity inMobile Devices - Wireless Sensor Networks - Traffic Profiles - Types of Ad hoc MobileCommunications - Types of Mobile Host Movements - Challenges Facing Ad HocMobile Networks-Ad hoc wireless Internet

UNIT II- AD HOC ROUTING PROTOCOLS

Introduction - Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks -Classifications of Routing Protocols -Table-Driven Routing Protocols –DestinationSequenced Distance Vector (DSDV) - Wireless Routing Protocol (WRP) - Cluster SwitchGateway Routing (CSGR) - Source-Initiated On-Demand Approaches - Ad Hoc On-Demand Distance Vector Routing (AODV) - Dynamic Source Routing (DSR) -Temporally Ordered Routing Algorithm (TORA) - Signal Stability Routing (SSR) -Location-Aided Routing (LAR) - Power-Aware Routing (PAR) - Zone Routing Protocol(ZRP)

UNIT III- MULTICASTROUTING IN AD HOC NETWORKS

Introduction - Issues in Designing a Multicast Routing Protocol - Operation of MulticastRouting Protocols - An Architecture Reference Model for Multicast Routing Protocols -Classifications of Multicast Routing Protocols - Tree-Based Multicast Routing Protocols-Mesh-Based Multicast Routing Protocols - Summary of Tree-and Mesh-Based Protocols- Energy-Efficient Multicasting - Multicasting with Quality of Service Guarantees -Application-Dependent Multicast Routing - Comparisons of Multicast Routing Protocols

UNIT IV- TRANSPORT LAYER, SECURITY PROTOCOLS

Introduction - Issues in Designing a Transport Layer Protocol for Ad Hoc WirelessNetworks - Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks -Classification of Transport Layer Solutions - TCP Over Ad Hoc Wireless Networks -Other Transport Layer Protocols for Ad Hoc Wireless Networks - Security in Ad HocWireless Networks - Network Security Requirements - Issues and Challenges in SecurityProvisioning - Network Security Attacks - Key Management - Secure Routing in Ad HocWireless Networks

UNIT V-QoS AND ENERGY MANAGEMENT

Introduction - Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks -Classifications of QoS Solutions - MAC Layer Solutions - Network Layer Solutions -QoS Frameworks for Ad Hoc Wireless Networks Energy Management in Ad HocWireless Networks –Introduction - Need for Energy Management in Ad Hoc WirelessNetworks - Classification of Energy Management Schemes - Battery ManagementSchemes - Transmission Power Management Schemes - System Power ManagementSchemes

SUGGESTED READINGS

1. Siva Ram MurthyC. and B.S. Manoj (2004), “Ad Hoc Wireless Networks: Architectures andProtocols”, Prentice Hall PTR,

2. TohC.K., (2001), Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice HallPTR

3. Charles E. Perkins,(2000), Ad Hoc Networking, Addison Wesley,

4. Mobile Ad Hoc Networking, Stefano Basagni, Marco Conti,(26 August 2010)Wiley India Private Limited ,

5. Mobile Ad Hoc Networks: Current Status and Future TrendsHardcover, Jonathan Loo, Jaime LloretMauri, (16 December 2011), CRC Press,.

19RCSE302 **BIGDATA** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To explore the fundamental concepts of big data analytics
- To learn and Analyse big data like Hadoop, NoSqlMapReduce.
- To understand the various search methods and visualization techniques.
- To learn the techniques and principles in achieving big data analytics with scalability and streaming capability
- To learn Hive and Pig scripts in the Hadoop environment.
- To explain various challenges and Solutions in Big Data.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Gain knowledge of Big Data and Hadoop ecosystem
- Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
- Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
- Design and implement MapReduce programs and implementing HBase
- Implement Hive and Pig scripts in the Hadoop Environment.
- Discuss the Challenges and Solutions in Big Data.

UNITI –UNDERSTANDINGBIGDATA

Whatis bigdata–whybigdata–convergenceofkeytrends–unstructureddata–industryexamplesofbigdata–webanalytics–bigdataandmarketing–fraudandbigdata–risk andbigdata–creditriskmanagement –bigdataandalgorithmic trading–bigdataand healthcare –bigdatainmedicine –advertising and bigdata –bigdata technologies – introductiontoHadoop–opensourcetechnologies– cloudandbigdata–mobilebusiness intelligence–Crowdsourcinganalytics–interandtransfirewallanalytics

UNITII –NOSQLDATAMANAGEMENT

Introduction toNoSQL–aggregate datamodels–aggregates –key-valueanddocument data models –relationships –graph databases –schemalessdatabases –materialized views–distributionmodels–sharding–master-slave replication–peer-peerreplication – shardingand replication –consistency –relaxing consistency –version stamps –map- reduce–partitioningandcombining–composingmap-reducecalculations

UNITIII –BASICSOFHADOOP

Dataformat –analyzing data withHadoop –scaling out–Hadoopstreaming –Hadooppipes–designofHadoopdistributedfilesystem(HDFS)–HDFSconcepts–Javainterface –dataflow–HadoopI/O–dataintegrity–compression –serialization–Avro–file-based datastructures

UNITIV –MAPREDUCEAPPLICATIONS

MapReduceworkflows –unittestswithMRUnit–testdataandlocaltests–anatomy of MapReducejobrun–classic Map-reduce –YARN –failures inclassic Map-reduce and YARN –jobscheduling –shuffle andsort–taskexecution –MapReducetypes–input formats–outputformats

UNITV HADOOPRELATEDTOOLS

Hbase– datamodeland implementations– Hbaseclients–Hbaseexamples– praxis.Cassandra–cassandradata model –cassandraexamples –cassandraclients – Hadoopintegration.Pig–Grunt–pigdatamodel–PigLatin– developingandtestingPigLatinscripts.Hive–datatypesandfileformats–HiveQLdatadefinition –HiveQLdatamanipulation – HiveQLqueries.

SUGGESTED READINGS

1.Michael Minelli, Michelle Chambers, andAmbigaDhiraj,(2013),"Big Data,BigAnalytics: EmergingBusinessIntelligenceandAnalyticTrendsforToday'sBusinesses",Wiley.

2. P. J.Sadalageand M. Fowler, (2012),"NoSQLDistilled: ABrief Guide totheEmergingWorldofPolyglotPersistence",Addison-WesleyProfessional,

3.TomWhite, (2012),"Hadoop:TheDefinitiveGuide",ThirdEdition,O'Reilley,

4.EricSammer,(2012), "HadoopOperations",O'Reilley,

5.E.Capriolo,D.Wampler,andJ.Rutherglen, (2012),"ProgrammingHive",O'Reilley,

6.LarsGeorge, (2011), "HBase:TheDefinitiveGuide",O'Reilley,

7. EbenHewitt,(2010), "Cassandra:TheDefinitiveGuide",O'Reilley,

8.AlanGates,(2011), "ProgrammingPig",O'Reilley,

19RCSE303 PERFORMANCE EVALUATION OF COMPUTER SYSTEMS ANDNETWORKS **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce basic concepts of performance evaluation of computer systems and networks
- To explain probability and stochastic processes
- To discuss about queuing theory
- To discuss about petri nets and system performance
- To discuss the process of analysis
- To explore various methods to perform evaluation of computer systems and networks

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Explain basic concepts of performance evaluation of computer systems and networks
- Understand probability and stochastic processes
- Learn about queuing theory
- Understand about petri nets and system performance
- Understand the process of analysis
- Apply various methods to perform evaluation of computer systems and networks

UNIT I- INTRODUCTION

Need for performance evaluation – Role of performance evaluation –performanceevaluation Methods – Performance Metrics and Evaluation Criteria – CPU and I/OArchitectures – Distributed and Network Architectures– Secondary Storage – Topologies– Computer Architecture - Fundamental Concepts and Performance Measures.

UNIT II- PROBABILITY AND STOCHASTIC PROCESSES

Scheduling Algorithms – Workloads – Random Variables – Probability Distributions –Densities – Expectation – Stochastic Processes – Poisson Process – Birth-Death Process –Markov Process.

UNIT III- QUEUING THEORY

Queuing Systems – Networks of Queues - Estimating Parameters and Distributions –Computational Methods – Simulation Process – Time Control – Systems and Modeling.

UNIT IV-PETRI NETS AND SYSTEM PERFORMANCE

Petri Nets – Classical Petri Nets – Timed Petri Nets – Priority-based Petri Nets – ColoredPetri Nets – Generalized Petri Nets – Tool Selection – Validation of Results –Performance Metrics – Evaluation – Multiple Server Computer System Analysis.

UNIT V- ANALYSIS

OS Components – System Architecture – Workloads – Design – Simulation – Analysis -Database System Performance – Computer Networks Components – SimulationModelling of LAN.

SUGGESTED READINGS

1. Paul J. Fortier, Howard E. Michael, (2003), "Computer Systems PerformanceEvaluation and Prediction", Elsvier Science (USA),
2. Thomas G. Robertazzi,(2000), "Computer Networks and Systems: Queing theory andPerformance Evaluation", 3rd Edition, Springer,
3. Domenico Ferrari , Giuseppe Serazzi ,AlexandroZeijher,(1983), Measurement &Tuningof Computer Systems –Prentice Hall Inc,
4. Michael F.Mories and Paul F.Roth,.(1982), Tools and techniques, Computer PerformanceEvaluation, Van Nostrand, New York,

19RCSE304 **DISTRIBUTED COMPUTING** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To understand the fundamentals and acquire knowledge of the architectures of distributed systems.
- To gain knowledge of various remote procedure call models.
- To understand concepts of distributed shared memory systems.
- To make students aware about synchronization and management mechanism for distributed environment.
- To learn features of distributed file systems.
- To explain various security aspect of distributed systems.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

- Understand the principles and desired properties of distributed systems based on different application areas.
- Understand and apply the basic theoretical concepts and algorithms of distributed systems in problem solving.
- Learn the concepts of distributed shared memory systems.
- Analyse various synchronization and management techniques for distributed environment.
- Identify the features of distributed file systems.
- Understand the security aspect of distributed systems.

UNIT I- INTRODUCTION

Characterization of Distributed Systems - Examples - Resource Sharing and the Web -Challenges - System Models - Architectural and Fundamental Models - Networking andInternetworking - Types of Networks - Network Principles - Internet Protocols - CaseStudies.

UNIT II- PROCESSES AND DISTRIBUTED OBJECTS

Interprocess Communication - The API for the Internet Protocols - External DataRepresentation and Marshalling - Client-Server Communication - Group Communication- Case Study - Distributed Objects and Remote Invocation - Communication BetweenDistributed Objects - Remote Procedure Call - Events and Notifications - Java RMI -Case Study.

UNIT III- OPERATING SYSTEM ISSUES – I

The OS Layer - Protection - Processes and Threads - Communication and Invocation –OS Architecture - Security - Overview - Cryptographic Algorithms - Digital Signatures -Cryptography Pragmatics - Case Studies - Distributed File Systems - File ServiceArchitecture - Sun Network File System - The Andrew File System

UNIT IV- OPERATING SYSTEM ISSUES – II

Name Services -Domain Name System - Directory and Discovery Services –GlobalName Service - X.500 Directory Service - Clocks, Events and Process States -Synchronizing Physical Clocks - Logical Time And Logical Clocks - Global States -Distributed Debugging - Distributed Mutual Exclusion – Elections – MulticastCommunication Related Problems.

UNIT V- DISTRIBUTED TRANSACTION PROCESSING

Transactions - Nested Transactions - Locks - Optimistic Concurrency Control -Timestamp Ordering - Comparison - Flat and Nested Distributed Transactions –AtomicCommit Protocols - Concurrency Control in Distributed Transactions –DistributedDeadlocks - Transaction Recovery - Overview of Replication And DistributedMultimedia Systems

SUGGESTED READINGS

1. George Coulouris, Jean Dollimore and Tim Kindberg, (2011), Distributed Systems Conceptsand Design, Pearson Education, 5th Edition,

2. SapeMullender,(1993), Distributed Systems, Addison Wesley, 2nd Edition,

3. Albert Fleishman, (1994), Distributes Systems- Software Design and Implementation,Springer-Verlag,

4. LiuM.L.,(2004), Distributed Computing Principles and Applications, Pearson Education,

5. Andrew S Tanenbaum , Maartenvan Steen, (2006), Distibuted Systems –Principles andPardigms,Pearson Education,

6. MugeshSinghal,Niranjan G Shivaratri, (2008), Advanced Concepts in OperatingSystems,Tata McGraw Hill Edition, 21st reprint,

19RCSE305 **COMPONENT BASED TECHNOLOGY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- Introduce Component based technology
- Explain about java component technologies
- Discuss about various Corba technologies
- Discuss various aspects of .com and .Net technologies
- Discuss about component frameworks and development
- Discuss application of Component based technology

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

- UnderstandComponent based technology
- Interpret about java component technologies
- Learn about various Corba technologies
- Understand various aspects of .com and .Net technologies
- Understand about component frameworks and development
- Interpret application of Component based technology

UNIT I- INTRODUCTION

Software Components – objects – fundamental properties of Component technology –modules – interfaces – callbacks – directory services – component architecture –components and middleware.

UNIT II- JAVA COMPONENT TECHNOLOGIES

Threads – Java Beans – Events and connections – properties – introspection – JAR files –reflection – object serialization – Enterprise Java Beans – Distributed Object models –RMI and RMI-IIOP.

UNIT III- CORBA TECHNOLOGIES

Java and CORBA – Interface Definition language – Object Request Broker – systemobject model – portable object adapter – CORBA services – CORBA component model –containers – Application server – model driven architecture.

UNIT IV -COM AND .NET TECHNOLOGIES

COM – Distributed COM – object reuse – interfaces and versioning – dispatch interfaces– connectable objects – OLE containers and servers – Active X controls – .NETcomponents - assemblies – appdomains – contexts – reflection – remoting.

UNIT V- COMPONENT FRAMEWORKS AND DEVELOPMENT

Connectors – contexts – EJB containers – CLR contexts and channels – Black Boxcomponent framework – directory objects – cross-development environment –component-oriented programming – Component design and implementation tools –testing tools - assembly tools.

SUGGESTED READINGS

1. Clemens Szyperski, (2011), “Component Software: Beyond Object-Oriented Programming”,Addison Wesley, 2nd Edition

2. Ed Roman, (2004), “Enterprise Java Beans”,3rd Edition, Wiley,

3. Andreas Vogel, Keith Duddy, (1998), “Java Programming with CORBA”, John Wiley &Sons

4. Corry, Mayfield, Cadman,(1999), “COM/DCOM Primer Plus”, Tec media, 1st Edition,

19RCSE306 **XML AND WEB SERVICES** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce the fundamentals of XML and web services
- To gain knowledge of XML technology
- To understand concepts of SOAP
- To make students aware about various web services available
- To learn features of XML security system available
- To explain various applications and research based on XML and web services

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

- Understand the fundamentals of XML and web services
- Interpret knowledge of XML technology
- Illustrate concepts of SOAP
- Be aware about various web services available
- Explain features of XML security system available
- Develop various applications and research oriented concepts based on XML and web services

UNIT I - INTRODUCTION

Role Of XML – XML and The Web – XML Language Basics – SOAP – Web Services –Revolutions Of XML – Service Oriented Architecture (SOA).

UNIT II- XML TECHNOLOGY

XML – Name Spaces – Structuring With Schemas and DTD – Presentation Techniques –Transformation – XML Infrastructure.

UNIT III- SOAP

Overview Of SOAP – HTTP – XML-RPC – SOAP: Protocol – Message Structure –Intermediaries – Actors – Design Patterns And Faults – SOAP With Attachments.

UNIT IV- WEB SERVICES

Overview – Architecture – Key Technologies - UDDI – WSDL – ebXML – SOAP And

Web Services In E-Com – Overview Of .NET And J2EE.

UNIT V- XML SECURITY

Security Overview – Canonicalization – XML Security Framework – XML Encryption –

XML Digital Signature – XKMS Structure – Guidelines For Signing XML Documents –

XML In Practice.

SUGGESTED READINGS

1. Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC, and XML Black Book, Kogent Learning Solutions Inc.Dreamtech Press, (2013).
2. XML and Web Services Unleashed Ron Schmelzer,(2008), Pearson Education; First edition,

3. Frank. P. Coyle,(2002), XML, Web Services And The Data Revolution, Pearson Education,

4. Ramesh Nagappan , Robert Skoczylas and Rima Patel Sriganesh,(2004), " Developing JavaWeb Services", Wiley Publishing Inc.,

5. SandeepChatterjee, James Webber, (2004), "Developing Enterprise Web Services", PearsonEducation,

6. McGovern, et al., (2005),"Java Web Services Architecture", Morgan KaufmannPublishers,

19RCSE307 **FUZZY LOGIC, NEURAL NETWORKS AND APPLICATIONS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES

- To introduce the basic concepts of Fuzzy logic and its applications in various domain
- To educate how to use Fuzzy computation to solve real-world problems
- To have a solid understanding of Basic fuzzy models.
- Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
- To learn about applications on Fuzzy based systems
- To familiarize with fuzzy fiction and de fuzzy fiction procedures

COURSE OUTCOMES

At the end of the course the students will be able to

- Understand the basic concepts of Fuzzy logic and its applications invarious domain
- Gain knowledge on theory of Reasoning
- Develop fuzzy controllers
- Understand concepts of adaptive fuzzy control
- Ability to develop how to use Fuzzy computation to solve real- world problems
- Design fuzzy based model for any application

UNIT I -INTRODUCTION TO NEURAL NETWORKS

Biological neural - Neural processing - Supervised and unsupervised learning - Neural network learning rules. Single layer perception - discrete and continuous perception - multi layer feed forward network – Back propagation Networks - feed back networks - Training Algorithms.

UNIT II -UNSUPERVISED NETWORKS

Unsupervised Learning – Competitive Learning Networks – Kohonen self organising networks – Learning Vector Quantization – Hebbian Learning – Hopfield Network –Content Addressable Nature – Binary Hopfield Network – Continuous Hopfield Network

UNIT III -ASSOCIATIVE MEMORIES AND SOM

Bidirectional Associative Memory – Principle Component Analysis. Auto associative memories - Bidirectional Associative memory (BAM) - Self Organization Maps (SOM) and ART1.

UNIT IV -FUZZY LOGIC

Fuzzy sets - Fuzzy Rules: Extension Principle, fuzzy measures - fuzzy relations - fuzzy functions-Fuzzy Reasoning.

UNIT V -FUZZY SYSTEMS AND APPLICATIONS

Representation of fuzzy knowledge - fuzzy inference systems- Mamdani Model – Sugeno Model – Tsukamoto Model– Fuzzy decision making – Multi Objective Decision Making – Fuzzy Classification– Fuzzy Control Methods – Application.

SUGGESTED READINGS

1. Jang J S R Sun C T and Mizutani E, (2004), “Neuro Fuzzy and Soft computing”, PearsonEducation, (Singapore),
2. S Rajasekaran and G A VijayalakshmiPai,(2004), “Neural networks Fuzzy logics and Genetic algorithms”, Prentice Hall of India,
3. Derong Liu , (2011), “Advances in Neural Networks--ISNN 2007 “, Springer, 8th edition,
4. Timothy J Ross,(2004), “Fuzzy Logic Engineering Applications”, John Wiley and Sons, James A. Anderson, (2010), “An Introduction to Neural Networks”, Prentice Hall, 3rd edition,

19RCSE308 ONTOLOGY AND SEMANTIC NETWORKS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To understand the basic concepts and layers of semantic web.
- To learn RDF data models and querying the semantic web using SPARQL
- To learn Ontology Engineering, construction and reusing.
- To understand the description logics and monotonic rules.
- To learn Social Network Analysis and semantic web
- To explain various applications of Semantic web technologies to real world.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Describe the rationale behind Semantic Web.
- Model ontologies using Resource Description Framework (RDF).
- Design RDF Schemas for ontologies.
- Model and design ontologies using Web Ontology Language (OWL).
- Query ontologies using SPARQL.
- Apply Semantic web technologies to real world applications.

UNIT I- INTRODUCTION

Components – Types – Ontological Commitments – Ontological Categories – Philosophical Background -Sample - Knowledge Representation Ontologies – Top Level Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need – Foundation – Layers – Architecture.

UNIT II- LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES

Web Documents in XML – RDF - Schema – Web Resource Description using RDF- RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics – Pragmatics - Traditional Ontology Languages – LOOM- OKBC – OCML - Flogic Ontology Markup Languages – SHOE – OIL - DAML + OIL - OWL

UNIT III- ONTOLOGY LEARNING FOR SEMANTIC WEB

Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning –Importing and Processing Ontologies and Documents – Ontology Learning Algorithms -Evaluation

UNIT IV -ONTOLOGY MANAGEMENT AND TOOLS

Overview – need for management – development process – target ontology – ontology mapping – skills management system – ontological class – constraints – issues. volution – Development of Tools and Tool Suites – Ontology Merge Tools – Ontology based Annotation Tools.

UNIT V- APPLICATIONS

Web Services – Semantic Web Services - Case Study for specific domain – Security issues – current trends.

SUGGESTED READINGS

1. Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL, Dean Allemang, James Hendler,(5 July 2011), Morgan Kaufmann; 2 edition,
2. Semantic Web: Concepts, Technologies and Applications, Karin Breitman, Marco Antonio Casanova(2009),Springer (sie),
3 . Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez (2004), "Ontological Engineering: with examples from the areas of Knowledge Management, e-Commerce and the Semantic Web" Springer,
4. Grigoris Antoniou, Frank van Harmelen,(2004), "A Semantic Web Primer (Cooperative Information Systems)", The MIT Press,
5. Alexander Maedche, (2002), "Ontology Learning for the Semantic Web", Springer; 1 edition,
4. John Davies, Dieter Fensel, Frank Van Harmelen, (2003),"Towards the Semantic Web: Ontology – Driven Knowledge Management", John Wiley& Sons Ltd.,
6. John Davies (Editor), Rudi Studer (Co-Editor), Paul Warren (Co-Editor) (Jul 2006), "Semantic Web Technologies: Trends and Research in Ontology-based Systems "Wiley Publications,

19RCSE309 **VISUALIZATION TECHNIQUES** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce the basic concepts of visualization techniques.
- To learn popular techniques in visualization techniques.
- To learn advanced techniques on visualization.
- To understand the description of visualization systems.
- To learn software visualization.
- To explain various applications ofvisualization to real world.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Interpret the basic concepts of visualization techniques.
- Learnpopular techniques in visualization techniques.
- Analyse variousadvanced techniques on visualization.
- Describe various visualization systems.
- Learn varioussoftware visualization techniques.
- Develop various applications ofvisualization to real world.

UNIT I- INTRODUCTION

Introduction to Visualisation - Principles of 2D & 3D Computer Graphics - Models andSimulation strategies.

UNIT II- POPULAR TECHNIQUES

Surface Plots - City scopes - Fish eye views - Benediktine Space - Perspective walls -Cone trees and Cam trees - Sphere Visualisation - Rooms - Emotical icons.

UNIT III-ADVANCED TECHNIQUES

Self-Organising graphs - Spatial Data arrangements - Benediktine Cyberspace -Statistical Clustering and Proximity measures - Hyper Structures - Human CenteredApproaches - Information Cube.

UNIT IV- VISUALIZATION SYSTEMS

Database Visualisation - Populated Information Terrains - Legibility enhancement -Hyper structure Visualisation - Information Visualisation.

UNIT V-SOFTWARE VISUALIZATION

Rapid Prototyping - Models for user interaction - Formal Specification of Software -DFD – Software Architecture.

SUGGESTED READINGS

1.Chaomei Chan, (2002),Information Visualisation and Virtual Environment **,** Springer –Verlag, New York**,**

2.Benedikt.M, (2004),Cyberspace First Steps **,** MIT Press, New Delhi**,**

3.Pauline Wills, (2002), Visualisation A Beginner's Guide , Hodder& Stoughton, New Delhi.,

4.Sheryl A Sorbyexal, (2002), 3D Visualisation for Engineering Graphics , Prentice Hall, New Delhi,

19RCSE310 VIRTUALIZATION TECHNIQUES 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To discuss the basic overviewof virtualization techniques.
- To explain popular techniques in server consolidation.
- To explain concepts of network virtualization.
- To discuss various virtualization storage systems.
- To discuss variousvirtual machines products.
- To develop various applications ofvirtualization to real world.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Introduce the basic overviewof virtualization techniques.
- Understandpopular techniques in server consolidation.
- Describe concepts of network virtualization.
- Describe various virtualization storage systems.
- Learn variousvirtual machines products.
- Develop various applications ofvirtualization to real world.

UNIT I- OVERVIEW OF VIRTUALIZATION

Basics of Virtualization - Virtualization Types – Desktop Virtualization – Network Virtualization – Server and Machine Virtualization – Storage Virtualization – System-level or Operating Virtualization – Application Virtualization-Virtualization Advantages - Virtual Machine Basics – Taxonomy of Virtual machines - Process Virtual Machines - System Virtual Machines – Hypervisor - Key Concepts

UNIT II -SERVER CONSOLIDATION

Hardware Virtualization – Virtual Hardware Overview- Sever Virtualization – Physical and Logical Partitioning - Types of Server Virtualization – Business cases for Sever Virtualization – Uses of Virtual server Consolidation – Planning for Development – Selecting server Virtualization Platform

UNIT III- NETWORK VIRTUALIZATION

Design of Scalable Enterprise Networks - Virtualizing the Campus WAN Design - WAN Architecture - WAN Virtualization - Virtual Enterprise Transport Virtualization–VLANs and Scalability - Theory Network Device Virtualization Layer 2 - VLANs Layer 3 VRF Instances Layer 2 - VFIs Virtual Firewall Contexts Network Device Virtualization - Data-Path Virtualization Layer 2: 802.1q - Trunking Generic Routing Encapsulation - IPsec L2TPv3 Label Switched Paths - Control-Plane Virtualization–Routing Protocols- VRF - Aware Routing Multi-Topology Routing.

UNIT IV- VIRTUALIZING STORAGE

SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables – Fiber Channel Hardware Devices – iSCSI Architecture– Securing iSCSI – SAN backup and recovery techniques – RAID – SNIA Shared Storage Model – Classical Storage Model – SNIA Shared Storage Model – Host based Architecture – Storage based architecture – Network based Architecture – Fault tolerance to SAN – Performing
Backups – Virtual tape libraries.

UNIT V- VIRTUAL MACHINES PRODUCTS

Xen Virtual machine monitors- Xen API – VMware – VMware products - Vmware Features – Microsoft Virtual Server – Features of Microsoft Virtual Server

SUGGESTED READINGS

1. William von Hagen, (January, 2008), Professional Xen Virtualization, Wrox Publications,
2. Chris Wolf , Erick M. Halter, (2005), Virtualization: From the Desktop to the Enterprise, APress
3. Kumar Reddy, Victor Moreno,(July 2006), Network virtualization, Cisco Press,
4. James E. Smith, Ravi Nair, (2005), Virtual Machines: Versatile Platforms for Systems and Processes, Elsevier/Morgan Kaufmann,
5. David Marshall, Wade A. Reynolds, (2006), Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications,

19RCSE311 **GRID COMPUTING** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To discuss the basic overviewof grid computing
- To explain popular grid computing initiatives
- To explain various grid computing applications.
- To discuss various technologies in grid computing.
- To discuss variousgrid computing tool kits available.
- To develop various applications ofgrid computing to real world.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Understand the basic overviewof grid computing
- Discuss popular grid computing initiatives
- Discuss various grid computing applications.
- Enumerate various technologies in grid computing.
- Learn variousgrid computing tool kits available.
- Develop various applications ofgrid computing to real world.

UNIT I- GRID COMPUTING

Introduction - Definition - Scope of grid computing

UNIT II- GRID COMPUTING INITIATIVES

Grid Computing Organizations and their roles – Grid Computing analog – GridComputing road map.

UNIT III- GRID COMPUTING APPLICATIONS

Merging the Grid sources – Architecture with the Web Devices Architecture.

UNIT IV- TECHNOLOGIES

OGSA – Sample use cases – OGSA platform components – OGSI – OGSA BasicServices.

UNIT V- GRID COMPUTING TOOL KITS

Globus Toolkit – Architecture, Programming model, High level services – OGSI .Netmiddleware Solutions.

SUGGESTED READINGS

1. Joshy Joseph & Craig Fellenstein, (2003), "Grid Computing", PHI, PTR

2. Ahmar Abbas, (2003), "Grid Computing: A Practical Guide to technology and Applications",Charles River media

19RCSE312 ADVANCED DATABASES 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To Introduce and describe current and emerging database models and technologies.
- To Design and implement relational database solutions for general applications.
- To Explain the query processing and techniques involved in query optimization
- To Explain common database administration tasks, such as database monitoring, performance tuning, data transfer, and security.
- To explain tools required for current issues in databases
- To Understand the concepts, current practices and issues of data warehouses and databases.

COURSE OUTCOMES:

Upon Completion of this course the student will be able to

- Know recent developments and current trend in database models.
- Develop applications for various relational databases
- Learn and optimize query processing techniques
- Evaluate designs and architectures for databases and data warehouses
- Analyse and develop tools for current issues in databases
- Organize strategic data in an enterprise and build a data Warehouse

UNIT I- DATABASE MANAGEMENT

Relational Data Model – SQL - Database Design - Entity-Relationship Model –Relational Normalization – Embedded SQL – Dynamic SQL – JDBC – ODBC.

UNIT II- ADVANCED DATABASES

Object Databases - Conceptual Object Data Model – XML and Web Data – XMLSchema – Distributed Data bases – OLAP and Data Mining – ROLAP and MOLAP

UNIT III- QUERY AND TRANSACTION PROCESSING

Query Processing Basics – Heuristic Optimization – Cost, Size Estimation - Models ofTransactions – Architecture – Transaction Processing in a Centralized and DistributedSystem – TP Monitor.

UNIT IV- IMPLEMENTING AND ISOLATION

Schedules – Concurrency Control – Objects and Semantic Commutativity – Locking –Crash, Abort and Media Failure – Recovery – Atomic Termination – DistributedDeadlock – Global Serialization – Replicated Databases – Distributed Transactions inReal World.

UNIT V- DATABASE DESIGN ISSUES

Security – Encryption – Digital Signatures – Authorization – Authenticated RPC -Integrity - Consistency - Database Tuning - Optimization and Research Issues.

REFERENCES:

1. Philip M. Lewis, Arthur Bernstein, Michael Kifer,(2001), "Databases and Transaction,

2. Processing: An Application-Oriented Approach", Addison-Wesley, (2002)

3. Elmasri R. and S.B. Navathe, (2011), Fundamentals of Database Systems, 6thEdition,Addison Wesley,

4. Abraham Silberschatz, Henry. F. Korth, S.Sudharsan,(2013), Database System Concepts, 6thEdition., Tata McGraw Hill,

5. Raghu Ramakrishnan& Johannes Gehrke,(2003), "Database Management Systems", 3rdEdition, TMH,

19RCSE313 WIRELESS SENSOR NETWORKS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To understand the concepts of wireless sensor networks.
- To learn how to program sensor nodes
- To understand the medium access protocol and address the physical layer issues.
- To learn network and transport layer protocols for sensor networks and design requirements.
- To understand the middleware and security issues of wireless sensor networks.
- Discuss applications of wireless sensor networks

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Apply knowledge of wireless sensor networks to various application areas.
- Design, implement and maintain wireless sensor networks.
- Define medium access layer issues.
- Address the transport protocol design issues.
- Design the efficient routing algorithm
- Analyse the security issues in wireless sensor networks

UNIT I- OVERVIEW OF WIRELESS SENSOR NETWORKS

Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless SensorNetworks.

UNIT II -ARCHITECTURES

Single-Node Architecture - Hardware Components, Energy Consumption of SensorNodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, GatewayConcepts.

UNIT III- NETWORKING SENSORS

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless, Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , TheMediation Device Protocol, Wakeup Radio Concepts, Address and Name Management,Assignment of MAC Addresses, Routing Protocols-Energy-Efficient Routing,Geographic Routing.

UNIT IV- INFRASTRUCTURE ESTABLISHMENT

Topology Control , Clustering, Time Synchronization, Localization andPositioning,Sensor Tasking and Control.

UNIT V- SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-levelsoftware platforms, Node-level Simulators, State-centric programming.

SUGGESTED READINGS

1. Holger Karl & Andreas Willig, (2011), " Protocols And Architectures for Wireless Sensor Networks" , John Wiley,
2. Feng Zhao & Leonidas J. Guibas,(2007), “Wireless Sensor Networks- An Information, Processing Approach", Elsevier,
3. KazemSohraby, Daniel Minoli, &TaiebZnati, (2007), “Wireless Sensor Networks-Technology, Protocols, AndApplications”,JohnWiley,
4. Anna Hac, (2003), “Wireless Sensor Network Designs”, John Wiley,

19RCSE314 CLOUD COMPUTING 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To learn the basic concepts of cloud computing
- To learn types of cloud services and its applications
- To understand the key components of Amazon Web Services
- To collaborate with real time cloud services
- To understand the security risk and application of cloud computing
- To discuss various applications of cloud computing

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Define basic concepts of cloud computing
- Use and Examine different cloud computing services.
- Understand and appreciate the technological impact of service and cloud computing for future enterprises, and the technologies underpinning it
- Describe importance of virtualization along with their technologies
- Analyze the key components of Amazon web Service
- Review and assess the risks, opportunities, costs and steps towards migrating existing systems to service and cloud computing

UNIT I -UNDERSTANDING CLOUD COMPUTING

Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage – Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing – Companies in the Cloud Today – Cloud Services

UNIT II- DEVELOPING CLOUD SERVICES

Web-Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service –Platform as a Service – Web Services – On-Demand Computing – Discovering Cloud Services Development Services and Tools Amazon Ec2 – Google App Engine – IBM Clouds

UNIT III- CLOUD COMPUTING FOR EVERYONE

Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation

UNIT IV- USING CLOUD SERVICES

Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaboratingon Word Processing - Collaborating on Databases – Storing and Sharing Files

UNIT V- OTHER WAYS TO COLLABORATE ONLINE

Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services –Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via Blogs and Wikis

SUGGESTED READINGS

1.Antonopoulos , (2012), Cloud Computing: Principles, Systems And Applications, Springer India Private Limited,

2.Dimitris N. Chorafas, (2 August 2010), Cloud Computing StrategiesHardcover, CRC Press ,.

3. Michael Miller, (August 2008), Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing,.

4. Haley Beard,(July 2008), Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited,

19RCSE315 **BIO INFORMATICS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: External: **100** Total: **100**
Exam: 3 Hours

COURSE OBJECTIVES:

- To introduce the basic concepts of bio informatics.
- To learn types database and networks used.
- To understand the key components of search engines and data visualization techniques.
- To discuss statistics, data mining and pattern matching techniques
- To understand the various modeling simulation and collaboration
- To discuss various applications of bio informatics

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Discuss the basic concepts of bio informatics.
- Categorize various types of database and networks used.
- Learn the key components of search engines and data visualization techniques.
- Discuss statistics, data mining and pattern matching techniques
- Learn various modeling simulation and collaboration
- Develop various applications of bio informatics

UNIT I-INTRODUCTION
The Central Dogma – Killer Application – Parallel Universes – Watson's Definition – Top Down Vs Bottom Up Approach – Information Flow – Conversance – Communications.

UNIT II -DATABASE AND NETWORKS
Definition – Data Management – Data Life Cycle – Database Technology – Interfaces – Implementation – Networks Communication Models – Transmission Technology – Protocols – Bandwidth – Topology – Contents – Security – Ownership – Implementation.

UNIT III -SEARCH ENGINES AND DATA VISUALIZATION
Search Process – Technologies – Searching And Information Theory – Computational Methods – Knowledge Management – Sequence Visualizations – Structure Visualizations – User Interfaces – Animation Vs Simulation.

UNIT IV- STATISTICS, DATA MINING AND PATTERN MATCHING
Statistical Concepts – Micro Arrays – Imperfect Data – Basics – Quantifying – Randomness – Data Analysis – Tools Selection – Alignment – Clustering – Classification – Data Mining Methods – Technology – Infrastructure Pattern Recognition – Discovery – Machine Learning – Text Mining – Pattern Matching Fundamentals – Dot Matrix Analysis – Substitution Matrix – Dynamic Programming – Word Method – Bayesian Method – Multiple Sequence Alignment Tools.

UNIT V -MODELING SIMULATION AND COLLABORATION
Drug Discovery Fundamentals – Protein Structure – System Biology Tools – Collaboration And Communication – Standards – Issues – Case Study.

SUGGESTED READINGS

1. Bryan Bergeron, (2009), Bio Informatics Computing, Prentice Hall, New York, 2009.
2. Vikram Singh, Dilbagh Singh, Joginder Singh,(2007), Bio Informatics Computing, Narosa Publishing House,
3. Anna Tramontano, (2007), Introduction to Bio Informatics, Chapman& Hall/CRC,
4. ZhengRong Yang, (2010), Machine learning approaches to bioinformatics, World Scientific,

FACULTY OF ENGINEERING

DEGREE OF DOCTOR OF PHILOSOPHY
IN
ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

(REGULAR PROGRAMME)

CURRICULUM & SYLLABI
(2019 -2020)

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Established Under Section 3 of UGC Act 1956)
COIMBATORE 641 021 INDIA

FACULTY OF ENGINEERING

DOCTORATE IN PHILOSOPHY (Ph.D.)

REGULATIONS 2019

These regulations are effective from the academic year 2019-2020 and applicable to the candidates admitted to Ph.D. during 2019-2020and onwards.

I. ELIGIBILITY CRITERIA

First class or 55% marks (50% marks for SC/ST), in M. Tech degree in Electonics and communication engineering or in related disciplines.

II. MODE OF SELECTION

The guidelines as given in the Regulations for M.Phil.,/ Ph.D., of Karpagam Academy of Higher Education are applicable.

III. PROGRAMME STRUCTURE AND RESEARCH WORK

Upon successful completion of the degree, the canddtate will be conferred with the degree of Doctorate of Philosophy (Ph.D.) in Electonics and Communication engineering under the Faculty of Engineering.

PART – I COURSE WORK SYLLABUS FOR Ph.D COURSE IN ELECTRONICS AND COMMUNICATION ENGINEERING

SL.NO	Course code	TITLE OF THE COURSE	C	EXAM. HRS	MA RKS
1	19RECE101	PAPER I-Research Methodology and Pedagogy	4	3	100
2	19RECE201	PAPER II Trends in Electronics	4	3	100
3	19RECE202	PAPER II Mobile communication	4	3	100
4	19RECE203	PAPER II Microcontroller System Design and Applications	4	3	100
5	19RECE204	PAPER II Soft Computing	4	3	100
6	19RECE205	PAPER II Basics of Nanotechnology	4	3	100
7	19RECE206	PAPER II Wireless Sensor Networks	4	3	100
8	19RECE207	PAPER II VLSI signal processing	4	3	100
9	19RECE208	PAPER II Wavelets and multi-resolution processing	4	3	100
10	19RECE209	PAPER II Computer Vision and Image processing	4	3	100

11	19RECE301	Paper III-Special Paper I: Solid State Device Modeling and Simulation	4	3	100
12	19RECE302	Paper III-Special Paper II**:** Low Power VLSI Design	4	3	100
13	19RECE303	Paper III-Special Paper III: Testing of VLSI Circuits	4	3	100
14	19RECE304	Paper III-Special Paper IV: Optical Fiber Communication	4	3	100
15	19RECE305	Paper III-Special Paper V: Mobile Ad-Hoc Networks	4	3	100
16	19RECE306	Paper III-Special Paper VI: Advanced Digital Image Processing	4	3	100
17	19RECE307	Paper III-Special Paper VII: Network Routing Algorithms	4	3	100
18	19RECE308	Paper III-Special PaperVIII: : Cryptography and Network Security	4	3	100
19	19RECE309	Paper III-Special Paper IX: Bio-Medical Signal Processing	4	3	100
20	19RECE310	Paper III-Special Paper X: Embedded Networking	4	3	100
21	19RECE311	Paper III-Special Paper XI: VLSI design methodologies and programming in HDL	4	3	100
22	19RECE312	Paper III-Special Paper XII: Pattern Recognition	4	3	100

23	19RECE313	Paper III-Special Paper XII : Digital System Design Using Verilog	4	3	100
		TOTAL	92	69	2300

19RECE101 **Paper I:** Research Methodology and Pedagogy 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is :

- To highlights the various postulates of research problems, research design, writing a thesis and modern statistical methods.
- To enable the researchers to carry out research problem individually in a perfect scientific method.
- To study on various sampling techniques
- To understand the fundamentals of hypothesis testing
- To know the pedagogical methods in higher learning objectives and roll of higher education
- To gain know methods of teaching and learning

Course Outcomes

At the end of the course the research scholars will be able to :

- Understand the various postulates of research problems, research design, writing a thesis and modern statistical methods.
- Enable the researchers to carry out research problem individually in a perfect scientific method.
- Gain knowledge on various sampling techniques
- Gain knowledge on the fundamentals of hypothesis testing
- Understand the pedagogical methods in higher learning objectives and roll of higher education
- Gain knowledge on methods of teaching and learning

UNIT I Introduction to Research

Research – Definition – Importance and Meaning of research – Characteristics of research – Types of Research – Steps in research – Identification, Selection and formulation of research problem – Research questions – Research design – Formulation of Hypothesis – Review of Literature.

UNIT II Sampling Techniques

Sampling techniques: Sampling theory – types of sampling – Steps in sampling – Sampling and Non-sampling error – Sample size – Advantages and limitations of sampling. Collection of Data : Primary Data – Meaning – Data Collection methods – Secondary data – Meaning – Relevances, limitations and cautions.

UNIT III Statistics in Research

Statistics in Research – Measure of Central tendency – Dispersion – Skewness and Kurtosis in research. Hypothesis – Fundamentals of Hypothesis testing – Standard Error – Point and Interval estimates – Important Non-Parametric tests : Sign, Run, Kruskal – Wallis tests and Mann-Whitney test.

UNIT IV Testing Methods

Para metric tests : Testing of significance – mean, Proportion, Variance and Correlation – testing for Significance of difference between means, proportions, variances and correlation co-efficient. Chi-square tests – ANOVA – One-way and Two-way. Research Report : Types of reports – contents – styles of reporting – Steps in drafting reports – Editing the final draft – Evaluating the final draft.

UNIT V Pedagogical Methods in Higher Learning

Pedagogical Methods in Higher Learning Objectives and roll of higher education – Important characteristics of an effective Lecture – Quality teaching and learning – Lecture preparation – Characteristics of instructional design – Methods of teaching and learning : Large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing Demonstration, Brain storing, case discussion, and assignment, Methods of evaluation – Self evaluation, student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education: - 'e' learning researches – web based learning

SUGGESTED READINGS

1. Gupta S.P. (2017) Statistical Methods Sultan Chand & Sons – Tb Publishers (P) Ltd.

2. Kothari C.R.(2004) Research Methodology Methods and Techniques-New age International (P) Ltd.Publishers.

3. Gupta B.N. Statistics(2015) (Theory and Practice) Publishers (P) Ltd SBPD Publications (P) Ltd.

4. Santosh Gupta,(1993) Research Methodology Methods and Statistical Techniques Deep & Deep Publications (P) Ltd.

   [**Research methodology** and **statistical techniques**.. [**Santosh Gupta**] ... Author: **Santosh Gupta**. Publisher: New Delhi : **Deep** and **Deep Publications Pvt**. **Ltd**., 2010.]

5. Rajasekar.S (2005) Computer Education and educational computing. Hyderabad: Neelkamal Publications.

6. Kumar K.L. (1997) Educational Technologies, New Delhi: New age International (P)

Ltd.Publishers.

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Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2019-2020

19RECE201 **Paper II: Trends in Electronics** 4H:4C

Instruction hours/week:L:T:P:C-	4 0 0 4	Marks:External 100	Total 100
		End semester Exam:	3Hrs

Course Objectives

The goal of this course for research scholars is:

- To obtain in depth knowledge in various pentium processors.
- To understand the VLSI design process in detail
- To understand spectrum of electromagnetic waves and OFDM based access techniques
- To design antenna in wireless communication
- To know about various wireless networks
- To gain knowledge on real time operating systems

Course Outcomes

At the end of the course the research scholars will be able to :

- Gain in depth knowledge in various pentium processors.
- Understand the VLSI design process in detail
- Understand spectrum of electromagnetic waves and OFDM based access techniques
- Design antenna in wireless communication
- Know about various wireless networks
- Gain knowledge on real time operating systems

UNIT I Embedded Computing and Multiprocessors

The Embedded system design process – Formalization for system design – System design techniques – Formalization of system design - Multiprocessors – Multiprocessor performance analysis – Consumer electronics architecture – Design example of cell phone , Audio players – Digital cameras – design methodologies and flows – requirement analysis – Quality assurance - The Intel 8086 Family Architecture – 80196, i286, i386 and i486 family Architecture – Pentium I, Pentium II, Pentium III, Pentium 4, and core 2 processors – PIC processor.

UNIT II VLSI Design Technology

The VLSI design process – Architectural design – Logical design – physical design –Layout styles – Full custom – Semi custom approaches - VLSI Design flow – NMOS & CMOS Inverters – Analysis and design of Inverters - Data path subsystems – Design – Shifters – Adders – ALUs – Multipliers – parity generators – comparators- Zero/one detectors – Counters – Array subsystems.

UNIT III Wireless Communication Systems

Spectrum of Electromagnetic waves – Radio transceivers architecture – Generation evolution of cellular communication systems – Multiple access techniques – Channel Estimation and Equalization – Modulation techniques – OFDM – OFDM based access techniques – Fundamentals of Antenna design in wireless communication –Source coding I –Source coding II.

UNIT IV Wireless Networks

Wireless Network Architecture - Wireless LAN Implementation and its Standards - Wireless PAN Implementation and its standards - Wireless MAN Implementation and its standards – Future scope of wireless networking technology – Gigabit Lans – Mesh network Routing – Cognitive Radio – Network independent roaming.

UNIT V Real Time Operating Systems

Operating system services –I/O subsystems – Network operating systems –Interrupt routines in RTOS Environment – RTOS Task scheduling models, Interrupt –Performance Metric in Scheduling Models – IEEE standard POSIX functions for standardization of RTOS and inter-task communication functions – List of Basic functions in a Preemptive scheduler – Fifteen point strategy for synchronization between processors, ISRs, OS Functions and Tasks – OS security issues- Mobile OS.

SUGGESTED READINGS:

1. Raj Kamal , (2003), Embedded Systems Architecture, Programming and Design, Tata McGraw-Hill, New Delhi,
2. Wayne Wolf, (2001), Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers,.
3. Ramesh S. Gaonkar, (2000) "Microprocessor Architecture, Programming and its Applications With 8085", Mumbai: Penram International Publishing,.
4. Ram. B., (2000) Fundamentals of Microprocessor and Microcontroller", Mumbai: Dhanpat rai Publication,
5. Ajay V Deshmukh, (2007) Microcontroller Theory and Applications, Tata McGraw Hill,
6. Daniel Tabak Advanced Microprocessor .E. Eshranghian, D.A. Pucknell and S. Eshraghian, (2005) "Essentials of VLSI circuit and systems", PHI.
7. Neil H.E. Weste, David Harris and Ayan Banerjee, (2006). "CMOS VLSI Design, A circuits and Systems Perspective", (3/e), Pearson,
8. W. Wolf, "Modern VLSI Design", (3/e), Pearson.S.M. Sze, (2015), "VLSI Technology",(2/e), McGraw Hill.
9. Ke lin Du & M.N.S. Swamy (2010), Wireless Communication Systems: From RF Subsystems to 4G Enabling Technologies" Cambridge University press.
10. Steve Rackley, (2007), Wireless Networking Technology: From Principles to Successful Implementation, Elsevier Publications

19RECE202 Paper II: Mobile Communication

4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To understand 8051 architecture
- To write simple 8051 programs
- To know about memory organization and timing characteristics
- To understand 8096 architecture
- To understand peripheral interfacing
- To write case study on generation of gating signals for converters and inverters

Course Outcomes

At the end of the course the research scholars will be able to :

- Understand 8051 architecture
- Write simple 8051 programs
- Know about memory organization and timing characteristics
- Understand 8096 architecture
- Understand peripheral interfacing
- Write case study on generation of gating signals for converters and inverters

UNIT I INTRODUCTION TO MOBILE AND PERSONAL COMMUNICATION

History of wireless communications, Mobile and Personal communications: Cell phone generations, cellular networks, The mobile radio environment, Cellular concept and frequency reuse, Multiple access technologies for cellular systems, Channel assignment and hand off, Mobile radio interference.

UNIT II PROPAGATION ISSUES

Prediction of propagation loss-Prediction over flat terrain, Point-point prediction, Calculation of fading and methods of reducing fading- Amplitude fading, Selective fading, Diversity schemes, combining techniques.

UNIT III ANTENNA SYSTEMS

Design parameters at the Base station- Antenna locations, spacing, heights, configurations, Design parameters at the Mobile unit- Directional antennas and diversity schemes, Antenna connections and locations.

UNIT IV PERSONAL COMMUNICATION SYSTEMS (PCS)

The concept of PCS/PCN, Function , Evolution of personal Communications, Requirements of PCS,PCS environment, Differences between PCS and Cellular systems, IS-136(TDMA)PCS, IS-95 CDMA PCS, Data Communication with PCS, PCS standards, PCS economics

UNIT V UNIVERSAL PERSONAL TELECOMMUNICATION (UPT)

UPT: Concept and service aspects, Functional Architecture, Numbering, Routing and Billing aspects, Access security requirements for UPT Digital Cellular Mobile Systems- GSM, IS-136, PDC, IS-95, IMT-2000: Third generation Mobile Communication Systems, W-CDMA, CDMA-2000, EDGE

SUGGESTED READINGS:

1. Lee.W.C.Y, (1993),"Mobile Communications Design Fundamentals", 2nd edition, John Wiley & sons, New York.

2. RajPandya,(2003), "Mobile and Personal Communication systems and services", PHI, New Delhi.

3. Blake,(2001), "Wireless Communication Technology", Thomson Asia Pte, Ltd, Singapore.

4. Bud Bates,(1995),"Wireless networked telecommunications"- Concepts, Technology and Implementation" , McGraw-Hill International Editions, New Delhi.

5. Holtzman.J.M, David J. Goodman Er.s,(1996), " Wireless and Mobile Communications", Allied Publishers Limited, New Delhi.

6. Andy Dorman,(2001), "The Essential Guide to Wireless Communications applications", Pearson Education Asia, New Delhi.

19RECE203 **Paper II: Microcontroller System Design and Applications** 4H:4C

Instruction hours/week:L:T:P:C-4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To understand 8051 architecture
- To write simple 8051 programs
- To know about memory organization and timing characteristics
- To understand 8096 architecture
- To understand peripheral interfacing
- To write case study on generation of gating signals for converters and inverters

Course Outcomes

At the end of the course the research scholars will be able to :

- Understand 8051 architecture
- Write simple 8051 programs
- Know about memory organization and timing characteristics
- Understand 8096 architecture
- Understand peripheral interfacing
- Write case study on generation of gating signals for converters and inverters

UNIT I 8051 ARCHITECTURE

Basic organization – 8051 CPU structure – Register file – Interrupts – Timers – Port circuits – Instruction set – Timing diagram – Addressing modes – Simple Program and Applications.

UNIT II PERIPHERALS AND INTERFACING Typical

Bus structure – Bus – memory organization – Timing characteristics – Extended Model and Memory Interfacing – Polling – Interfacing Basic I/O devices – Analog and Digital interfacing – PWM mode operation – Serial port application.

UNIT III 8096 ARCHITECTURE operation

– Interrupt structure – Timers – High Speed Input / Output Ports – I/O control and Status registers – Instruction Set – Addressing Modes – Simple Programming – Queues – Tables and Strings – Stack Memories – Key Switch – Parsing.

UNIT IV PERIPHERALS AND INTERFACING Analog

Interface – Serial Ports – Watch dog timers – Real Time Clock – Multitasking – Bus Control – Memory Timing – External ROM and RAM expansion – PWM control – A/D interfacing.

UNIT V CASE STUDY FOR 8051 AND 8096

Real Time clock – DC Motor Speed Control – Generation of Gating Signals for Converters and Inverters – Frequency Measurement – Temperature Control.

SUGGESTED READINGS:

1. John B.Peatman, (1989), “Design with Micro controllers”, McGraw Hill international Limited, Singapore.
2. Michael Slater, (2001), “Microprocessor based design A comprehensive guide to effective Hardware design” Prentice Hall, New Jersey.
3. Ayala, Kenneth, (2000), “The 8051 Microcontroller” Upper Saddle River, Prentice Hall, New Jersey
4. Muhammad Ali Mazidi, Janice Gillispie mazidi, (2009),“The 8051 Microcontroller and Embedded systems”, Person Education, New Delhi.

19RECE204 **Paper II: Soft Computing** 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To understand machine learning basics
- To gain in depth knowledge of genetic algorithms
- To understand supervised learning neural networks and unsupervised learning neural networks
- To gain knowledge on fuzzy logic concepts
- To gain knowledge advances in neural networks
- To understand neuro-fuzzy modeling

Course Outcomes

At the end of the course the research scholars will be able to :

- Understand machine learning basics
- Gain in depth knowledge of genetic algorithms
- Understand supervised learning neural networks and unsupervised learning neural networks
- Gain knowledge on fuzzy logic concepts
- Gain knowledge advances in neural networks
- Understand neuro-fuzzy modeling

UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS

Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics

UNIT II GENETIC ALGORITHMS

Introduction to Genetic Algorithms (GA) – Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition.

UNIT III NEURAL NETWORKS

Machine Learning Using Neural Network, Adaptive Networks – Feed forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance architectures – Advances in Neural networks.

UNIT IV FUZZY LOGIC

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.

UNIT V NEURO-FUZZY MODELING

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rulebase Structure Identification – Neuro-Fuzzy Control – Case studies.

SUGGESTED READINGS:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani,(2003) "Neuro-Fuzzy and Soft Computing", Prentice-Hall of Indi,.
2. George J. Klir and Bo Yuan,(1995) "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall.
3. James A. Freeman and David M. Skapura,(2003) "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn.,.
4. Mitchell Melanie,(1998) "An Introduction to Genetic Algorithm", Prentice Hall,.
5. David E. Goldberg,(1997) "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley,.

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19RECE205 Paper II: Basics of Nanotechnology 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To understand basics of nano scale
- To study about classification of nanostructures
- To understand synthesis of nano material
- To learn about nano material properties
- To understand physical properties of nano structured materials
- To study about chemistry of tailored monolayer

Course Outcomes

At the end of the course the research scholars will be able to :

- Understand basics of nano scale
- Study about classification of nanostructures
- Understand synthesis of nano material
- Learn about nano material properties
- Understand physical properties of nano structured materials
- Study about chemistry of tailored monolayer

UNIT - I INTRODUCTION

Introduction to nanoscale materials-atomic & molecular size. Scientific revolutions-nanotechnology applicationarea. Scope of nanoscience and technology.

UNIT - II NANOSTRUCTURES AND DIMENSIONS

Classification of nanostructures-zero, one, two and three dimensional nanostructures.Size Dependency inNanostructures-quantum size effects in nanostructures.Chemistry of tailored nano shapes.

UNIT - III NANOMATERIAL SYNTHESIS

Synthesis of nanomaterials-top down and bottom up approach. Method of nanomaterials preparation–wetchemical synthesis-mechanical grinding-gas phase synthesis.

UNIT - IV NANOMATERIAL PROPERTIES

Surface to volume ratio. Surface properties of nanoparticles. Mechanical, optical, electronic, magnetic, thermaland chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra.Shape impact.

UNIT - V PHYSICAL PROPERTIES OF NANOSTRUCTUREDMATERIALS

Quantum dots-optical properties and applications. Carbon nano tubes-physical properties and applications.Magnetic behavior of nanomaterials. Electronic transport in quantum wires. Surface chemistry of tailoredmonolayer

SUGGESTED READINGS:

1. Mick Wilson,Kamali Kannargare., Geoff Smith, (2005)"Nano technology: Basic Science and Emergingtechnologies", Overseas Press,.
2. Charles P. Poole, Frank J. Owens,(2003) "Introduction to Nanotechnology", Wiley Interscience.
3. Mark A. Ratner, Daniel Ratner, (2002)"Nanotechnology: A gentle introduction to the next Big Idea", Prentice HallP7R:1stEdition,.
4. T. Pradeep,(2007) " Nano the Essential Nanoscience and Nanotechnology", Tata McGraw hill,.
5. J. Dutta, H. Hoffmann, (2003)"Nanomaterials", Topnano-21.

19RECE206 **Paper II: Wireless Sensor Networks** 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To understand network architecture
- To study about communication fundamentals
- To understand data link layer
- To understand network layer
- To write case study of target detection tracking etc
- To understand IEEE 802.15.4 low rate WPAN

Course Outcomes

At the end of the course the research scholars will be able to :

- Understand network architecture
- Study about communication fundamentals
- Understand data link layer
- Understand network layer
- Write case study of target detection tracking etc
- Understand IEEE 802.15.4 low rate WPAN

UNIT I INTRODUCTION

Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture –Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks– WINS ,µAMPS Underwater Acoustic and Deep space networks.

UNIT II PHYSICAL LAYER

Introduction wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication , packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management

UNIT III DATA LINK LAYER

MAC protocols –fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols, Link Layer protocols –fundamentals task and requirements, error control, framing, link management

UNIT IV NETWORK LAYER

Gossiping and agent-based uni cast forwarding , Energy-efficient unicast, Broadcast and multicast, geographic routing , mobile nodes, Data –centric and content-based networking –Data –centric routing, Data aggregation, Data-centric storage, Higher layer design issues

UNIT V CASE STUDY

Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN, Sensor Network Platforms and tools-Sensor node hardware, Node-level software platforms, node – level simulators.

SUGGESTED READINGS:

1. Feng zhao, Leonidas (2004), Wireless Sensor Networks An information processing approach – guibas, Elsivier publication,.

2. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati,(2004)- Wireless Sensor Networks – Springer publication,.

3. Holger Karl, Andrea’s willig, John(2006) Wireless Sensor Networks: Architecture and protocol – Edgar H .Callaway, CRC press.Protocol and Architecture for Wireless Sensor Networks –wiley publication.
4. Wireless Sensor Networks: First European workshop, EWSN 2004, Berlion, germany,
5. January 2004 proceedings –Holger Karl, Andreas willig,Adam holisz,Springer publication.

6. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, “Wireless sensor networks: a survey”, computer networks, Elsevier, 2002, 394 - 422.

7. Jamal N. Al-karaki, Ahmed E. Kamal,” Routing Techniques in Wireless sensor networks: A survey”, IEEE wireless communication, December 2004, 6 – 28.

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19RECE207 **Paper II: VLSI signal processing** 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To make the student Data flow and Dependence graphs in digital filter design
- To familiarize the student about algorithmic strength reduction in filters and transforms
- To imparts a good knowledge about Look-Ahead pipelining in first-order IIR filters
- To acquaint the student with various **-** bit-level arithmetic architectures.
- Provide students the insight multiple constant multiplication

- To acquaint the student with the knowledge of asynchronous pipelining

Course Outcomes

At the end of the course the research scholars will be able to :

- Understanding of the ideas Data flow and Dependence graphs in digital filter design
- Students will be able to demonstrate a knowledge and broad understanding about algorithmic strength reduction in filters and transforms
- Gain a good knowledge about various Look-Ahead pipelining in first-order IIR filters
- Acquire knowledge about various - bit-level arithmetic architectures
- Understanding the design of Cross layer and its optimization techniques.
- Gain knowledge in integration of asynchronous pipelining .

UNIT I - PIPELINING AND PARALLEL PROCESSING OF DIGITAL FILTERS

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs – critical path, Loop bound, iteration bound, Longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

UNIT II – ALGORITHMIC STRENGTH REDUCTION TECHNIQUE

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms – parallel FIR filter, parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

UNIT- III ALGORITHIMIC STRENGTH REDUCTION

Fast convolution –Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with powerof-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV - BIT-LEVEL ARITHMETIC ARCHITECTURES

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, bit-serial FIR filter, CSD representation, CSD multiplication, Distributed Arithmetic fundamentals and FIR filters

UNIT V- NUMERICAL STRENGTH REDUCTION, WAVE AND ASYNCHRONOUS PIPELINING

Numerical strength reduction – sub expression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining. Asynchronous pipelining bundled data versus dual rail protocol.

SUGGESTED READINGS:

- Keshab K. Parhi, (2007)“VLSI Digital Signal Processing Systems, Design and implementation “, Wiley, Interscience, 2007.
- U. Meyer – Baese,(2004) “Digital Signal Processing with Field Programmable Gate Arrays”, Springer, Second Edition.

19RECE208 Paper II: Wavelets and multi-resolution processing 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To make the student familiarize with vector spaces and its properties
- To familiarize the student about Multi Resoultion Analysis (MRA)
- To imparts a good knowledge on continuous wavelet transform
- To acquaint the student scale plane for CWT.
- Provide students the insight discrete wavelet transform
- To acquaint the student about Image Compression using DWT

Course Outcomes

At the end of the course the research scholars will be able to :

- Understanding with vector spaces and its properties
- Students will be able to demonstrate Multi Resoultion Analysis (MRA)
- Gain a good knowledge about continuous wavelet transform
- Acquire knowledge about scale plane for CWT
- Understanding the design the insight discrete wavelet transform
- Gain knowledge in Image Compression using DWT

UNIT I - INTRODUCTION

Vector Spaces - properties - dot product - basis - dimension, orthogonality and orthonormality - relationship between vectors and signals - Signal spaces – concept of Convergence - Hilbert spaces for energy signals - Generalized Fourier Expansion.

UNIT I I- MULTI RESOLUTION ANALYSIS

Definition of Multi Resolution Analysis (MRA) – Haar basis - Construction of general orthonormal MRA-Wavelet basis for MRA – Continuous time MRA interpretation for the DTWT – Discrete time MRA- Basis functions for the DTWT – PRQMF filter banks

UNIT- III CONTINUOUS WAVELET TRANSFORM

Wavelet Transform - definition and properties - concept of scale and its relation with frequency - Continuous Wavelet Transform (CWT) - Scaling function and wavelet functions (Daubechies, Coiflet, Mexican Hat, Sinc, Gaussian, Bi-Orthogonal) – Tiling of time -scale plane for CWT.

UNIT IV - DISCRETE WAVELET TRANSFORM

Filter Bank and sub band coding principles - Wavelet Filters - Inverse DWT computation by Filter banks - Basic Properties of Filter coefficients - Choice of wavelet function coefficients - Mallat's algorithm for DWT - Lifting Scheme: Wavelet Transform using Polyphase matrix Factorization – Geometrical foundations of lifting scheme - Lifting scheme in Z –domain

UNIT V- APPLICATIONS

Image Compression using DWT – Sequential / Progressive - JPEG 2000 standard - Image denoising - Edge detection and object Isolation and Object Detection - Image Fusion -Wavelet Packets ,Multiwavelets - Non linear wavelets – Ridgelets – Curvelets – Contourlets.

SUGGESTED READINGS:

1. C. Sidney Burvus, Ramesh A.Gopinath haito ,(1995) “Introduction to wavelets and wavelet Transform”, Prentice Hall International,.
2. Gilbert Strang, “Linear Algebra and its Applications”, 3rd edition.
3. J.C. Goswami, A.K. Chan,(1999) “Fundamentals of wavelets”, John wiley and sons.
4. Mallat S., (1996)"Wavelet Signal Processing”, Academic Press,.

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19RECE209 **Paper II: Computer Vision and Image processing** 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

The goal of this course for research scholars is:

- To know about image formation and coordinate transformations
- To understand various parameters in image processing
- To familiarize with segmentation techniques
- To gain knowledge on Bayesian Classification
- To acquire knowledge on Temporal sequence learning
- To understand Contours, and Appearance Models

Course Outcomes

At the end of the course the research scholars will be able to :

- Gain knowledge on image formation and coordinate transformations
- Understand various parameters in image processing
- Familiarize with segmentation techniques
- Gain knowledge on Bayesian Classification
- Acquire knowledge on Temporal sequence learning
- Understand Contours, and Appearance Models

UNIT I - IMAGE FORMATION

Image Formation and Coordinate Transformations, Camera Matrix, Motion/Stereo Pin-hole model, Human eye, cognitive aspects of colour space; illumination; Sampling and Quantization, Coordinate transformations and camera parameters.

UNIT II – IMAGE PROCESSING

Noise Removal, Blurring, Edge Detection: Canny , Gaussian,Gabor,Texture Edges, Curvature , Corner Detection.

UNIT III – SEGMENTATION

Types of segmentation techniques, Watershed, Change Detection, Background Subtraction, Texture Segmentation, Gaussian Mixture Models - Applications in Color based Image Segmentation, Background Modeling and Shape Clustering

UNIT IV - MACHINE LEARNING TECHNIQUES IN VISION

Bayesian Classification, Maximum Likelihood Methods, Neural Networks; Non-parametric models; Manifold estimation Support Vector Machines ; Temporal sequence learning

UNIT V - INTRODUCTION TO OBJECT TRACKING

Exhaustive vs. Stochastic Search Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models, Object Modeling and Recognition Applications: Surveillance, Object detection.

SUGGESTED READINGS:

1. David Forsyth and Jean Ponce, (2004)Computer Vision: A modern Approach, Prentice Hall India .
2. Christopher Bishop,(2008) Pattern Recognition and Machine Learning, Springer.
3. E.R. Davies,(2005) Machine Vision, Theory Algorithms Practicalities, Elsevier .
4. Richard O. Duda, Peter E. Hart, and David G. Stork, (2002)Pattern Classification, 2nd ed., Wiley Asia.

19RECE301 Paper III-Special Paper I: Solid State Device Modelling and Simulation 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To know about quantum mechanical concepts
- To understand transient and AC conditions
- To study SPICE model for a Diode
- To understand bipolar device modeling
- To understand MOSFET modeling
- To know optoelectronic device modeling

Course Outcomes

At the end of the course the research scholars will be able to :

- Know about quantum mechanical concepts
- Understand transient and AC conditions
- Study SPICE model for a Diode
- Understand bipolar device modeling
- Understand MOSFET modeling
- Know optoelectronic device modeling

UNIT I BASIC SEMICONDUCTOR PHYSICS

Quantum Mechanical Concepts, Carrier Concentration, Transport Equation, Band gap, Mobility and Resistivity, Carrier Generation and Recombination, Avalanche Process, Noise Sources.
Diodes: Forward and Reverse biased junctions – Reverse bias breakdown – Transient and AC conditions -– Static and Dynamic behavior- Small and Large signal models – SPICE model for a Diode – Temperature and Area effects on Diode Model Parameters.

UNIT II BIPOLAR DEVICE MODELING

Transistor Models: BJT – Transistor Action – Minority carrier distribution and Terminal currents - Switching- Eber - Molls and Gummel Poon Model, SPICE modeling - temperature and area effects.

UNIT III MOSFET MODELING

MOS Transistor – NMOS, PMOS – MOS Device equations - Threshold Voltage – Second order effects - Temperature Short Channel and Narrow Width Effect, Models for Enhancement, Depletion Type MOSFET, CMOS Models in SPICE.

UNIT IV PARAMETER MEASUREMENT

Bipolar Junction Transistor Parameter – Static Parameter Measurement Techniques – Large signal parameter Measurement Techniques, Gummel Plots, MOSFET: Long and Short Channel Parameters, Measurement of Capacitance.

UNIT V OPTOELECTRONIC DEVICE MODELING

Static and Dynamic Models, Rate Equations, Numerical Technique, Equivalent Circuits, Modeling of LEDs, Laser Diode and Photo detectors.

SUGGESTED READINGS:

1. Ben.G.Streetman, (1997), "Solid State Devices", 3rd Edition,Prentice Hall.
2. Giuseppe Massobrio and Paolo Antogentti, (1993), "Semiconductor Device Modeling with SPICE", 2nd Edition, McGraw-Hill Inc, New York.
3. Tyagi.M.S, (1981), "Introduction to Semiconductor Devices",2nd Edition, Mc Graw Hill, New York.
4. Sze.S.M, (1985),"Semiconductor Devices - Physics and Technology",2nd Edition,John Wiley and sons.
5. Mohammed Ismail & Terri Fiez, (2001), "Analog VLSI-Signal & Information Processing", 1st Edition,Tata McGraw Hill Publishing company Ltd, New Delhi.

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19RECE302 Paper III-Special Paper II: Low Power VLSI Design 4H:4C

Instruction hours/week:L:T:P:C-	4 0 0 4	Marks:External 100	Total 100
		End semester Exam:	3Hrs

Course Objectives

The goal of this course for research scholars is:

1. To give an experience in the implementation of power dissipation in CMOS.
2. To study different methods of construction to successfully achieve the power optimization with recommended specifications.
3. To involve the application of design of low power CMOS circuits.
4. To study and construction equipment of power estimation and analysis.
5. To provide a synthesis and software design for low power.
6. To present the new technology of low power VLSI design concepts and Advanced construction technology.

Course Outcomes

At the end of the course the research scholars will be able to :

1. Implementation of power dissipation in CMOS
2. Different methods of construction to successfully achieve the power optimization with recommended specifications.
3. Application of design of low power CMOS circuits.
4. Will gain the Knowledge of power estimation and analysis.
5. Development to the students for the courses in synthesis and software design for low power.
6. The new technology of low power VLSI design concepts and Advanced construction technology.

UNIT I POWER DISSIPATION IN CMOS

Sources of power dissipation – Physics of power dissipation in CMOS FET devices- Basic principle of low power design.

UNIT II POWER OPTIMIZATION

Logical level power optimization – Circuit level low power design: logic styles, transistor sizing and ordering – Circuit techniques for reducing power consumption in adders and multipliers.

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS

Computer Arithmetic techniques for low power systems – Reducing power consumption in memories – Advanced techniques: Adiabatic Computation, Asynchronous Circuits – Special techniques

UNIT IV POWER ESTIMATION AND ANALYSIS

Logic level power estimation – Simulation power analysis – Probabilistic power analysis

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER

Synthesis for low power –Behavioral level transforms- Software design for low power – Software Power Estimation – Software Power Optimization

SUGGESTED READINGS:

1. Roy.K and Prasad.S.C, (2000) Low Power CMOS VLSI circuit design, Wiley, New Jersey.
2. Dimitrios Soudris, Chirstian Pignet, Costas Goutis,(2002) Designing CMOS Circuits For Low Power, Kluwer academic publishers, Boston,.
3. Kuo.J.B and Lou.J.H, (2009)Low voltage CMOS VLSI Circuits, Wiley, New Jersey,.
4. Chandrakasan.A.P and Broadersen.R.W, (1995)Low power digital CMOS design, Kluwer academic publishers, Boston .
5. Gary Yeap Practical low power digital VLSI design,(1998) Kluwer academic publishers, Boston.

19RECE303 Paper III-Special Paper III: Testing of VLSI Circuits 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To impart the basic knowledge about the testing and fault modelling of VLSI circuit.
- To understand the concept of test generation for combinational and sequential circuits.
- To understand the working ofdesign of testable sequential circuits.
- To impart the basic knowledge of design for testability.
- To understand the fundamentals of self-test and test algorithms.
- To imparts a good knowledge about fault diagnosis.

Course Outcomes

At the end of the course the research scholars will be able to :

- Attributing the testing and fault modelling of VLSI circuit.
- Attributing thetest generation for combinational and sequential circuits.
- Reproduce the design of testable sequential circuits.
- Evaluate the various design for testability applications.
- Analysis various self-test and test algorithmsin real time applications.
- Reproduce the fault diagnosis.

UNIT I BASICS OF TESTING AND FAULT MODELLING

Introduction to Testing - Faults in digital circuits - Modeling of faults - Logical Fault Models - Fault detection - Fault location - Fault dominance - Logic Simulation – Types of simulation - Delay models - Gate level Event-driven simulation.

UNIT II TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS

Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.

UNIT III DESIGN FOR TESTABILITY

Design for Testability - Ad-hoc design - Generic scan based design - lassical scan based design - System level DFT approaches.

UNIT IV SELF-TEST AND TEST ALGORITHMS

Built-In Self Test - Test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test algorithms - Test generation for Embedded RAMs.

UNIT V FAULT DIAGNOSIS

Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

SUGGESTED READINGS:

1. M. Abramovici, M.A. Breuer and A.D. Friedman,(2002) "Digital Systems and Testable Design", Jaico Publishing House,.
2. P.K. Lala, (2002)"Digital Circuit Testing and Testability", Academic Press,.
3. M.L. Bushnell and V.D. Agrawal,(2002) "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers,.
4. A.L. Crouch(2002), "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International,.

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19RECE304 Paper III-Special Paper IV: Optical Fiber Communication 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion in optical wave guides and other
- signal degradation factors.Designoptimization of SM fibers, R I profile and cut-off wave length.
- To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes and different fiber amplifiers.
- To learn the fiber optical receivers such as P IN AP D diodes, noise performance in photo detector, receiver operation and configuration.
- To learn fiber slicing and connectors, noise effects on system performance, operational principles WDM and solutions.

Course Outcomes

At the end of the course the research scholars will be able to :

- Gain knowledge in basic elements of optical fiber transmission link, fiber modes configurations and structures.

- Gain knowledge in different kind of losses, signal distortion in optical wave guides and other signal degradation factors. Design optimization of SM fibers, R I profile and cut-off wave length.
- Gain knowledge in the various optical source materials, LED structures, quantum efficiency, Laser diodes and different fiber amplifiers.
- Gain knowledge in the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.
- Gain knowledge in fiber slicing and connectors, noise effects on system performance, operational principles WDM and solutions.
- Gain knowledge on optical amplifiers and networks.

UNIT - I : INTRODUCTION TO OPTICAL FIBERS

Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure.

UNIT - II : SIGNAL DEGRADATION OPTICAL FIBERS

Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling -Design Optimization of SM fibers-RI profile and cut-off wavelength

.UNIT - III : FIBER OPTICAL SOURCES AND COUPLING

Direct and indirect Band gap materials-LED structures -Light source materials -Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition -Rate equations -External Quantum efficiency -Resonant frequencies -Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers- Power Launching and coupling, Lencing schemes, Fibre -to- Fibre joints, Fibre splicing.

UNIT - IV : FIBER OPTICAL RECEIVERS

PIN and APD diodes -Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise -Comparison of Photo detectors -Fundamental Receiver Operation - preamplifiers, Error Sources -Receiver Configuration -Probability of Error - Quantum Limit.

UNIT - V : DIGITAL TRANSMISSION SYSTEM

Point-to-Point links System considerations -Link Power budget -Rise - time budget -Noise Effects on System Performance-Operational Principles of WDM, Solitons-Erbium-doped Amplifiers. Basic on concepts of SONET/SDH Network.

SUGGESTED READINGS:

- Gerd Keiser,(2000) "Optical Fiber Communication" McGraw -Hill International, Singapore, 3rd ed..
- J.Senior,(1994) "Optical Communication, Principles and Practice", Prentice Hall of India,.
- J.Gower, (2001)"Optical Communication System", Prentice Hall of India,.

19RECE305 Paper III-Special Paper V: Mobile Ad-Hoc Networks 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To study about adhoc networks, characteristics features, applicationsof Wireless channel.
- To study about fundamentals of medium access protocolsand applications.
- To study about the network protocols and applications.
- To study the fundamentals ofend-end delivery and security.
- To introduce the concept of cross layer design and integration of adhoc for 4G
- To learn the main factors affecting performance of networks.

Course Outcomes

At the end of the course the research scholars will be able to :

- Conversant with the latest adhoc networks, characteristics features, applicationsof Wireless channel.
- Design and implement of medium access protocols and applications.
- Apply the concept of the network protocols and applications.
- Identify the importance of end-end delivery and security.
- Understand the concept of cross layer design and integration of adhoc for 4G
- Implement different type of factors affecting performance of networks.

UNIT I INTRODUCTION

Introduction to adhoc networks – definition, characteristics features, applications. Charectristics of Wireless channel, Adhoc Mobility Models:- Indoor and outdoor models.

UNIT II MEDIUM ACCESS PROTOCOLS

MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT III NETWORK PROTOCOLS

Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

UNIT IV END-END DELIVERY AND SECURITY

Transport layer : Issues in desiging- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT V CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary prespective. Intergration of adhoc with Mobile IP networks.

SUGGESTED READINGS:

1. C.Siva Ram Murthy and B.S.Manoj,(2007)' Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic,(2004) Mobile adhoc networking, Wiley-IEEE press,.
4. Mohammad Ilyas, (2002)The handbook of adhoc wireless networks, CRC press,.
5. T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network Research," Wireless Commun. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.
6. A survey of integrating IP mobility protocols and Mobile Ad hoc networks, Fekri M. Abduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, v 9.no.1 2007
7. V.T.Raisinhani and S.Iyer "Cross layer design optimization in wireless protocol stacks"Comp. communication, vol 27 no. 8, 2004.
8. V.T.Raisinhani and S.Iyer,"ÉCLAIR; An Efficient Cross-Layer Architecture for wireless protocol stacks",World Wireless cong., San francisco,CA,May 2004.
9. V.Kawadia and P.P.Kumar,"A cautionary perspective on Cross-Layer design,"IEEE Wireless commn., vol 12, no 1,2005.

19RECE306 Paper III-Special Paper VI: Advanced Digital Image Processing 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

End semester Exam: 3Hrs

Course Objectives

The goal of this course for research scholars is:

- To understand the Fundamentals of image processing.
- To learn Various transforms used in image processing.
- To learn the Image processing techniques like image enhancement, reconstruction, compression and segmentation.
- To familiarize the students with the the images for enhancement of certain properties or for optimized use of the resources.
- To inculate colour transformations.
- To study smoothing and sharpening of images

Course Outcomes

At the end of the course the research scholars will be able to :

- Understand the Fundamentals of image processing.
- Knowledge about various transforms used in image processing.
- Knowledge about the Image processing techniques like image enhancement, reconstruct ion, compression and segmentation.
- Gain knowledge on Multi resolution analysis.

- Understand about video coding and compression techniques.
- Develop algorithms for image compression and coding.

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D imagetransforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain,Review of morphological image processing

UNIT II SEGMENTATION

Edge detection, Thresholding, Region growing, Fuzzyclustering, Watershed algorithm, Activecontour methods, Texture feature based segmentation, Model based segmentation, Atlas basedsegmentation, Wavelet based Segmentation methods

UNIT III FEATURE EXTRACTION

First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundarydescriptors, Moments, Texture descriptors-Autocorrelation, Co-occurrence features, Runlengthfeatures, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION

Registration-Preprocessing, Feature selection-points, lines, regions and templates Featurecorrespondence-Point pattern matching, Line matching, region matching Template matching.Transformation functions-Similarity transformationand Affine Transformation. Resampling-NearestNeighbour and Cubic SplinesImage Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusiondiscrete wavelettransform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color,Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connectedsurfaces, Image processing in 3D, Measurements on 3D images.

SUGGESTED READINGS:

1. John C.Russ, (2007)"The Image Processing Handbook", CRC Press,.
2. Mark Nixon, Alberto Aguado, (2008)"Feature Extraction and Image Processing", Academic Press,.
3. Ardeshir Goshtasby,(2005) " 2D and 3D Image registration for Medical, Remote Sensing andIndustrial Applications",John Wiley and Sons,
4. Rafael C. Gonzalez, Richard E. Woods, (2004) Digital Image Processing', Pearson,Education, Inc.,Second Edition,.
5. Anil K. Jain, (2002) Fundamentals of Digital Image Processing', Pearson Education,Inc.,.
6. Rick S.Blum, Zheng Liu,(2006)" Multisensor image fusion and its Applications",Taylor& Francis,.

Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2019-2020

19RECE307 Paper III-Special Paper VII: Network Routing Algorithms 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

Course Objectives

The goal of this course for research scholars is:

- To introduce the concept of circuit switching networks.
- To introduce the concept of packet switching networks.
- To introduce the concepts of high-speed networks.
- To introduce the need for mobile networks.
- To study the mobile ad-hoc networks.
- To introduce the Ad-hoc On- demand Distance Vector.

Course Outcomes

At the end of the course the research scholars will be able to :

- Knowledge about the circuit switching networks.
- Knowledge about concept of packet switching networks.
- Knowledge about the concepts of high-speed networks.
- Knowledge about the need for mobile networks
- Knowledge about the mobile ad-hoc networks.
- Distributions for Ad-hoc On- demand Distance Vector.

UNIT I CIRCUIT SWITCHING NETWORKS

AT & T's Dynamic Routing Network, Routing in Telephone Network-Dynamic Non Hierarchical Routing-Trunk Status Map Routing-Real Time Network Routing, Dynamic Alternative Routing-Distributed Adaptive Dynamic Routing-Optimized Dynamic Routing

UNIT II PACKET SWITCHING NETWORKS

Distance vector Routing, Link State Routing, Inter domain Routing-Classless Interdomain routing (CIDR), Interior Gateway routing protocols (IGRP) - Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Exterior Gateway Routing Protocol (EGRP) - Border Gateway Protocol (BGP), Apple Talk Routing and SNA Routing

UNIT III HIGH SPEED NETWORKS

Routing in optical networks-The optical layer, Node Designs, Network design and operation, Optical layer cost tradeoffs, Routing and wavelength assignment, Architectural variations, Routing in ATM networks-ATM address structure, ATM Routing, PNNI protocol, PNNI signaling protocol, Routing in the PLANET network and Deflection Routing.

UNIT IV MOBILE NETWORKS

Routing in Cellular Mobile Radio Communication networks-Mobile Network Architecture, Mobility management in cellular systems, Connectionless Data service for cellular systems, Mobility and Routing in Cellular Digital Packet Data (CDPD) network, Packet Radio Routing-DARPA packet radio network, Routing algorithms for small, medium and large sized packet,radio networks.

UNIT V MOBILE AD-HOC NETWORKS (Manet)

Internet based mobile ad-hoc networking, communication strategies, routing algorithms – Table-driven routing - Destination Sequenced Distance Vector (DSDV), Source initiated on demand routing- Dynamic Source Routing (DSR), Ad-hoc On- demand Distance Vector (AODV), Hierarchical based routing- Cluster head Gateway Switch Routing (CGSR) and Temporally-Ordered Routing Algorithm (TORA), Quality of Service.

SUGGESTED READINGS:

1. Steen strub.M,(1995), "Routing in Communication networks", PH International, New York.

2. William Stallings,(2004), "ISDN & Broadband ISDN with Frame Relay & ATM", PHI, New Delhi.

3. Behrouz A Forouzan,(2004), "Data Communications and Networking (3/e), TMH, New Delhi.

4. William Stallings,(1998), "High Speed Networks TCP/IP and ATM Design Principles", Prentice Hall International, New York.

5. Mohammad Ilyas,(2002), "The Handbook of Ad hoc Wireless Networks", CRC Press, USA.

Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2019-2020

19RECE308 Paper III-Special Paper VIII: Cryptography and Network Security 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

Course Objectives

The goal of this course for research scholars is:

-
- To introduce the students the functions of symmetric ciphers.
- To introduce the public-key encryption and hash functions.
- To make students to get familiarized with different network security practice.
- To familiarize the students with system security concepts.
- To imparts a good knowledge in wireless security.
- To learn about Wireless LAN Security Factors and Issues.

Course Outcomes

At the end of the course the research scholars will be able to :

- Adequate knowledge about the functions of symmetric ciphers.
- Adequate knowledge about the public-key encryption and hash functions.
- Familiarize with different network security practice.
- Trace the flow of information from system security concepts.
- Gain knowledge to wireless security.
- Analyze the performance of the Wireless LAN Security Factors and Issues.

UNIT I SYMMETRIC CIPHERS

Overview – classical Encryption Techniques – Block Ciphers and the Data Encryption standard – Introduction to Finite Fields – Advanced Encryption standard – Contemporary Symmetric Ciphers – Confidentiality using Symmetric Encryption.

UNIT II PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS

Introduction to Number Theory – Public-Key Cryptography and RSA – Key Management – Diffie-Hellman Key Exchange – Elliptic Curve Cryptography – Message Authentication and Hash Functions – Hash Algorithms – Digital Signatures and Authentication Protocols.

UNIT III NETWORK SECURITY PRACTICE

Authentication Applications – Kerbors – X.509 Authentication Service – Electronic mail Security – Pretty Good Privacy – S/MIME – IP Security architecture – Authentication Header – Encapsulating Security Payload – Key Management.

UNIT IV SYSTEM SECURITY

Intruders – Intrusion Detection – Password Management – Malicious Software – Firewalls – Firewall Design Principles – Trusted Systems.

UNIT V WIRELESS SECURITY

Introduction to Wireless LAN Security Standards – Wireless LAN Security Factors and Issues.

SUGGESTED READINGS:

1. William Stallings, (2003), "Cryptography And Network Security – Principles and Practices", Pearson Education, 3rd Edition.
2. Atul Kahate, (2003),"Cryptography and Network Security", Tata McGraw Hill.
3. Bruce Schneier, (2001),"Applied Cryptography", John Wiley and Sons Inc,.
4. Stewart S. Miller, (2003), "Wi-Fi Security", McGraw Hill.
5. Charles B. Pfleeger, Shari Lawrence Pfleeger, (2003),"Security In Computing", 3rd Edition, Pearson Education.
6. Mai, (2003),"Modern Cryptography: Theory and Practice", First Edition

Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2019-2020

19RECE309 Paper III-Special Paper IX: Bio-Medical Signal Processing 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

Course Objectives

The goal of this course for research scholars is:

- To know about wavelet transforms
- To understand neurological signal processing
- To understand cardiological signal processing
- To know 60- Hz adaptive canceling using a sine wave model
- To understand applications of adaptive filtering
- To gain knowledge on VLSI signal processing

Course Outcomes

At the end of the course the research scholars will be able to :

- Know about wavelet transforms
- Understand neurological signal processing
- Understand cardiological signal processing
- Know 60- Hz adaptive canceling using a sine wave model
- Understand applications of adaptive filtering
- Gain knowledge on VLSI signal processing

UNIT I INTRODUCTION TO WAVELET TRANSFORMS

Basics of FT,FFT, DTFT, DFT, DIT-FFT, DIF-FFT algorithms, Introduction to wavelet transforms, Advantages, Applications, Limitations, Different types of wavelet transforms & their characteristics, The Discrete Wavelet Series, The Discrete Wavelet Transform, Multi Resolution Analysis

UNIT II NEUROLOGICAL SIGNAL PROCESSING

The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, The autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination

UNIT III CARDIOLOGICAL SIGNAL PROCESSING

Basic electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation, the use of multiscale analysis for parameters estimation of ECG waveforms, Arrhythmia analysis monitoring, Long-term continuous ECG is recording

UNIT IV ADAPTIVE FILTERS & ECG DATA REDUCTION TECHNIQUES

Principal noise canceller model, 60- Hz adaptive canceling using a sine wave model, applications of adaptive filtering, Direct data compression techniques, Direct ECG data compression techniques, Transformation compression technique

UNIT V VLSI IN DSP

Digital signal processors. High performance VLSI signal processing, VLSI applications in medicine, VLSI sensors for biomedical signals, VLSI tools, choice of custom, ASIC, or off- the- shelf components

SUGGESTED READINGS:

1. D.C. Reddy (2005)Biomedical Signal Processing, Principles and Techniques , Tata McGraw Hill,.
2. Wills J. Tompkins,(2007) "Biomedical digital signal processing", Prentice Hall of India Pvt. Ltd.

Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2019-2020

19RECE310 Paper III-Special Paper X: Embedded Networking 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

Course Objectives

The goal of this course for research scholars is:

- To understand embedded networking
- To study about basics of Controller Area Network (CAN)
- To understand CAN Networking Configuration
- To study CAN development tools.
- To know the comparison of various implementation methods
- To know about communication objects

Course Outcomes

At the end of the course the research scholars will be able to :

- Understand embedded networking
- Study about basics of Controller Area Network (CAN)
- Understand CAN Networking Configuration
- Study CAN development tools.
- Gain the knowledge on the comparison of various implementation methods
- Understand about communication objects

UNIT I INTRODUCTION

Embedded networking – code requirements – Communication requirements – Introduction to CAN open – CAN open standard – Object directory – Electronic Data Sheets & Device – Configuration files – Service Data Objectives – Network management CAN open messages – Device profile encoder.

UNIT II NETWORKING CONFIGURATION

CAN open configuration – Evaluating system requirements choosing devices and tools – Configuring single devices – Overall network configuration – Network simulation – Network Commissioning – Advanced features and testing.

UNIT III CONTROLLER AREA NETWORK

Controller Area Network – Underlying Technology CAN Overview – Selecting a CAN Controller – CAN development tools.

UNIT IV IMPLEMENTATION

Implementing CAN open Communication layout and requirements – Comparison of

implementation methods – Micro CAN open – CAN open source code – Conformance test – Entire design life cycle.

UNIT V COMMUNICATION OBJECTS

Implementation issues – Physical layer – Data types – Object dictionary – Communication object identifiers – Emerging objects – Node states.

SUGGESTED READINGS:

1. Glaf P.Feiffer, Andrew Ayre and Christian Keyold, (2005), "Embedded Networking with CAN and CAN open". Embedded System Academy.

Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2019-2020

19RECE311 Paper III-Special Paper XI: VLSI design methodologies and programming in HDL

4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

Course Objectives

The goal of this course for research scholars is:

- To know about MOS transistor theory in detail
- To analyze various parameters of the CMOS inverter characteristics.
- To understand design of combinational and sequential circuit
- To understand verilog programming styles
- To know about system tasks and compiler directives
- To know HDL programming with structural and switch level models

Course Outcomes

At the end of the course the research scholars will be able to :

- Gain knowledge about MOS transistor theory in detail
- Analyze various parameters of the CMOS inverter characteristics.
- Understand design of combinational and sequential circuit
- Understand verilog programming styles
- Gain knowledge about system tasks and compiler directives
- HDL programming with structural and switch level models

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UNIT I - MOS TRANSISTOR THEORY

MOS transistor theory introduction - Ideal V-I characteristics - second order effects- CMOS logic - CMOS fabrication and layout - VLSI design flow.

UNIT II - CIRCUIT CHARACTRIZATION AND PERFORMANCE ESTIMATION

CMOS inverter - DC transfer characteristics- Delay estimation - logical effort - Power dissipation - scaling - latch up.

UNIT III - COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN

Static CMOS - ratioed circuits - differential cascode voltage switch logicDynamic circuit - domino logic-pass transistor circuits - CMOS D latch and edge triggered flipflop - Schmitt trigger.

UNIT IV - HDL PROGRAMMING USING BEHAVIORAL AND DATA FLOW MODELS Verilog introduction - Typical design flow-Modules and ports-instances – components –lexical conventions - number specification - strings – identifiers and keywords –data types - System tasks and compiler directives - behavioral modeling - dataflow modeling - RTL - Gate level modeling - programs for combinational and sequential.

UNIT V - HDL PROGRAMMING WITH STRUCTURAL AND SWITCH LEVEL MODELS

Tasks and functions –difference between tasks and functions-switch levelMOS switches - CMOS switches-examples - CMOS NAND and NOR – MUX using transmission gate – CMOS flipflop.

SUGGESTED READINGS:

1. Neil H.E Weste, David Harris, Ayan Banenjee,(2004) "CMOS VLSI Design", 3 rd Edition, Pearson,.

2. Sung Mu Kang , Yusuf Leblebici (2002)"CMOS Digital Integrated Circuits", 3 rd Edition, Tata Mc-Graw Hill,.
3. Samir Palnitkar,(2004) "Verilog HDL", 2nd Edition, Pearson,.

Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2019-2020

19RECE312 Paper III-Special Paper XII : Pattern Recognition 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

Course Objective

The goal of this course for students is :

- To provide basic insight on pattern recognition
- To make aware of various classifiers for pattern recognition
- To study of parameter estimation methods
- To introduce nonparametric techniques
- To impart knowledge on unsupervised learning
- To learn about clustering in pattern recognition

Course Outcomes

At the end of the course the students will be able to :

- Understand the basic concepts of pattern recognition
- Choose different classifiers based on applications
- Acquire knowledge on parameter estimation methods
- Identify various estimation techniques for different models
- Gain knowledge on unsupervised learning
- Apply K-means for pattern clustering

UNIT I – INTRODUCTION

Introduction and mathematical preliminaries What is pattern recognition?,Clustering vs. Classification; Applications; Linear Algebra, vector spaces, probability theory, estimation techniques.

UNIT II – CLASSIFICATION

Bayes decision rule, Error probability, Error rate, Minimum distance classifier, Mahalanobis distance; K-NN Classifier, Linear discriminant functions and Non-linear decision boundaries. Fisher's LDA, Single and Multilayer perceptron, training set and test sets, standardization and normalization.

UNIT III – CLUSTERING

Different distance functions and similarity measures, Minimum within cluster distance criterion, K-means clustering, single linkage and complete linkage clustering, MST, medoids, DBSCAN, Visualization of datasets, existence of unique clusters or no clusters.

UNIT IV - FEATURE SELECTION

Problem statement and Uses, Probabilistic separability based criterion functions, interclass distance based criterion functions, Branch and bound algorithm, sequential forward/backward selection algorithms, (l,r) algorithm.

UNIT V - FEATURE EXTRACTION

Principal component analysis, Kernel PCA. Recent advances in Pattern recognition: Structural PR, SVMs, FCM, Soft-computing and Neuro-fuzzy.

SUGGESTED READINGS:

1. R.O.Duda, P.E.Hart and D.G.Stork, (2001.)Pattern Classification, John Wiley.

2. K. Fukunaga(2000); . Statistical pattern Recognition ,Academic Press,.

3. S.Theodoridis and K.Koutroumbas,(2009) Pattern Recognition, 4th Ed., Academic Press,.

Ph.D ELECTRONICS AND COMMUNICATION ENGINEERING 2019-2020

19RECE313 Paper III-Special Paper XII : Digital System Design Using Verilog 4H:4C

Instruction hours/week:L:T:P:C- 4 0 0 4 Marks:External 100 Total 100

Course Objectives

The goal of this course for research scholars is:

- To know about design methodology used for real world circuits
- To understand number and sequential basics in digital circuits
- To understand memories and implementation fabrics
- To know about processor basics and I/O interfacing

- To understand design flow in detail
- To know design for test concepts in detail

Course Outcomes

At the end of the course the research scholars will be able to :

- Know about design methodology used for real world circuits
- Understand number and sequential basics in digital circuits
- Understand memories and implementation fabrics
- Know about processor basics and I/O interfacing
- Understand design flow in detail
- Know design for test concepts in detail

UNIT : Introduction and Methodology

Digital Systems and Embedded Systems, Binary representation and Circuit Elements, Real-World Circuits, Models, Design Methodology.

UNIT II : **Number and Sequential Basics**

Unsigned and Signed Integers, Fixed and Floating-point Numbers, Storage elements, Counters, Sequential Data paths and Control, Clocked Synchronous Timing Methodology.

UNIT III : Memories and Implementation Fabrics

Concepts, Memory Types, Error Detection and Correction, ICs, PLDs, Packaging and Circuit Boards, Interconnection and Signal Integrity.

UNIT IV : Processor Basics and I/O interfacing

Embedded Computer Organization, Instruction and Data, Interfacing with memory, I/O devices, I/O controllers, Parallel Buses, Serial Transmission, I/O software.

UNIT V : Design Methodology

Concepts, case study, Verification of accelerators. Design flow, Design optimization, Design for test.

SUGGESTED READINGS:

1. Peter J. Ashenden, “Digital Design: An Embedded Systems Approach Using VERILOG”, Elesvier, 2010.
2. Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition By Samir Palnitkar.

PhD Course Work Subjects

(Effective from the academic year 2019-2020 onwards)

Paper No.		Subject Code	Subject	Credit	ESE	total
Paper 1		19REEE101	Research Methodology and Pedagogy	3	100	100
Paper II		19REEE201	Renewable Energy Sources	3	100	100
		19REEE202	Advances in Power Electronics	3	100	100
		19REEE203	Advances in Power Systems	3	100	100
		19REEE204	Distributed Generation	3	100	100
		19REEE205	Smart Grids	3	100	100
		19REEE206	Advanced Control Systems	3	100	100
Paper III	Special Paper I	19REEE301	Analysis of Inverter Circuits	3	100	100
	Special Paper II	19REEE302	Analysis of Converter Circuits	3	100	100
	Special Paper III	19REEE303	Power Quality Assessment and Mitigation	3	100	100
	Special Paper IV	19REEE304	Computer Aided Design of Electrical Apparatus	3	100	100
	Special Paper V	19REEE305	Energy Auditing, Energy Efficiency and Energy Conversion	3	100	100
	Special Paper VI	19REEE306	Power Electronics Applications to Power Systems	3	100	100
	Special Paper VII	19REEE307	Special Electrical Machines	3	100	100
	Special Paper VIII	19REEE308	Advanced Bio-Medical Digital Signal Processing	3	100	100
	Special Paper IX	19REEE309	Power Sector Economics, Management and Restructuring	3	100	100
	Special Paper X	19REEE310	Wind Energy Conversion Systems	3	100	100
	Special Paper XI	19REEE311	Theory and Design of Neuro-Fuzzy Controllers	3	100	100
	Special Paper XII	19REEE312	Soft Computing Techniques	3	100	100
	Special Paper XIII	19REEE313	Flexible AC Transmission Systems	3	100	100

	Special Paper XIV	19REEE314	HVDC Systems	3	100	100
	Special Paper XV	19REEE315	Digital Power System Protection	3	100	100
	Special Paper XVI	19REEE316	Optimization Techniques	3	100	100
	Special Paper XVII	19REEE317	Embedded Systems	3	100	100
	PaperXVIII	19REEE318	Artificial Intelligence Applications to Power Systems	3	100	100

Part I - Ph.D - Syllabus
Paper I: 19REEE101 RESEARCH METHODOLOGY AND PEDAGOGY
(Effective from the academic year 2019-2020 onwards)

Course Objectives:
At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand various test
5. Understand Patent Rights
6. New Developments in pedagogy

Course Outcomes:

1. Understanding of the basic framework of research process
2. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
3. Understand the tests provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
4. Effective technical writing
5. Nature of Intellectual Property
6. Patent Rights

UNIT I INTRODUCTION TO RESEARCH METHODOLOGY
Research – Definition – Importance and Meaning of research – Characteristics of research – Types of Research – Steps in research – Identification, Selection and formulation of research problem – Research questions – Research design – Formulation of Hypothesis – Review of Literature.

UNIT II SAMPLING TECHNIQUES
Sampling theory – types of sampling – Steps in sampling – Sampling and Non-sampling error – Sample size – Advantages and limitations of sampling. Collection of Data: Primary Data – Meaning – Data Collection methods – Secondary data – Meaning – Relevances, limitations and cautions.

UNIT III HYPOTHESES TESTS
Statistics in Research – Measure of Central tendency – Dispersion – Skewness and Kurtosis in research. Hypothesis – Fundamentals of Hypothesis testing – Standard Error – Point and Interval estimates – Important Non-Parametric tests : Sign, Run, Kruskal – Wallis tests and Mann-Whitney test.

UNIT IV PARAMETRIC TESTS AND REPORT WRITING
Para metric tests : Testing of significance – mean, Proportion, Variance and Correlation – testing for Significance of difference between means, proportions, variances and correlation co-efficient. Chi-square tests – ANOVA – One-way and Two-way. Research Report : Types of reports – contents – styles of reporting – Steps in drafting reports – Editing the final draft – Evaluating the final draft.

UNIT VPEDAGOGICAL METHODS IN HIGHER LEARNING
Objectives and roll of higher education – Important characteristics of an effective Lecture – Quality teaching and learning – Lecture preparation – Characteristics of instructional design – Methods of

teaching and learning : Large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing Demonstration, Brain storing, case discussion, and assignment, Methods of evaluation – Self evaluation, student evaluation, Diagnostic testing and remedial teaching – Question banking – Electronic media in education: - 'e' learning researches – web based learning

TEXT BOOKS:

- Rajasekar.S (2005) Computer Education and educational computing. Hyderabad: Neelkamal Publications.
- Kumar K.L. (1997) Educational Technologies, New Delhi: New age International.
- Vedanayagam, E.G (1989) Teaching Technology for college teachers. New Delhi: Sterling Publishers (P) Ltd.,

REFERENCES:

- Kothari C.R. Research Methodology Methods and Techniques, New Age Publications,Second edition,2009
- Panneerselvam R., Research Methodology, Prentice-Hall of India, New Delhi,2004

Paper II: 19REEE201 RENEWABLE ENERGY SOURCES
(Effective from the academic year 2019-2020 onwards)

Course Objectives

1. To gain the knowledge about environmental aspects of energy utilization.
2. To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
3. To study about solar energy collectors and its storages
4. To study about the inter connected system in wind power
5. To understand the basic principles fuel cell, Geo thermal power plants.
6. To gain the knowledge about hydro energy.

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Analyze the different energy sources
2. Able to perform an initial design of a renewable energy system.
3. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
4. Understand the basic physics of wind and solar power generation.
5. Understand the basics of chemical ,ocean and geothermal energy.
6. Understand the power electronic interfaces for wind and solar generation.

UNIT – I SOLAR ENERGY

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storages.

UNIT – II WIND ENERGY

Introduction – Basic principles of wind energy conversion – wind data and energy estimation – site selection consideration – basic components of wind energy conversion system –Types of wind machines – basic components of wind electric conversion systems. Schemes for electric generations – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNIT – III CHEMICAL ENERGY SOURCES

Introduction – fuel cells – design and principles of operation of a fuel cell –
Classification of fuel cells.Types of fuel cells – conversion efficiency of fuel cells. Types of electrodes, work output and emf of fuel cell, Applications of fuel cells. Hydrogen energy: Introduction – hydrogen production – electrolysis, thermo chemical methods, Westing House Electro-chemical thermal sulphur cycle. Fossil fuel methods.Hydrogen storage, Utilization of hydrogen gas.

UNIT – IV ENERGY FROM OCEANS

Introduction, ocean thermal electric conversion (OTEC), methods of ocean thermal electric power generation, open cycle OTEC system, closed OTEC cycle. Energy from tides: Basic principles of tidal power, component of tidal power plants, operation methods of utilization of tidal energy, site requirements, storage, advantages and limitations of tidal power generation. Ocean waves, energy and power from the waves, wave energy conversion devices.

UNIT – V GEOTHERMAL ENERGY

Introduction, estimation of geothermal power, nature of geothermal fields, Geothermal sources, inter connection of geothermal fossil systems, prime movers for geo thermal energy conversion. Application of geothermal energy. Energy from biomass: Introduction, Biomass conversion technologies, photosynthesis, classification of biogas plants. Biomass Energy conversion, Energy from waste.

TEXT BOOKS:

- Goswami, D.Y., Kreith, F., and Kreider, J.F., 2000, Principles of Solar Engineering, Taylor and Francis, Philadelphia.
- Duffie, J.A., and Beckman, W.A., 1991, Solar Engineering of Thermal Processes, 2nd Edition, John Wiley, New York.

REFERENCES

- Rai, G.D., Non Conventional Energy Sources. Khanna publishers ,Fourth edition,2010
- Twidell, J., and Weir, T., 2006 , Renewable Energy Resources, E&FN Spon Ltd., London.
- Sukatme, S.P., 1991, Solar Energy – Principles of thermal collection and storage, 2nd Edition, Tata McGraw Hill, New Delhi.

Paper II: 19REEE202ADVANCES IN POWER ELECTRONICS
(Effective from the academic year 2019-2020 onwards)

Course Objectives

1. To review basic concepts of power electronics in the field of power control and drives
2. To address the underlying concepts and methods behind Advanced Power Electronics
3. To impart knowledge of power semiconductor technologies and their advancement in the field of power conversion.
4. To study the real time application of it.
5. To study the safe operating area of the power devices
6. MOS controlled thyristors

Course Outcomes

At the end of the course the student will be able to

1. Understand the concepts of Advanced Power Electronics
2. Understand the different characteristics of Advanced Power Electronics devices
3. Analysis the real time application of it.
4. To learn deep knowledge of FACT technologies
5. To study about real time applications of inverters and rectifiers
6. To learn about protection of device circuits

UNIT-I RESONANT CONVERTERS

Zero voltage and zero current switching-Classification of resonant converters-Basic resonant circuit concepts-Load resonant converters-Resonant switch converters-Zero voltage switching, clamped voltage topologies-Resonant DC link inverters and zero voltage switching- High frequency link integral half cycle converters – Applications in SMPS and lighting.

UNIT-II IMPROVED UTILITY INTERFACE

Generation of current harmonics – Current harmonics and power factor-Harmonic standards and recommended practices-Need for improved utility interface-Improved single phase utility interface-Improved three phase utility interface – Electromagnetic interference

UNIT-III FACTS

Introduction – Principles of reactive power control in load and transmission line compensation-Series and shunt reactive power compensation – Concepts of flexible AC Transmission system(FACTS) – Static var compensators(SVC)-Thyristor controlled reactor-Thyristor switched capacitor –Solid state power control-Static condensers-Controllable series compensation-Thyristor controlled phase angle regulator and unified power flow control.

UNIT-IV MODELING AND ANALYSIS

Modeling and methods of analysis of SVC and FACTS controllers – System control and protection – Harmonics and Filters –Simulation and study of SVC and FACTS under dynamic conditions.

UNIT-V EMERGING DEVICES AND CIRCUITS

Power Junction Field Effect Transistors-Field Controlled Thyristors-JFET based devices Vs other power devices-MOS controlled thyristors-Power integrated circuits-New semiconductor materials for power devices.

TEXT BOOKS:

- Bimal k Bose, "Modern Power Electronics-Evolution, Technology and application", Jaico Publishing House, Mumbai, 2006
- Ned Mohan., Undeland and Robbins,"Power Electronics: Convertors, Applications and Design", John Wiley and Sons(Asia) Pte Ltd, Singapore, 2003.

REFERENCES

- Rashid, M.H., "Power Electronics-Circuits, Devices and Applications", Pearson Education(Singapore)Pte. Ltd, New Delhi, 2004./Prentice Hall of India, New Delhi.
- Mohan Mathur P, Rajiv K Varma, "Thyristor- Based Facts Controllers for Electrical Transmission Systems", John Wiley and Sons Inc., IEEE Press, UAS, 2002.
- Roger C Durgan, Maric F Mcgranaghan, "Electrical Power System Quality", Mc-Graw Hill Inc, New York ,1996.
- Joseph Vithayathil., "Power Electronics", Mc-Graw Hill series in Electrical and Computer Engineering, USA, 1995.

Paper II: 19REEE203ADVANCES IN POWER SYSTEMS
(Effective from the academic year 2019-2020 onwards)

Course Objectives

1. To become familiar with different aspects of modeling of components and system
2. To study different methods of analysis of power system for power system planning andoperation.
3. To model steady-state operation of large sized power system
4. To understand the power flow problem using efficient numerical methods suitable for computer application.
5. To model and analyze power systems under abnormal(fault) conditions.
6. Tomodelandanalyzethedynamicsofpowersystemforsmallsignaland large signal disturbances and to design the system for enhancing stability.

Course Outcomes

At the end of this course, students will demonstrate the ability to
1.Understand the concepts of power systems.
2. Understand the various power system components.
3. Evaluate fault currents for different types of faults.
4. Understand the generation of over-voltages and insulation coordination.
5. Understand basic protection schemes.
6. Understand concepts of EMTP.

UNIT-I ECONOMIC DISPATCH
Planning and operational problems of power systems - review of economic dispatch and calculation using B matrix loss formula - Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method-Base point and participation factors in on line economic dispatch. Economic dispatch controller added to LFC control.

UNIT-II REAL POWER AND REACTIVE POWER
Fundamentals of speed governing mechanism and modeling- Speed-load characteristics – Load sharing between two synchronous machines in parallel - Plant and system level control problem - ALFC of single area system - modelling-static and transient response - ALFC of multi area system-modelling - static and transient response of two area system - development of state variable model - Two area system- AGC system design Kalmans method. Modeling of AVR loop -components - dynamic and static analysis - stability compensation - system level voltage control using OLTC, capacitor and generator voltages -expert system application for system voltage control.

UNIT-III VOLTAGE STABILITY ANALYSIS-I
Transmission and generation and load aspects. Instability mechanisms and analysis methods: mathematical background -differential equations, bifurcations, multiple time scales.

UNIT-IV VOLTAGE STABILITY ANALYSIS-II

Modeling for voltage stability analysis: time scale decomposition Equilibrium equations for voltage stability analysis.Loadability, sensitivity and bifurcation analysis-eigenvector and singular vector properties-loadability or bifurcation surface-case studies short term and long term voltage instability and counter measures.

UNIT-V SOLUTIONS METHODS AND MODELS FOR ANALYSIS OFELECTROMAGNETIC TRANSIENTS

Steady state and time step solutions in EMTP and their uses-models of synchronous, and induction machines EMTP; Selected case studies.

TEXT BOOKS:

- Allen J Wood and Bruce F Wollenberg, 2013, Power generation and control, John Wiley and sons, New York.
- Kundur, P., 2008 , Power system stability and control, EPRI publications, California.

REFERENCES

- Cutsem,T.V., Vournas, C., 1998,Voltage stability of power systems, Kluwer Academic Publishers.
- Dommel, H.W., August 1986, Electromagnetic Transients Program, Reference Mannual prepared for Bonnerville Power Administration, U.S.A..

Paper II: 19REEE204DISTRIBUTED GENERATION
(Effective from the academic year 2019-2020 onwards)

Course Objectives

1. To study about the distributed generationsystem.
2. To study about the relaying and protections in the distributedsystem.
3. To get the knowledge of distributed generation, boiler turbine monitoring system.
4. To get the knowledge in Planning of distributed system
5. To know the control of DG inverter
6. To gather knowledge of protection of distributed systems

Course Outcomes

At the end of the course the students will

1. Understand the distributed generation system , boiler turbine monitoring system.
2. Understand the Planning of distributed system
3. Analysis the control of DG inverters
4. Analysis the protection of distributed systems
5. Understand the real time system
6. Analysis the norms and standards used in it

UNIT I INTRODUCTION TO DISTRIBUTED GENERATION

Introduction to the concept of distributed generation - Distributed generation advantages and needs - Radial distribution system protection: Fuse, circuit breakers, reclosers- Per-unit analysis, fault analysis, sequence component analysis, sequence models of distribution system components. Implications of DG on distribution system protection coordination.

UNIT II DISTRIBUTION SYSTEM LOADING

Introduction – Distribution system loading, line drop model, series voltage regulators and on line tap changers- Power quality requirements and source switching using SCR based static switches- Loop and secondary network distribution grids and impact of DG operation.

UNIT III RELAYING AND PROTECTION

Relaying and protection, distributed generation interconnection relaying, sensing using CTs and PTs- Intentional and unintentional islanding of distribution systems. Passive and active detection of unintentional islands, non detection zones - EMI considerations in DG applications.

UNIT IV DISTRIBUTED GENERATION PLANNING

DG planning and forecasting techniques - Load characteristics: Definitions - tariffs and metering of energy, cost implications of power quality, cost of energy and net present value calculations and implications on power converter design- Distribution Transformers: Types. Distribution sub-stations and primary systems: Voltage drop and power loss calculations: Distribution feeder costs.

UNIT V DG INVERTERS CONTROL

Control of DG inverters, phase locked loops, current control and DC voltage control for stand alone and grid parallel operations. Protection of the converter.

TEXT BOOKS

- A Textbook of Electric Power Distribution Automation by Dr. M.K. Khedkar, Dr. G.M. Dhole Laxmi Publications, Ltd 2010.

REFERENCES

- Power Electronics: Converters, Applications, and Design by Ned Mohan, Tore M. Undeland, William P. Robbins Wiley,2002
- Electric Power Distribution Systems by TuranGonen, CRC Press, 2006
- Electric Power Distribution by Pabla, A. S 6th Edition, Tata McGraw-Hill Education 2011

Paper II: 19REEE205 SMART GRIDS
(Effective from the academic year 2019-2020 onwards)

Course Objectives:
1.Understand concept of smart grid and its advantages over conventional grid
2.Know smart metering techniques
3.Learn wide area measurement techniques
4.Understanding the problems associated with integration of distributed generation & its solution through smart grid.
5. Learn Web based Power Quality monitoring

Course Outcomes
Students will be able to:
1.Appreciate the difference between smart grid & conventional grid
2.Apply smart metering concepts to industrial installations
3. Apply smart metering concepts to commercial installations
4.Formulate solutions in the areas of smart substations,distributed generation and wide area measurements
5.Come up with smart grid solutions using modern communication technologies
6. Understand the concept of Power Quality & SCADA in Smart Grid

UNIT I INTRODUCTION : SMART GRID AND EMERGING TECHNOLOGIES
Defining a smart grid – Characteristics of smart grid - Values of a smart grid – The economic Case – The environmental Case – Benefits to utilities – Benefits to consumers – Power system components – Power system protection: Traditional Vs Smart – Case study – Generation fundamentals – Traditional Generations – Distributed Generations – micro grid generation – Generator Protection – Challenges and Opportunities – Cost of smart grid – Government Regulations – Emerging Technologies - FACTS – optimizing integration systems – Multi generation buildings – Case study.

UNIT II SMART GRID: MODELS AND OPERATING PRINCIPLES
Solar Photovoltaic models and grid Integration – Design of a 2 MVA PV station – DG system as part of utility power system – The smart grid PV - UPS DG system – Split DC Bus UPS – PV DG system – Island mode of operation – Parallel operation of Inverters – Power Quality. Wind turbine model and grid Integration – Micro turbine model & Grid Integration. Electric Vehicle model and Grid Integration.

UNIT III SMART GRID: DISTRIBUTED GENERATION SYSTEMS
Power Converter System – Control System Development – Current limit and Saturation Control, Simulation using simulate and MATLAB. Inverter Parallel operation – Load sharing control Algorithm – Distributed Generation System and Newton Raphson method in power flow – Plant modeling and 3 phase 4 wire DG unit topology – Single distributed generation System –MIMO Linear system Stability robustness – PWM rectifier control – 3 Phase AC – DC – AC topology.

UNIT IV ENERGY STORAGE AND COMMUNICATION
State–of–the art storage devices – Battery types – Ultra capacitors based Energy Storage System – Flywheel – Wide Area Network – Substation Information System – Wireless Networks – Distribution Automation – AMI Networks – Utility monitoring and Control – Inter-system Coordination – Industrial systems – Consumer Residential Systems – Network Protection – Channel model Fundamental – Low, medium, High voltage, main Topologies – Residential and Business Indoor wiring Topologies – The Power line Channel model – Digital Transmission Techniques - Threats – IEC61850 Considerations.

UNIT V SMART GRID: RELIABILITY, STABILITY AND COMPONENT INTEGRATION

Smart Grid Programming – Virtual Power Producer – Intelligent reconfiguration using SCADA – Problems in distributed grids – Solutions. Integration of Mini – Micro generation in distribution Grids – Power supply Quality generic standards – Renewable Energies specific standards – Smart Grid stability analysis schemes – Supply guarantee and Power quality – Integration in power systems – Distributed Generation advantages and needs.

REFERENCES

- Smart Power: Climate Change, the Smart Grid, and the Future of ElectricUtilities by Fox-PennerIsland Press, Washington DC 2010

- Smart Grid: Modernizing Electric Power Transmission and Distribution; Energy Independence, Storage and Security; Energy Independence and Security Act and Resiliency by StanMark Kaplan, Fred SissineThe Capitol.Net, Washington DC,2009

- Integration of Green and Renewable Energy in Electric Power Systems by Ali Keyhani Mohammad N. Marwali , Min Dai Wiley, USA ,2009

- Power Electronics in Smart Electrical Energy Networks by Ryszard Michal Strzelecki , GrzegorzPawelBenysek Springer, USA 2008

- Power Line Communications: Theory and Applications for Narrowband and Broadband Communications over Power Lines by Hendrik C. Ferreira ,Lutz Lampe , John Newbury,Theo G Swart Wiley, New York 2010

Paper II: 19REEE206 ADVANCED CONTROL SYSTEMS
(Effective from the academic year 2019-2020 onwards)
ADVANCED CONTROL SYSTEMS

Course Objectives

1. To study the state variableanalysis
2. To provide adequate knowledge in the phase plane analysis andalso describing functionanalysis.
3. To study the analysis discrete time systems using conventionaltechniques.
4. To analyze the stability of the systems using differenttechniques.
5. To study the design of optimalcontroller.
6. To study the types of compensators

Course Outcomes

At the end of the course the student will be able to

1. understand the state variable analysis, Z- transform and stateequation
2. Construct the frequency response of the system using various plots
3. Correlate the time and frequency domain specifications and effect of compensation
4. Design the different types of compensators using frequency response plots to stabilize the control system
5. Analysis the state variable representation of physical systems with the effects of state feedback its assessment for linear-time invariant systems.

UNIT 1 STATE VARIABLE ANALYSIS
Concept of state – State Variable and State Model – State models for linear and continuous time systems – Solution of state and output equation – controllability and observability - Pole Placement – State observer Design of Control Systems with observers

UNIT II PHASE PLANE AND DESCRIBING FUNCTION ANALYSIS
Features of linear and non-linear systems - Common physical non-linearities – Methods of linearising non-linear systems - Construction of phase portraits – Singular points – Limit cycles Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.

UNIT III Z-TRANSFORM AND DIGITAL CONTROL SYSTEM
Z transfer function – Block diagram – Signal flow graph – Discrete root locus – Bode plot.

UNIT 1V STATE-SPACE DESIGN OF DIGITAL CONTROL SYSTEM
State equation – Solutions – Realization – Controllability – Observability – Stability – Jury's test.

UNIT V OPTIMAL CONTROL
Introduction -Decoupling - Time varying optimal control – LQR steady state optimal control Optimal estimation – Multivariable control design.

TEXT BOOKS

- Control Systems Engineering By I.J. Nagrath and M. Gopal New Age International Publishers – 4th edition 2006
- Modern control Design with Matlab and Simulink by AshishTewari John Wiley, New Delhi 2002
- Digital Control Systems by Benjamin C. Kuo Oxford University Press – 2nd edition,2012.

REFERENCES

- Modern control system theory by M.Gopal New Age International Publishers,2002
- Feedback Control of Dynamic Systems by Gene F. Franklin, J. David Powell and Abbasemami-NaeiniPrentice Hall, 7th edition,2014
- Design of feedback Control systems by Raymond T. Stefani & Co Oxford University Press,2002

Special Paper I: 19REEE301 ANALYSIS OF INVERTER CIRCUITS
(Effective from the academic year 2019-2020 onwards)

Course Objectives

To impart knowledge on the following topics

1. Operation and performance of single phase inverters
2. Operation of different types of three phase inverters
3. Operation and performance of current source inverters
4. Operation and performance of resonant inverters
5. Operation and performance of multilevel inverters

Course Outcomes

At the end of the course, the student will able to

1. Analysis the application of single phase inverters
2. Analysis the application of three phase inverters
3. Analysis the application of current source inverters
4. Analysis the application of resonant inverters
5. Analysis the application of multilevel inverters
6. Analysis the real time application of it

UNIT- I SINGLE PHASE INVERTERS

Principle of operation of half and full bridge inverters – Performance parameters – Voltage and wave form control of single phase inverters using various PWM techniques – SVM Technique.

UNIT- II THREE PHASE VOLTAGE SOURCE INVERTERS

180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage and wave form control of three phase inverters –SVM Technique.

UNIT- III CURRENT SOURCE INVERTERS

Operation of six-step thyristors inverter – inverter operation modes – load – commutated inverters – Auto sequential current source inverter (ASCI) – current pulsations – comparison of current source inverter and voltage source inverters.

UNIT- IV MULTILEVEL INVERTERS

Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - comparison of multilevel inverters - application of multilevel inverters.

UNIT- V RESONANT INVERTERS

Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC – link inverters.

TEXT BOOKS

- Rashid, M.H., 2004, Power Electronics Circuits, Devices and Applications, 3rd Edition, Prentice Hall of India, New Delhi.

- Jai P Agrawal, 2002, Power Electronics Systems, Pearson Education, 2nd Edition.

- Ned Mohan, Undeland and Robins, 1995, Power Electronics: converters, Application and design, John Wiley and sons Inc, Newyork.

REFERENCES

- Sen, P.C. 1998, Modern Power Electronics, 1st Edition, Wheeler Publishing Co, NewDelhi.
- Bimbra, P.S., 2003, Power Electronics, 11th Edition, Khanna Publishers.
- Bimal K Bose, 2003, Modern Power Electronics and AC Drives, 2nd Edition, Pearson Education.
- Singh, M.D., Khanchandan, K.B., 2002, Power Electronics, Tata McGraw Hill Publishing Limited, New Delhi.

Special Paper II: 19REEE302 ANALYSIS OF CONVERTER CIRCUITS
(Effective from the academic year 2019-2020 onwards)

Course Objectives
To impart knowledge on the following topics

1. Operation and performance of single-phase converters
2. Operation of different types of three phase converters
3. Operation and performance of DC-DC converters
4. Operation and performance of AC voltage controller
5. Operation and performance of cyclo-converters
6. dual Converters

Course Outcomes
At the end of the course, the student will able to

1. Analysis the application of single-phaseconverters
2. Analysis the application of three phase converters
3. Analysis the application of DC-DC converters
4. Analysis the application of AC voltage controller
5. Analysis the application of cyclo-converters
6. Analysis the real time application of it

UNIT- I SINGLE PHASE AC-DC CONVERTER
Uncontrolled, half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - inverter operation – Dual converter - Sequence control of converters – performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap.

UNIT -II THREE PHASE AC-DC CONVERTER
Uncontrolled and fully controlled – converter with R, R-L, R-L-E - loads and freewheeling diodes – inverter operation and its limit – dual Converter – performance parameters – effect of source impedance and overlap.

UNIT- III DC-DC CONVERTERS
Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and Cuk converters – time ratio and current limit control – Full bridge converter – Resonant and quasi – resonant converters.

UNIT- IV AC VOLTAGE CONTROLLERS
Principle of phase control: single phase and three phase controllers – various configurations – analysis with R and R-L loads.

UNIT- V CYCLOCONVERTERS
Principle of operation – Single phase and three phase cycloconverters – power circuits – Output Voltage control – Control Schemes.

TEXT BOOKS

- Ned Mohan, Undeland and RoMEPEin, 2007, Power Electronics: converters, Application and design, John Wiley and sons.Inc, Newyork.

- Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall of India, New Delhi, 1995.

REFERENCES

- Bimbra, P.S., 2003, Power Electronics, 11th Edition, Khanna Publishers.
- Dubey, G.K.,Doradla, S R., Joshi, A., Sinha, R.M K., 2004, ThyristorisedPowerControllers, 1st Edition, New Age International Private Ltd.

Special Paper III: 19REEE303 POWER QUALITY ASSESSMENT AND MITIGATION
(Effective from the academic year 2019-2020 onwards)

Course Objectives

1. To study the production of voltages sags, over voltages and harmonics and methods ofcontrol.
2. To study various methods of power qualitymonitoring.
3. To understand the concept of power and powerfactor in single phase and three phasesystems supplying non linear loads
4. To understand the conventional compensation techniques used forpower factor correction and load voltageregulation.
5. To understand the activecompensation techniquesused forpower factor correction.
6. To understand the activecompensation techniquesused forload voltage regulation.

Course Outcomes

At the end of the course the student will be able to

1.Evaluate the characteristics of ac transmission
2.Reproduce the effect of shunt and series reactive compensation.
3.Justify the working principles of power quality measuring instruments and their operating characteristics.
4.Reproduce the basic concepts of power quality.
5.Rewrite the concept of Harmonics
6.Reproduce and justify the working principles of devices to improve power quality.

UNIT- I INTRODUCTION

Importance of power quality, terms and definitions of power quality as per IEEE std. 1159.such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality.Definitions and terminology of grounding.Purpose of groundings. Good grounding practices and problems due to poor grounding.

UNIT- II FLICKERS AND TRANSIENT VOLTAGES

RMS voltage variations in power system and voltage regulation per unit system, complex power.Principles of voltage regulation. Basic power flow and voltage drop. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Short term and long term flickers. Various means to reduce flickers.Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.

UNIT- III VOLTAGE SAG, SWELLS AND INTERRUPTIONS

Definitions of voltage sag and interruptions. Voltage sags versus interruptions. Economic impact of voltage sag.Major causes and consequences of voltage sags.Voltage sag characteristics.Voltage sag assessment. Influence of fault location and fault level on voltage sag. Areas of vulnerability. Assessment of equipment sensitivity to voltage sags. Voltage sag *limits for computer equipment, CBEMA, ITIC, SEMI F 42 curves. Representation of the results of voltage sags analysis. Voltage sag indices. Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc., utility solutions and end user solutions.

UNIT- IV WAVEFORM DISTORTION

Definition of harmonics, inter-harmonics, sub-harmonics.Causes and effect of harmonics.Voltage versus current distortion. Overview of fourier analysis. Harmonic indices.A.C. quantities under non-sinusoidal conditions.Triplen harmonics, characteristics and non characteristics harmonics.Harmonics series and parallel resonances.Consequences of harmonic resonance.Principles for controlling harmonics.Reducing harmonic currents in loads.K-rated transformer.Harmonic study procedure. Computer tools for harmonic analysis. Locating sources of harmonics. Harmonic filtering, passive and active filters. Modifying the system frequency response.IEEE Harmonic standard 519-1992.

UNIT -V POWER QUALITY MONITORING, ASSESSMENT AND MITIGATION

Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements.Initial site survey.Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors,

data collection and analysis. Selection of transducers.Harmonic monitoring, transient monitoring, event recording and flicker monitoring.

Power Quality assessment, Power quality indices and standards for assessment disturbances, waveform distortion, voltage and current unbalances.Power assessment under waveform distortion conditions.Power quality state estimation, State variable model, observability analysis, capabilities of harmonic state estimation. Test systems. Mitigation techniques at different environments.

TEXT BOOKS

- M. H. J. Bollen IEEE press, 2000, Understanding power quality problems, voltage sag and interruptions - series on power engineering.

- Roger C. Dugan, Mark F. McGranghan, Surya santoso, H. Wayne Beaty 2002 ,Electrical power system quality ,second edition, McGraw Hill Pub.

Special Paper IV: 19REEE304 COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS
(Effective from the academic year 2019-2020 onwards)

Course Objectives

1. To study the structure and behaviour of processors, memories and input and output units and to study theirinteractions.
2. To get basic knowledge on geometric modeling
3. To study the graphic transformation needs
4. To study about the basics of parametric design and object representation
5. To get basic knowledge in product design and development.
6. To study about 3D design introduction

Course Outcomes

At the end of the course the student will be able to

1. Draw electrical drawings usingCAD.
2. Acquire basic knowledge on geometric modeling
3. Acquire knowledge on graphic transformation needs
4. Gaining CAD software application in engineering
5. Gaining basics of parametric design and object representation
6. Analysis the real time application of it

UNIT- I INTRODUCTION

Conventional design procedures – Limitations – Need for field analysis based design.

UNIT- II MATHEMATICAL FORMULATION OF FIELD PROBLEMS

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in field problems – Inductance- Development of torque/force- Lap lace and Poisson’s Equations – Energy functional - Principle of energy conversion.

UNIT - III PHILOSOPHY OF FEM

Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method- 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT - IV CAD PACKAGES

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions – Setting up solution – Post processing.

UNIT- V DESIGN APPLICATIONS

Design of Solenoid Actuator – Induction Motor – Insulators – Power transformer.

TEXT BOOKS

- Salon, S.J., 1995, Finite Element Analysis of Electrical Machines, Kluwer Academic Publishers, London.

- Hoole, S.R.H., 1989, Computer – Aided, Analysis and Design of Electromagnetic Devices, Elsevier, New York, Amsterdam, London.

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- Silvester and Ferrari, P.P., 1983, Finite Elements for Electrical Engineers, CambridgeUniversity press.

- Lowther, D.A., and Silvester, P.P., 1986, Computer Aided Design in Magnetics, Springer verlag, New York.

Special Paper V: 19REEE305 ENERGY AUDITING, ENERGY EFFICIENCY AND ENERGY CONVERSION

(Effective from the academic year 2019-2020 onwards)

Course Objectives:

1. To gain the knowledge about energy management.
2. To understand the basic concepts in economic analysis in energy management.
3. To understand the basic principles of energy audit.
4. To gain the knowledge about the basic concept of types of Energy Audit
5. To gain and Evaluate the different energy efficient motors
6. Understand the concept of Energy conservation.
7. To study about the behavior changes of PF requirement in motor currents

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concept of Energy Management.
2. Analyze the different methods for economic analysis
3. Knowledge about the basic concept of Energy Audit and types.
4. Evaluate the different energy efficient motors
5. Understand the concept of Energy conservation.
6. Investigate the different methods to improve power factor.

UNIT-I INTRODUCTION

Scope of energy management, necessary steps in energy management programme, general principles of energy management, qualities of energy manager, functions of energy manager, language of energy manager.

UNIT-II ENERGY AUDIT AND ENERGY CONSERVATION

Energy surveying and auditing, objectives, uses of energy, energy conservation schemes, energy index, cost index, pie charts, Sankey diagrams, load profiles(histrograms), types of energy audits preliminary energy audit-detailed energy audit, questionnaire, energy audit instruments, energy audit report writing.

Indian energy conservation act-2001, second law of thermodynamics, rules for efficient energy conservation of energy and materials, technologies for energy conservation(reducing demand using alternative supplies, load factor, balancing and energy storage), supply side options, demand side options, maximum demand controller, transmission and distribution side options.

UNIT-III ENERGY EFFICIENT MOTORS AND BOILERS

Constructional details, factors affecting efficiency, losses distribution, soft starters, variable speed drives.

Power Factor: Causes and disadvantages of low power factor, methods to improve power factor.

Energy Efficient lighting: Terminology, cosine law of luminance, types of lamps, characteristics, design of illumination systems, good lighting practice, lighting control, steps for lighting energy conservation.

Boilers: Fuels and combustion, type of boilers, performance evaluation, factors affecting boiler performance, data collection format for boiler performance assessment, case studies.

Steam Distribution System: Steam pipe sizing, proper selection of steam traps, optimum insulation, steam utilization, steam balance-energy saving opportunities.

Furnaces: Types and classification of furnaces, performance evaluation of a typical furnace, general fuel economy measures in furnaces, case studies.

UNIT-IV HEAT RECOVERY SYSTEMS AND COMPRESSED AIR NETWORK

Sources of waste heat, guidelines to identify waste heat, grading of waste heat, feasibility study of waste heat recovery, gas to gas heat recovery, rotary generators, heat pipes, gas to liquid heat recovery, waste heat boilers

Cogeneration: Definition and need, basics of thermodynamic cycles, classification of cogeneration systems, steam turbine, typical heat to power ratio in various industries, operating strategies for cogeneration plant, typical cogeneration performance parameters relative merits of cogeneration systems.

Compressed Air Network: Types of compressors, compressor selection, monitoring performance, specific power consumption, FAD test, capacity control and power consumption, compressed air distribution system, moisture separation.

UNIT-V HVAC (HEATING VENTILATION AND AIR CONDITIONING)

Vapour compression system, vapour absorption system, measurements/field testing, performance evaluation, heat pump, energy efficiency ratios, energy conservation opportunities, case studies.

Cooling Towers: Classification of pumps, centrifugal pump, system characteristics, pump operating point, factors affecting pump performance, pump efficiency, effect of over-sizing the pump, effect of speed variation/impeller diameter change, energy performance and evaluation of pumping system at sites, flow control strategies, meeting the fixed flow reduction, meeting the variable flow reduction.

Fans and Blowers: Types of fans and blowers, fan performance evaluation and efficient system operation, fan performance curves, fan selection, variable loads, flow control methods, energy.

TEXT BOOKS

- LC Witte, PS Schmidt and DR Brown: Industrial Energy Management and Utilization (Hemisphere Publishing corporation, Wasington, 1998).

- W Trinks, MH Mawhinney, RA Shannon, RJ Reed, JR Garvey: Industrial Furnaces, Sixth Edition, (John Wiley &Sons, 2003).

REFERENCES

- JL Threlkeld: Thermal Environmental Engineering, Second Edition (Prentice Hall, 1970).

- YP Abbi and Shashank Jain: Handbook on energy Audit and Environment Management, (TERI Press, 2006).

- WC Turner: Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007).

- George Polimeros:Enrgy Cogeneration Handbook,(Industrial Press,Inc.,New York,1981)

Special Paper VI: 19REEE306 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS
(Effective from the academic year 2019-2020 onwards)

To expose the students to the concepts of

1. High power devices for power system controllers
2. Properties of Single and Three Phase Converters
3. Converter control
4. Stability of Control
5. Application of converters
6. Energy conversion system

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Analyze and design of power system controllers.
2. Acquire the knowledge on csingle and 3 phase converters
3. Understand the concept of ractive power control
4. Acquire the knowledge on Concept of Flexible AC Transmission system
5. Acquire the knowledge on Harmonics and Power factor improvement
6. DC and AC power conditioners

UNIT-1 INTRODUCTION

High power devices for power system controllers-Characteristics-Converters Configurations for large power control.

UNIT-II SINGLE AND THREE PHASE CONVERTERS

Properties-Current and Voltage harmonics-Effects of source and load impedance-Choice of best circuit for power systems.

UNIT III CONVERTER CONTROL

Gate control-Basic means of control-Control characteristics- Stability of Control –Reactive power control.

UNIT IV HVDC SYSTEMS AND FACTS

Application of converters in HVDC systems-Static VAR control-Sources of reactive power-Harmonics and Filters-Concept of Flexible AC Transmission system-Static VAR compensators-Thyristors controlled reactor – Thyristors switched capacitor- Static condenser-Controllable series compensation-UPFC-Static Voltage and Phase angle Regulators-Transient Stabilty Analysis.

UNIT-V ENERGY CONVERSION SYSTEM

Basic components-Generator control-Harmonics –Power factor improvement-PV Conversion Systems: Different schemes-DC and AC power conditioners- Synchronised operation with grid supply –Harmonic problems.

TEXT BOOKS

- Arrillaga and Watson, "Computer Modellingof Electrical Power Systems,: John Wiley, London, 2001.
- NarainG.Hingorani, "Understanding FACTS," IEEE Press, New York, 2000.

REFERENCES

- E.Acha and VG Agilidis, "Power Electronic Control in Electrical Systems", Elsevier,2002
- Mukund R. Ptel., Wind and Solar Power Systems, CRC Press, London, 1999.
- Rai, G.D., "Solar Energy Utilization", Khanna Publishers, New Delhi, 1991.

Special Paper VII: 19REEE307 SPECIAL ELECTRICAL MACHINES
(Effective from the academic year 2019-2020 onwards)

Course Objectives

To expose the students to the

1. concepts of special electrical machinesand analyze their performance and to impart knowledgeon
2. Construction and performance of synchronous reluctancemotors.
3. Principle of operation and performance of stepping motors.
4. To study the knowledge on construction and operation of permanent magnet brushless D.C. motors.
5. To study the real time need of special machines
6. Construction, principle of operation and performance of switched reluctance motors, permanent magnet synchronousmotors.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Analyze and design controllers for special Electrical Machines.
2. Acquire the knowledge on construction and operation of stepper motor.
3. Understand the concept of construction and operation of stepper switched reluctance motors.
4. Acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
5. Acquire the knowledge on construction and operation of permanent magnet synchronous motors.
6. Determine a special Machine for a particular application.

UNIT- I SYNCHRONOUS RELUCTANCE MOTORS

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – phasor diagram, motor characteristics.

UNIT- II SWITCHED RELUCTANCE MOTORS

Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control Microprocessor based controller.

UNIT- III PERMANENT MAGNET SYNCHRONOUS MOTORS

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

UNIT- IV PERMANENT MAGNET BRUSHLESS DC MOTORS

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessor based controller.

UNIT- V STEPPING MOTORS

Constructional features, principle of operation, modes of excitation torque production in Variable Reluctance (VR) stepping motor, dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor.

TEXT BOOKS

- Miller, T.J.E., 1989, Brushless permanent magnet and reluctance motor drives, Clarendon Press, Oxford.
- Kenjo, T., 1989, Stepping motors and their microprocessor control,Clarendon Press, Oxford.

REFERENCES

- Kenjo, T and Naganori, S., 1989, Permanent Magnet and brushless DC motors, Clarendon Press, Oxford.
- Kenjo, T., 1989, Power Electronics for the microprocessor Age.
- Bose, B.K., 1997, Modern Power Electronics & AC drives, Prentice Hall, New Jersey.

Special Paper VIII: 19REEE308 ADVANCED BIO-MEDICAL DIGITAL SIGNAL PROCESSING
(Effective from the academic year 2019-2020 onwards)

Course Objectives

To expose the students to the

1. Concepts of wavelet transforms
2. Concepts of Neurological Signal Processing
3. Principle of operation Cardiological Signal Processing
4. To study the knowledge on Adaptive Filters
5. To study the real time need of Adaptive Filters
6. VLSI IN DSP **Course**

Outcomes

At the end of this course students will demonstrate the ability to

1. Analyze and design of various wavelet transforms
2. Acquire the knowledge on NSP
3. Understand the concept of CSP
4. Acquire the knowledge on noise canceller model
5. Acquire the knowledge on Direct data compression techniques
6. High performance VLSI signal processing

UNIT- I: INTRODUCTION TO WAVELET TRANSFORMS

Basics of FT,FFT, DTFT, OFT, DIT-FFT, DIF-FFT algorithms, Introduction to wavelet transforms, Advantages, Applications, Limitations, Different types of wavelet transforms & their characteristics, The Discrete Wavelet Series, The Discrete Wavelet Transform, Multi Resolution Analysis

UNIT- II: NEUROLOGICAL SIGNAL PROCESSING (NSP)

The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, The autoregressive (AR)· method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination

UNIT- III: CARDIOLOGICAL SIGNAL PROCESSING (CSP)

Basic electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation, the use of multistate analysis for parameters estimation of ECG waveforms, Arrhythmia analysis monitoring, Long-term continuous ECG is recording.

UNIT- IV: ADAPTIVE FILTERS &ECG DATA REDUCTION TECHNIQUES

Principal noise canceller model, 60- Hz adaptive canceling using a sine wave model, applications of adaptive filtering, Direct data compression techniques, Direct ECG data compression techniques, Transformation compression technique,

UNIT- V: VLSI IN DSP:

Digital signal processors. High performance VLSI signal processing, VLSI applications in medicine, VLSI sensors for biomedical signals, VLSI tools, choice of custom, ASIC, or off-the- shelf components

TEXT BOOKS

- Biomedical Signal Processing: Principles and Techniques ,Tata McGraw-Hill Education, 2005 - Biomedical engineering.
- James D. Broesch, Dag Stranneby and William Walker. Digital Signal Processing: Instant access. Butterworth-Heinemann, 2004

REFERENCES

- VLSI digital signal processing systems Keshab K. Parhi, 1999
- Digital signal processing in VLSI Richard J. Higgins Prentice Hall, 1990.

Special Paper IX: 19REEE309 POWER SECTOR ECONOMICS, MANAGEMENT AND RESTRUCTURING
(Effective from the academic year 2019-2020 onwards)

Course Objectives
To expose the students to the
1. Concepts of Power Sector In India, Economics And Regulation
2. Calculation of Power Tariff
3. Knowledge of Power Sector Restructuring and Market Reform
4. Concepts of Electricity Markets Pricing and Non-Price Issues
5. Design idea of Transmission Planning and Pricing
6. Concepts of power purchase

Outcomes
At the end of this course students will demonstrate the ability to
1. UnderstandPlanning Commissions
2. Acquire Different tariff principles
3. Analyze Competition in the electricity sector
4. Understand Spot prices for real and reactive power
5. Understand Price based Unit commitment
6. Analyze Power purchase agreements

UNIT-I POWER SECTOR IN INDIA, ECONOMICS AND REGULATION
Introduction to various institutions in Indian Power sector such as CEA, Planning Commissions, PGCIL, PFC, Ministry of Power, state and central governments, REC, utilities and their roles. Critical issues / challenges before the Indian power sector, Salient features of Electricity act 2003, Various national policies and guidelines under this act. Typical cost components and cost structure of the power sector, Different methods of comparing investment options, Concept of life cycle cost , annual rate of return , methods of calculations of Internal Rate of Return(IRR) and Net Present Value(NPV) of project, Short term and long term marginal costs, Different financing options for the power sector . Different stakeholders in the power sector, Role of regulation and evolution of regulatory commission in India, types and methods of economic regulation, regulatory process in India.

UNIT-II POWER TARIFF
Different tariff principles (marginal cost, cost to serve, average cost), Consumer tariff structures and considerations, different consumer categories, telescopic tariff, fixed and variable charges, time of day, interruptible tariff, different tariff based penalties and incentives etc., Subsidy and cross subsidy, life line tariff, Comparison of different tariff structures for different load patterns. Government policies in force from time to time.Effect of renewable energy and captive power generation on tariff.Determination of tariff for renewable energy.

UNIT-III POWER SECTOR RESTRUCTURING AND MARKET REFORM
Different industry structures and ownership and management models for generation, transmission and distribution.Competition in the electricity sector- conditions, barriers, different types, benefits and challenges Latest reforms and amendments. Different market and trading models / arrangements, open access, key market entities- ISO, Genco, Transco, Disco, Retailco, Power market types, Energy market, Ancillary service market, transmission market, Forward and real time markets, market power.

UNIT-IV ELECTRICITY MARKETS PRICING AND NON-PRICE ISSUES

Electricity price basics, Market Clearing price (MCP), Zonal and locational MCPs. Dynamic, spot pricing and real time pricing, Dispatch based pricing, Power flows and prices. Optimal power flow Spot prices for real and reactive power. Unconstrained real spot prices, constrains and real spot prices. Non price issues in electricity restructuring (quality of supply and service, standards of performance by utility, environmental and social considerations) Global experience with electricity reforms in different countries.

UNIT -V TRANSMISSION PLANNING AND PRICING

Transmission planning, Different methods of transmission pricing, Different transmission services, Congestion issues and management, Transmission cost allocation methods, Locational marginal price, firm transmission right. Transmission ownership and control, Transco and ISO, Transmission pricing Model in India, Availability based tariff, role of load dispatch centers (LDCs) Salient features of Electricity act 2003, Price based Unit commitment, concept of arbitrage in Electricity markets, game theory methods in Power System, security constrained unit commitment. Ancillary services for restructuring, Forward ancillary service auction. Power purchase agreements.

TEXT BOOKS

- Sally Hunt, Making Competition Work in Electricity, 2002, John Wiley Inc.
- Electric Utility Planning and Regulation, Edward Kahn, American Council for Energy Efficient Economy. 1988

REFERENCES

- Regulation in infrastructure Services: Progress and the way forward - TERI, 2001.
- Maharashtra Electricity Regulatory Commission Regulations and Orders - Various publications, reports and presentations by Prayas, Energy Group, Pune ,2011
- Central Electricity Regulatory Commission, Regulations and Orders - Electricity Act 2003 and National Policies – Market Operations in Electric Power Systems Forecasting, Scheduling and Risk

Special Paper X: 19REEE310 WIND ENERGY CONVERSION SYSTEMS
(Effective from the academic year 2019-2020 onwards)

Course Objectives
To expose the students to the
1. Wind machine types
2. Aerodynamics Theory and Wind Turbine Types
3. Horizontal Axis Wind Turbine
4. Modern Wind Turbine Control
5. Wind Energy Conversion System
6. Integration of Wind Energy Converters

Outcomes
At the end of this course students will demonstrate the ability to
1. Understand Wind machine types, classification
2. Acquire the knowledge Wind turbine aerodynamics, momentum theories
3. Able to HAWT rotor design considerations
4. Understand the Wind turbine loads
5. Applying WECS control system
6. Understand Testing of WECS

UNIT I INTRODUCTION
Wind machine types, classification, parameters. Wind, its structure, statistics, measurements, data presentation, power in the wind.

UNIT II AERODYNAMICS THEORY AND WIND TURBINE TYPES
Wind turbine aerodynamics, momentum theories, basic aerodynamics, airfoils and their characteristics, Horizontal Axis Wind Turbine (HA WT) - Blade Element Theory, wake analysis, Vertical Axis Wind Turbine (VA WT) aerodynamics.

UNIT III HORIZONTAL AXIS WIND TURBINE
HAWT rotor design considerations, number of blades, blade profile, 2/3 blades and teetering, coning, power regulation, yaw system, tower.

UNIT IV MODERN WIND TURBINE CONTROL
Wind turbine loads, aerodynamic loads in steady operation, wind turbulence, static - dynamic - fatigue analysis, yawed operation and tower shadow, WECS control system, requirements and strategies.

UNIT V WIND ENERGY CONVERSION SYSTEM
Wind Energy Conversion System (WECS) siting, rotor selection, Annual Energy Output (AEO). Synchronous and asynchronous generators and loads, integration of wind energy converters to electrical networks, inverters.Testing of WECS- Noise- Miscellaneous topics.

TEXT BOOKS:

- Kaldellis., Stand-alone and hybrid wind energy systems,CRS Press,2010

- John D Sorensen and Jens N Sorensen,Wind energy systems,Woodhead publishi8ng Ltd,2011

REFERENCES

- Mario Garcia Sanz,Wind Energy Systems,CRC Press,2012
- Spera D.A., Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering, ASME Press, NY 1994.

Special Paper XI: 19REEE311 THEORY AND DESIGN OF NEURO-FUZZY CONTROLLERS
(Effective from the academic year 2019-2020 onwards)

Course Objectives
To expose the students to the
1. Neural Network
2. Neural Networks In Control
3. Fuzzy Logic
4. Fuzzy Logic In Control
5. Non-Linear Fuzzy Control
6. Fuzzy Control Applications

Outcomes
At the end of this course students will demonstrate the ability to
1. Understand the concepts of back propagation learning and training
2. Acquire the knowledge of Neural network for non-linear systems
3. Design Fuzzy sets
4. Understand the Structure of fuzzy logic controller
5. Understand Non-linear fuzzy control
6. Design - fuzzy control applications-case studies.

UNIT-I NEURAL NETWORK
Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules types of neural networks-single layer, multilayer-feed forward, feedback networks; back propagation learning and training-Hop field network.

UNIT-II NEURAL NETWORKS IN CONTROL
Neural network for non-linear systems-schemes of neuro control-system identification forward model and inverse model-indirect learning neural network control applications-case studies.

UNIT-III FUZZY LOGIC
Fuzzy sets-fuzzy operation-fuzzy arithmetic-fuzzy relations-fuzzy relational equations-fuzzy measure-fuzzy functions-approximate reasoning-fuzzy propositions-fuzzy quantifiers-if-then rules.

UNIT-IV FUZZY LOGIC IN CONTROL
Structure of fuzzy logic controller-fuzzification models-data base-rule base-inference engine defuzzification module.

UNIT-V NON-LINEAR FUZZY CONTROL
Introduction of Non-linear fuzzy control-PID like FLC-Sliding mode FLC - Sugeno FLC-adaptive fuzzy control-fuzzy control applications-case studies.

TEXT BOOKS

- FarinWah, S.S., Filev, D., Langari, R., 2000, Fuzzy control synthesis and analysis, John Wiley and Sons.

- Jacek M Zurada, 1999, Introduction to Artificial Neural Systems, Jaico Publishing House.

REFERENCES

- Kosko, B., 1994, Neural Networks And Fuzzy Sstems, Prentice-Hall of India Pvt.Ltd.

- Klir, G.J. and Folger, T.A., 1993, Fuzzy sets, uncertainty and Information, Prentice-Hall of India Private Ltd.

- Zimmerman, H.J., 1994, Fuzzy set theory-and its Applications, Kluwer Academic Publishers.

Special Paper XII: 19REEE312 SOFT COMPUTING TECHNIQUES

(Effective from the academic year 2019-2020 onwards)

Course Objectives

To expose the students to the

At the end of this course students will demonstrate the ability to

1. Architecture For Intelligent Control
2. Artificial Neural Networks
3. Fuzzy Logic System
4. Genetic Algorithm
5. Ga Application To Power System
6. Stability Analysis Of Fuzzy Control Systems

Outcomes

At the end of this course students will demonstrate the ability to

1. Understand the Approaches to intelligent control
2. Design Concepts of Artificial Neural Networks
3. Understand the Learning and Training the neural network
4. Design concepts of Fuzzification
5. Solution of typical control problems using genetic algorithm
6. GA application to power system optimization problem

UNIT I INTRODUCTION

Approaches to intelligent control.Architecture for intelligent control.Symbolic reasoning system, rule-based systems, the AI approach.Knowledge representation.Expert systems.

UNIT II ARTIFICIAL NEURAL NETWORKS

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller.

UNIT III FUZZY LOGIC SYSTEM:

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control.Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control.Fuzzy logic control for nonlinear time-delay system.

UNIT IV GENETIC ALGORITHM

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters.Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and and-colony search techniques for solving optimization problems.

UNIT-VAPPLICATIONS

GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab- eural Network toolbox. Stability analysis of eural-Network interconnection systems.Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox.Stability analysis of fuzzy control systems.

REFERENCES

- Oscar Castillo,PatriciaMelin, Soft Computing For Hybrid Intelligent Systems,Wiltold Pedrycz,2008
- .MadanM.Gupta, Naresh K Sinha, “ Soft computing and intelligent systems: Theory and applications,2000.
- 3. J.Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 199

Special Paper XIII: 19REEE313 FLEXIBLE AC TRANSMISSION SYSTEMS
(Effective from the academic year 2019-2020 onwards)

Course Objectives

To Expose the Students To

1. Concepts of Facts
2. Sub-Synchronous Resonance
3. Implementation Of Power Flow Control Using Conventional Thyristors
4. Multi-Model Decomposition
5. Static Var Compensation
6. Thyristor Controlled Reactor

Outcomes

At the end of this course students will demonstrate the ability to

1. Understand the Basic Concepts of Static Var Compensator
2. Acquire the knowledge of Series Compensation Schemes
3. Understand Unified Power Flow Control
4. Design of Facts Controllers
5. Understand Static Var Compensation
6. Acquire the knowledge of Thyristors Switched Reactor

UNIT-I INTRODUCTION

FACTS-a toolkit, Basic concepts of Static VAR compensator, Resonance damper, Thyristor controlled series capacitor, Static condenser, Phase angle regulator, and other controllers.

UNIT-II SERIES COMPENSATION SCHEMES

Sub-Synchronous resonance, Torsional interaction, torsional torque, Compensation of conventional, ASC, NGH damping schemes, Modelling and control of thyristor controlled series compensators.

UNIT-III UNIFIED POWER FLOW CONTROL

Introduction, Implementation of power flow control using conventional thyristors, Unified power flow concept, Implementation of unified power flow controller.

UNIT-IV DESIGN OF FACTS CONTROLLERS

Approximate multi-model decomposition, Variable structure FACTS controllers for Power system transient stability, Non-linear variable-structure control, variable structure series capacitor control, and variable structure resistor control.

UNIT-V STATIC VAR COMPENSATION

Basic concepts, Thyristor controlled reactor (TCR), Thyristors switched reactor (TSR), Thyristor switched capacitor (TSC), saturated reactor (SR), Fixed Capacitor (FC).

TEXT BOOKS

- Mohan Mathur. R., Rajiv.K.Varma, Thyristor–Based Facts Controllers for Electrical Transmission Systems , IEEE press and John Wiley & Sons, Inc, New York ,2002.

- Narin G Hingorani, Understanding FACTS : Concepts and Technology of Flexible AC Transmission Systems , Standards publishers, New Delhi ,2001Flexible AC Transmission, IEEE Spectrum, pp 40-45.

REFERENCES

- Narin G Hingorani, High Power Electronics and Flexible AC Transmission Systems, IEEE High Power Engineering Review volume 8: issue 7,2002

- Einar V Larsen, Juan J Sanchez-Gasca, Joe H Chow, May 1995, Concepts for design of FACTS Controllers to damp power swings, IEEE Trans On Power Systems, Vol.10, No.2.

- Gyugyi.L, July 1992, Unified power flow control concept for flexible AC transmission, IEEE Proc-C Vol.139, No.4.

Special Paper XIV: 19REEE314 HVDC SYSTEMS
(Effective from the academic year 2019-2020 onwards)

Course Objectives
To Expose the Students To
1. Comparison of Ac - Dc Transmission
2. Analysis of Hvdc Converters
3. Hvdc System Control
4. Transient Stability Analysis
5. Dynamic Stability and Power Modulation
6. Power Modulation Controls

Outcomes
At the end of this course students will demonstrate the ability to
1. Understand the concepts of HVDC transmission
2. Design of converter configuration
3. Understand the Principles of DC link control
4. Design and Modelling of converter
5. AC network and synchronous generator
6. Power modulation controls

UNIT-I INTRODUCTION
Comparison of AC - DC transmission - Description and application of HVDC transmission - DC system components and their functions.

UNIT-II ANALYSIS OF HVDC CONVERTERS
Pulse number - converter configuration, analysis greatz circuit - bridge characteristics - 12-pulse converter.

UNIT-III HVDC SYSTEM CONTROL
Principles of DC link control - converter control characteristics - system control, firing angle control – current and excitation angle control, DC link power control - higher level controllers - reactive power control and VAR sources - Multi terminal DC system - types - control and protection.

UNIT-IV TRANSIENT STABILITY ANALYSIS
Modelling of converter - DC network - AC network and synchronous generator -solution methodology - transient stability improvement using DC link control.

UNIT-V DYNAMIC STABILITY AND POWER MODULATION
Power modulation controls, reactive power modulation, voltage stability in AC -DC systems control.

TEXT BOOKS:

- Naidu, M. S. and Kamaraju, V ,High Voltage Engineering, Tata McGraw Hill, New Delhi ,2004
- Padiyar K.R., " HVDC power transmission system ", Wiley Eastern Pvt. Ltd., 1990.

REFERENCES

- Arrillaga J. and Arnald C.P., & Parker B.J., " Computer modeling of Electric power systems ", John wiley& sons, 2001.
- Arrillaga J., " High voltage direct current transmission ", Peter Peregrinus, London, 1983.

Special Paper XV: 19REEE315 DIGITAL POWER SYSTEM PROTECTION
(Effective from the academic year 2019-2020 onwards)

Course Objectives
To Expose the Students To
1. Numerical Protection
2. Digital Protection of Transmission Line
3. Digital Protection of Synchronous Generator
4. Digital Protection of Power Transformer
5. Directional Instantaneous Idmt Over Current Relay

Outcomes
At the end of this course students will able to understand the concepts of
1. sampling theorem
2. distance relays, traveling wave relays
3. faults in synchronous generator
4. digital protection of synchronous generator
5. faults in a transformer
6. protection of transformer

UNIT- I NUMERICAL PROTECTION
Introduction, block diagram of numerical relay, sampling theorem, correlation with a reference wave, least error squared (LES) technique, digital filtering, numerical over- current protection.

UNIT- II DIGITAL PROTECTION OF TRANSMISSION LINE
Introduction, Protection scheme of transmission line, distance relays, traveling wave relays, digital protection scheme based upon fundamental signal, hardware design, software design, digital protection of EHV/UHV transmission line based upon traveling wave phenomenon, new relaying scheme using amplitude comparison.

UNIT- III DIGITAL PROTECTION OF SYNCHRONOUS GENERATOR
Introduction, faults in synchronous generator, protection schemes for synchronous generator, digital protection of synchronous generator.

UNIT- IV DIGITAL PROTECTION OF POWER TRANSFORMER
Introduction, faults in a transformer, schemes used for transformer protection, digital protection of transformer

UNIT-V DISTANCE AND OVERCURRENT RELAY SETTING AND CO-ORDINATION PC APPLICATIONS IN SHORT CIRCUIT STUDIES FOR DESIGNING RELAYING SCHEME
Directional instantaneous IDMT over current relay, directional multi zone distance realy, distance relay setting, co-ordination of distance relays, co-ordination of over current relays, computer graphics display, man-machine interface subsystem, integrated operation of national power system, application of computer graphics.

Types of faults, assumptions, development of algorithm for S.C. studies, PC based integrated software for S.C. studies, transformation to component quantities, S.C. studies of multiphase systems. Ultra high speed protective relays for high voltage long transmission line.

TEXT BOOKS

- L. P. Singh , Digital Protection, New Age International Private Ltd. Publishers, New Delhi, 2nd Edition,1997
- Paithankar, Marcel and Dekker, Transmission Network Protection, New York,1997

REFERENCE

- Paithankar&Bhide ,Fundamentals of Power System Protection ,Prentice Hall of India Pvt Ltd., New Delhi,2010
- Stanley Horowitz, Protective Relaying for Power System II IEEE press , New York,1992

Special Paper XVI: 19REEE316 OPTIMIZATION TECHNIQUES
(Effective from the academic year 2019-2020 onwards)

Course Objectives

To Expose the Students To

1. Engineering application of Optimization
2. Linear Programming
3. Non-Linear Programming
4. Dynamic Programming
5. Advanced Techniques of Optimization
6. Optimization and Search

Outcomes

At the end of this course students will able to understand the concepts of

1. Formulation of design
2. mathematical programming problems
3. Simplex method
4. Direct search methods
5. Direct and indirect methods
6. computational procedure

UNIT I INTRODUCTION:

Historical Development, Engineering application of Optimization, Formulation of design problems as mathematical programming problems, classification of optimization problems.

UNIT II LINEAR PROGRAMMING:

Graphical method, Simplex method, Revised simplex method, Duality in linear programming (LP), Sensitivity analysis, other algorithms for solving LP problems, Transportation, assignment
and other applications.

UNIT III NON LINEAR PROGRAMMING:

Unconstrained optimization techniques, Direct search methods, Descent methods, Constrained optimization, Direct and indirect methods, Optimization with calculus, Khun-Tucker conditions.

UNIT IV DYNAMIC PROGRAMMING:
Introduction, Sequential optimization, computational procedure, curse of dimensionality.

UNIT V ADVANCED TECHNIQUES OF OPTIMIZATION:
Introduction, Genetic algorithms for optimization and search.

TEXT BOOKS:

- S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International (P) Ltd., New Delhi, 2000.

- K. Deb, "Optimization for Engineering Design - Algorithms and Examples", Prentice-Hall oflndia Pvt. Ltd., New Delhi, 1995.

REFERENCE :

- H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.

- G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.

Special Paper XVII 19REEE317 EMBEDDED SYSTEMS
(Effective from the academic year 2019-2020 onwards)

Course Objectives
To Expose the Students To
1. Embedded System
2. Architecture of Embedded System
3. OSFor Embedded Systems
4. Performance IssusesOfEmbedded Systems
5. Design andImplementation
6. ProgramValidation and Testing

Outcomes
At the end of this course students will understand the concepts of
1. functionalbuilding blockofembeddedsystem
2. Computerarchitecture taxonomy
3. Introduction to RTOS
4. CPUPerformance
5. Developmentand debugging
6. I^2CBus,CAN Bus

UNIT-I INTRODUCTION TO EMBEDDED SYSTEM (09)
Anembeddedsystem,functionalbuilding blockofembeddedsystem,Characteristicsof embedded system, applications, Challenges in embedded system design, embedded system design processes.

UNIT-II ARCHITECTURE OF EMBEDDED SYSTEM (09)
Computerarchitecture taxonomy,CPUs–programming inputandoutput,Supervisor mode,exceptionsandtraps,Co-processors,memory systemmechanisms-CPUbus- memory devices-I/Odevices-componentinterfacing-Assembly andlinking-basic compilation techniques.

UNIT-III OSFOR EMBEDDED SYSTEMS (09)
Introduction to RTOS, multipletasks and multipleprocesses, context switching, operating system,schedulingpolicies,interprocesscommunicationmechanisms.Introductionto µC/OSII

UNIT-IV PERFORMANCE ISSUSESOFEMBEDDED SYSTEMS (09)
CPUPerformance,CPUPowerconsumption,Analysisandoptimizationofexecution time,programsize,energy andpower,Evaluatingoperatingsystemperformance,power optimizationstrategies for processes, Hardwareaccelerators.

UNIT-V DESIGN ANDIMPLEMENTATION (09)
Developmentand debugging, manufacturing, Testing, Programvalidation and testing, Needof Distributedembeddedarchitecture,I^2CBus,CAN Bus,Designexamples:GPS Movingmap, Personal Digital Assistant, Elevatorcontroller.

REFERENCES

- Wayne Wolf, ,Computers as Components:Principles of Embedded Computer Systems Design, The Morgan Kaufmann Series in Computer Architecture and Design Harcourt Asia Pvt.Ltd., Dehiwella, Srilanka 2000
- Rajkamal, Embedded Systems Tata McGraw-Hill Publishing company Ltd., New Delhi, 2003
- David E, Simon, An Embedded software primer Pearson education India, New Delhi 2004
- Sriram V Iyer, Pankaj Gupta, , EmbeddedReal-time Systems ProgrammingTata McGraw-Hill Publishing 2004

WEBSITES

1. www.ece.cmu.edu
2. www.cs.rice.edu

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FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Special Paper XVII 19REEE318 ArtificialIntelligenceApplications to Power Systems
(Effective from the academic year 2019-2020 onwards)

Course Objectives
To Expose the Students To
1. Basics of AI systems
2. Knowledge components
3. Neurobiologicalmodelsof neurons
4. Artificial Neural Networks
5. VAr controland otherpower system problems
6. power system problems

Outcomes
At the end of this course students will demonstrate the ability to
1. Knowledge of introduction toexpertsystems
2. Understand Expert Systembuilding task
3. Design basicsof ANN
4. Understand the memory models
5. Design using Boltzmann's network
6. Understand the Applicationof expert systems

UNIT-I INTRODUCTION TO EXPERT SYSTEMS
Basics of AI systems - introduction to expert systems - definitions - architecture - differences from conventional programming.

UNIT-II EXPERT SYSTEMS
Knowledge components-levelsofrepresentation-representationschemes-formaland non-formalrepresentationschemes-Expert Systembuilding task-development-knowledgeacquisition-typical buildingprocess

UNIT-III INTRODUCTION TO NEURAL NETWORKS
Neurobiologicalmodelsof neurons-basicsof ANN- perceptron- backpropagation network–memorymodels-bi-directional associativememory -Hopfield network.

UNIT-IV ARTIFICIAL NEURAL NETWORKS
Theory,architecture andapplicationsof computer propagationnetwork- Boltzmann's network– adaptive resonancetheory-introduction to cognitronand neocognitron.

UNIT-V APPLICATION OFAITO POWER SYSTEMS
Applicationof expert systemsandneuralnetworksinload forecasting,contingency analysis, VAr controland otherpower system problems.

REFERENCES

- Rolston, D.W Principles of AI and EIdevelopment McGrawHill,New York 1988
- Wassermann P.D, Van Reinhold Neural Computing Springer,New York 1988

- DejanJ. SobajicIEEEtutorialon application of Neural Network topower systems
- LawrenceErlabumassociates, Inc., USA 1996.

WEBSITES

1. www.slideshare.net
2. www.globalspec.com

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Ph.D. COURSE WORK SYLLABUS

MECHANICAL ENGINEERING

RESEARCH METHODOLOGY
(Effective from the academic year 2019-2020 onwards)

CODE: 19RME101

COURSE OBJECTIVES

1. To impart knowledge in the concept of problem identification and research methodology
2. To familiarize with basic of research and the research process
3. To demonstrate the different types of research and its applicability
4. To comprehend the knowledge of social research
5. To exhibit in sampling design and sampling techniques
6. To enrich the knowledge in writing a good research report.

COURSE OUTCOMES

1. Read, interpret, and critically evaluate social research.
2. Identify, explain, and apply the basic concepts of research, such as variables, operationalization, sampling, reliability, and validity.
3. Recognize the ethical issues involved in research, and practice ethical research standards.
4. Identify and explain the difference between quantitative, qualitative, and mixed methods research and what types of research questions can be answered with each method.
5. Use theory and previous research to create research questions and hypotheses and to identify and analyze the appropriate method and variables needed for research questions.
6. Use a variety of research methods through hands-on experience.

UNIT I
INTRODUCTION TO RESEARCH

Research Methodology: An Introduction –Meaning of research—Objectives of Research-Motivation in Research—Types of Research. -Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Need for theoretical frame work – Hypothesis development – Hypothesis testing with quantitative data. Research design – Purpose of the study: Exploratory, Descriptive, Hypothesis Testing. Impact Factor--Citation and Citation Index.

UNIT II
EXPERIMENTAL DESIGN

Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales – Validity testing of scales – Reliability concept in scales being developed – Stability Measures.

UNIT III
DATA COLLECTION, ANALYSIS AND INFERENCE
Binomial, Poisson, Normal, Exponential, Weibull and Geometric Distributions.Random sampling, stratified sampling, systematic sampling and cluster sampling. Student–t-test, F-test and $\chi 2$ test and their applications in research studies. Forecasting methods. Factor analysis, Cluster Analysis and Discriminant Analysis (Basic ideas only). Completely Randomized Design Randomized Block Design and Latin Square Design. Accuracy, Precision and error analysis.

UNIT IV
MULTIVARIATE STATISTICAL TECHNIQUES
Data Analysis – Factor Analysis – Cluster Analysis – Discriminant Analysis – Multiple Regression and Correlation – Canonical Correlation – Application of Statistical (SPSS) Software Package in Research.

UNIT V
RESEARCH REPORT AND ETHICS IN RESEARCH
Significance of Report Writing- different steps in report writing-Layout of Research Report—Types of Reports-- Integral parts of a report – Precautions for writing a research report—Oral Presentation. Policy on academic Honesty and Integrity—academic cheating and Plagiarism. Opportunities to carry out research projects with funding/assistance from government agencies.

REFERENCE BOOKS:

1. Donald R. Cooper and Ramela S. Schindler, “Business Research Methods”, Tata McGraw-Hill, Publishing Company Limited, New Delhi, 2000.
2. Uma Sekaran, “Research Methods for Business”, John Wiley and Sons Inc., New York, 2000.
3. C.K.Kothari, “Research Methodology, methods and techniques”, New Age International, New Delhi, 2001.
4. Donald H.McBurney, “Research Methods”, Thomson Asia Pvt. Ltd. Singapore, 2002.
5. G.W.Ticehurst and A.J.Veal, “Business Research Methods”, Longman, 1999.
6. Ranjit Kumar, “Research Methodology”, Sage Publications, London, New Delhi, 1999.
7. Garg, B.L.Karadia, R.Agarwal, &F.Agarwal, U.K. 2002. “An Introduction to Research Methodology”, RBSA Publishers.
8. Panneerselvan.R., “Research Methodology”, Prentice hall of India, New Delhi, 2004.
9. Ganesan R, “Research Methodology for Engineers”, MJP Publishers, Chennai. 2011
10. Walpole R.A, Myers R.H, Myers S.L. and Ye King: “Probability & Statistics for Engineers and Scientists”, Pearson Prentice Hall, Pearson Education, Inc. 2007.
11. Graziano, A.M.andRaulin, M.,L.: “Research Methods – A Process of Inquiry”, Sixth Edition, Pearson, 2007.
12. Leedy, P.D.“Practical Research – Planning and Design”, Eighth Edition, Pearson.2005.

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OPTIMIZATION TECHNIQUES
(Effective from the academic year 2019-2020 onwards)

CODE: 19RME201

COURSE OBJECTIVES
This course will enable the students
1. To introduce various optimization techniques.
2. To give exposure to nonlinear programming.
3. To give exposure to nonlinear programming with constraints.
4. To provide exposure to integer and dynamic programming.
5. To explain the network optimization techniques.
6. To enlighten the recent optimization techniques.

COURSE OUTCOMES
At the end of the course, students will be able to
1. Formulate an optimization problem.
2. Apply the appropriate decision.
3. Formulate and solve a non-linear problem.
4. Determine the shortest path.
5. Describe nontraditional optimization techniques.
6. Apply newer optimization techniques for problem solving.

UNIT I
NONLINEAR OPTIMIZATION
Introduction – unconstrained optimization - one-dimensional optimization – elimination methods – Fibonacci method, golden section methods – interpolation methods – quadratic, direct route method – multivariable optimization **-** direct search methods – pattern search methods – univariate method, hooks and jeeves method, simplex method – descent methods – steepest descent, Newton methods.

UNIT II
CONSTRAINED NONLINEAR OPTIMIZATION
Direct methods – the complex method, cutting plane method – indirect methods – interior and exterior penalty function methods, Khun-Tucker conditions, Lagrangian method.

UNITIII
INTEGER AND DYNAMIC PROGRAMMING
Introduction to integer programming – solution techniques - graphical method, the branch and bound technique, gomary's cutting plane method, examples on the application in manufacturing / design systems – introduction to dynamic programming - bellman's principle of optimality, examples on the application on routing problem, inventory problem.

UNITIV
NETWORK OPTIMIZATION MODELS
Terminology of networks – the shortest route problem – the minimum spanning tree problem – the maximum flow problem – the minimum cost flow problem – the network simplex method.

UNITV
NON TRADITIONAL OPTIMIZATION MODELS
Introduction to non-traditional optimization, computational complexity – NP-hard, NP-complete, no free lunch theorem – working principles of simulated annealing, Tabu search, and neural networks, simple applications.Introduction to Genetic Algorithms, Ants Colony Algorithm, Particle Swarm Algorithm, Hybrid Algorithms, Simple Applications.

REFERENCE BOOKS:

1. Singiresu S Rao, "Engineering Optimization: Theory and Practice", Wiley-Interscience, Third Edition, 1996.
2. Kalyanmoy Deb, "Optimization for engineering design", Prentice Hall India Pvt. Ltd., New Delhi, 2000.
3. David E Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning",
4. Addison Wesley Pub Co., 1989.
5. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", Prentice Hall of India, 2005.
6. Maurice Clerc, "Particle Swarm Optimization", ISTE, 2007
7. Dimitri P Bertsekas, "Dynamic Programming: Deterministic and Stochastic Models", Prentice Hall, 1987.
8. Stephen G Nash and ArielaSofer, "Linear and Nonlinear Programming", McGraw Hill College Div., 1995.
9. Fred Glover, Manuel Laguna and Fred Laguna, "Tabu Search", Kluwer Academic Publishers,1997.

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COMPUTATIONAL METHODS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME202

COURSE OBJECTIVES

This course will enable the students

1. To understand the basic computational methods.
2. To solve problems by numerical approach
3. To understand the difference between various numerical methods.
4. To solve problems related to partial differential equations.
5. To solve problems related to parabolic and hyperbolic partial differential equations.
6. To fit the nonlinear curves through various curve fitting techniques.

COURSE OUTCOMES

At the end of the course, students will be able to

1. Explain the concept of computational methods.
2. Solve problems using various numerical methods.
3. Find numerical solutions for partial differential equations.
4. Apply partial differential equations for heat transfer problems.
5. Solve wave equation.
6. Apply various techniques to fit curves.

UNIT I
INTRODUCTION TO COMPUTATIONAL METHODS

Examples, solving sets of equations, Gauss elimination method, Choleski method, Iterative methods, Relaxation method, system of non-linear equations- Newton Raphson method, computer programs.

UNIT II
NUMERICAL INTEGRATION

Newton-Cotes integration formulas, Trapezoidal rule, Simpson's rules, Gaussian quadrature, adaptive integration, cubic spline functions - Bezier curves and B-splines, computer programs. Boundary value problems and characteristic value problems:Shooting method, solution through a set of equations, derivative boundary conditions, Rayleigh-Ritz method, characteristic value problems, solution using characteristic polynomial method, Jacobi method, power method and Inverse power method.

UNIT III
NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS

Laplace's equations, representations as a difference equation, Iterative methods for Laplace's equations, Poisson equation, derivative boundary conditions, irregular and non-rectangular grids, Matrix patterns, Sparseness, ADI method, applications to heat flow problems, computer programs.

UNIT IV
PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS
Explicit method, Crank-Nicholson method, derivative boundary condition, stability and convergence criteria, Parabolic equations in two or more dimensions, applications to heat flow problems, computer programs. Hyperbolic Partial differential equations**:**Solving wave equation by finite differences, stability of numerical method, method of characteristics, Wave equation in two space dimensions, computer programs.

UNIT V
CURVE FITTING AND APPROXIMATION OF FUNCTIONS
Least square approximation, fitting of non-linear curves by least squares, regression analysis, computer programs.

REFERENCE BOOKS:

1. Curtis F Gerald and Patrick O Wheatley, “Applied Numerical Analysis”, Pearson Education, 2002.
2. Rajasekaran S, “Numerical Methods in Science and Engineering – A Practical Approach”, Wheeler Publishing, 1999, Second Edition.
3. Douglas J Faires and Riched Burden, “Numerical Methods”, Brooks/Cole Publishing Company, 1998, Second Edition.
4. Steven C Chapra and Raymond P Canale, “Numerical Methods for Engineers with Software and Programming Applications”, Tata McGraw Hill Edition, 2004.
5. John H Mathews and Kurtis D Fink, “Numerical Methods using MATLAB”, Prentice Hall, 1998.
6. Ward Cheney and David Kincaid, “Numerical Mathematics and Computing”, Brooks/Cole Publishing Company, 1999, Fourth Edition.

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MODELING SIMULATION AND ANALYSIS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME203

COURSE OBJECTIVES

This course will enable the students

1. To define the basics of simulation modeling and replicating the practical situations in organizations
2. To generate random numbers and random variates using different techniques.
3. To develop simulation model using heuristic methods.
4. To analysis of Simulation models using input analyzer, and output analyzer
5. To explain Verification and Validation of simulation model.
6. To develop Model for the manufacturing system

COURSE OUTCOMES

At the end of the course, students will be able to

1. Describe the basics of simulation modeling and analysis.
2. Describe the role of important elements of discrete event simulation and modeling paradigm.
3. Conceptualize real world situations related to systems development decisions, originating fromsource requirements and goals.
4. Develop skills to apply simulation software to construct and execute goal-driven system models.
5. Examine the simulation model of a problem.
6. Interpret the model and apply the results to resolve critical issues in a real-world environment.

UNIT I
INTRODUCTION TO SIMULATION

Definition – history - nature of computer modeling and simulation, limitations of simulation, areas of application. System and environment**:** Components of a system – types of simulation - discrete and continuous systems. Modeling approaches – simulation examples - manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem.

UNIT II
RANDOM NUMBER GENERATION AND TESTING

Techniques for generating random numbers - midsquare method - midproduct method - constant multiplier technique - additive congruential method - linear congruential method – combined linear congruential generators – feedback shift register generators - tests for random numbers – frequency test - the Kolmogorov-Smirnov test, the chi-square test. Independence test – runs up and runs down, runs above and below the mean, autocorrelation.

UNIT III
RANDOM VARIATE GENERATION
Inverse transform technique - exponential distribution, uniform distribution, Weibull distribution, Triangular distribution. Empirical continuous distribution - generating approximate normal variates - Erlang distribution. empirical discrete distribution - discrete uniform distribution - poisson distribution - geometric distribution - acceptance - rejection technique for poisson distribution - gamma distribution.

UNIT IV
STAGES IN MODEL BUILDING
Input modeling – data collection, identifying the distribution with data, parameter estimation, goodness of fit tests, selecting input models without data, models of arrival processes. verification and validation of simulation models – variance reduction techniques, antithetic variables, calibration and validation of models. output analysis –stochastic nature of output data, measures of performance and their estimation, output analysis for terminating simulation.

UNIT V
MANUFACTURING SYSTEMS MODELING
Objectives and performance measures – modeling system randomness – sources of randomness, machine downtime.

REFERENCES BOOKS:

1. Jerry Banks, John S, Carson II, Barry L Nelson and David M Nicol, “Discrete Event System Simulation”, Prentice Hall Inc., 2006.
2. Law A M, “Simulation Modeling and Analysis”, Tata McGraw Hill Companies Inc, 2008.
3. Gordon G, “Systems Simulation”, Prentice Hall Ltd., 2006.
4. Narsingh Deo, “System Simulation with Digital Computer”, Prentice Hall of India, 2007.
5. Francis Neelamkovil, “Computer Simulation and Modeling”, John Wiley and Sons, 1987.
6. Ruth M Davis and Robert M O'Keefe, “Simulation Modeling with Pascal”, Prentice Hall Inc., 1989.

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QUALITY CONCEPTS IN DESIGN
(Effective from the academic year 2019-2020 onwards)

CODE: 19RME204

COURSE OBJECTIVES
This course will enable the students
1. To introduce basic quality concepts.
2. To give exposure to design for quality.
3. To provide exposure to failure mode effect analysis.
4. To explain the design of experiment concept.
5. To explain the statistical consideration in experimental design.
6. To introduce basics of reliability and enlighten design for six sigma process.

COURSE OUTCOMES
At the end of the course, students will be able to
1. Understand the basic quality concepts.
2. Find the root cause through failure mode effect analysis.
3. Design the experiments for analysis for product testing.
4. Analyze the product testing experiment results.
5. Analyze the problems with the aid of charts.
6. Create quality designs with the help of six sigma like quality concepts.

UNIT I
DESIGN FOR QUALITY
Quality Function Deployment -House of Quality-Objectives and functions-Targets Stakeholders-Measures and Matrices-Design of Experiments –design process Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT II
FAILURE MODE EFFECT ANALYSIS
Basic methods: Refining geometry and layout, general process of product embodiment checklist-Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling-Case study- computer monitor stand for a docking station.

UNIT III
DESIGN OF EXPERIMENTS
Design of experiments-Basic methods- Two factorial experiments-Extended method ,reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional

factorial design-Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual t-test, ANOVA-ratio test, other indicators-residual plots, Advanced DOE method for product testing-Product applications of physical modeling and DOE, Blender panel display evaluation, coffee grinder experimental optimization-Taguchi method.

UNIT IV
STATISTICAL CONSIDERATION AND RELIABILITY
Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams –Multivariable charts –Matrix plots and 3-D plots.- Reliability-Survival and Failure-Series and parallel systems-Mean time between failure.Weibull distribution

UNIT V
DESIGN FOR SIX SIGMA
Basics of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services L -45

REFERENCE BOOKS:

1. “Product Design Techniques in Reverse Engineering and New Product Development”, Kevin Otto & Kristin Wood, Pearson Education (LPE), 2001.
2. Product Design And Development, Karl T. Ulrich, Steven D. Eppinger, Tata Mcgraw-Hill-3rd Edition, 2003.
3. “The Management and control of Quality”-6th edition-James R. Evens, William M Lindsay Pubson south-western(www.swlearning.com)
4. “Fundamentals of Quality control and improvement”, 2nd edition, Amitava Mitra, Pearson Education Asia, 2002.

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FINITE ELEMENT ANALYSIS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME205

COURSE OBJECTIVES

This course will enable the students

1. To formulate the problems related to bending of plates and shells.
2. To explain Numerical difficulties in solving nonlinear problems.
3. To understand the fundamental concepts of using FEA to model dynamic problems.
4. To understand the fundamental concepts of the theory of plasticity.
5. To understand the application of FEA concepts in fluid and heat transfer problems.
6. To select proper mesh refinement technique.

COURSE OUTCOMES

At the end of the course, students will be able to

1. Analyze the problems related to bending of plates and shells.
2. Develop and build appropriate finite element models to solve complex engineering problems.
3. Critique numerical results and their validity.
4. Synthesize information and ideas for use in the evaluation process.
5. Apply FE methods for solving fluid mechanics and heat transfer.
6. Select the appropriate mesh refinement technique

UNIT I
BENDING OF PLATES AND SHELLS

Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 Continuity Elements –Degenerated shell elements- Application and Examples.

UNIT II
NON-LINEAR PROBLEMS

Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity – Visco Plasticity – Geometric Non linearity – large displacement Formulation –Solution procedure-Application in Metal Forming Process and Contact Problems.

UNIT III
DYNAMIC PROBLEM

Direct Formulation – Free, Transient and Forced Response – Solution Procedures – Eigen solution-Subspace Iterative Technique – Response analysis-Houbolt, Wilson, Newmark – Methods – Explicit &Implict Methods- Lanchzos, Reduced method for large size system equations.

UNIT IV
FLUID MECHANICS AND HEAT TRANSFER
Governing Equations of Fluid Mechanics – Solid structure interaction - Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming – Navier Stokes Equation – Steady and Transient Solution.

UNIT V
ERROR ESTIMATES AND ADAPTIVE REFINEMENT
Error norms and Convergence rates – h-refinement with adaptivity – Adaptive refinement.

REFERENCE BOOKS:

1. Zienkiewicz, O.C. and Taylor, R.L., "The Finite Element Method", Fourth Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics Services, 1991.
2. Cook R.D., "Concepts and Applications of Finite Element Analysis", John Wiley and Sons Inc., New York, 1989.
3. Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, 1990.

COMPUTATIONAL FLUID DYNAMICS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME206

COURSE OBJECTIVES

1. To introduce Governing Equations of viscous fluidflows.
2. To introduce numerical modeling and its role in the field of fluid flow and heattransfer
3. To enable the students to understand the various discretization methods, solution procedures and turbulencemodeling.
4. To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speedcomputers.
5. To equip them with skills to solve convection and diffusionproblems.
6. To understand the importance continuity and momentum equations for different types of fluidflow

COURSE OUTCOMES

Upon completion of this course, the students can able

1. Identify, solve engineering problems by computational fluiddynamics.
2. Understand the importance of governing equations involved inCFD.
3. Formulate and solve problems in the field of fluid flow and heattransfer.
4. Solve the heat conduction problems using finite differencemethod.
5. Analyze and provide solutions for convection and diffusionproblems.
6. Develop continuity and momentum equations for different types of fluidflow.

UNIT I
GOVERNING DIFFERENTIAL EQUATIONS AND FINITE DIFFERENCE METHOD
Classification, Initial and Boundary conditions – Initial and Boundary Value problems – Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II
CONDUCTION HEAT TRANSFER BY FINITE DIFFERENCE METHOD AND FINITE VOLUME METHOD
Steady one-dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT III
CONVECTION HEAT TRANSFER BY FINITE DIFFERENCE METHOD AND FINITE VOLUME METHOD
Steady One-Dimensional and Two-Dimensional Convection – diffusion, Unsteady one-dimensional convection – diffusion, Unsteady two-dimensional convection – Diffusion.

UNIT IV
INCOMPRESSIBLE FLUID FLOW BY FINITE DIFFERENCE METHOD AND FINITE VOLUME METHOD
Governing Equations, Stream Function – Vorticity method, Determination of pressure for viscous flow, SIMPLE, Computation of Boundary layer flow - Finite difference approach.

UNIT V
FINITE ELEMENT METHOD AND TURBULENCE MODELS
Introduction to finite element method – solution of steady heat conduction by FEM. Algebraic Models – One equation model, k – □ models - Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes – Prediction of flow in a sudden pipe contraction and pipe.

REFERENCE BOOKS:

1. Muralidhar, K.and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”,NarosaPublishing House, New Delhi, 2003.
2. Ghoshdasdidar, P.S.,“Computer Simulation of flow and heat transfer” Tata McGraw-Hill Publishing Company Ltd., 1998.
3. Subas, V.Patankar “Numerical heat transfer fluid flow”, Hemisphere Publishing Corporation, 1980.
4. Versteeg and Malalasekera, N, “An Introduction to computational Fluid Dynamics The Finite volume Method”, Pearson Education, Ltd., 2007.
5. Taylor, C and Hughes, J.B. “Finite Element Programming of the Navier-Stokes Equation”, Pineridge Press Limited, U.K., 1981.
6. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., “Computational fluid Mechanics and Heat Transfer “Hemisphere Publishing Corporation, New York, USA, 2012.
7. Fletcher, C.A.J. “Computational Techniques for Fluid Dynamics 1, Fundamental and GeneralTechniques”, Springer – Verlag, 1991.
8. Fletcher, C.A.J. “Computational Techniques for fluid Dynamics 2 ,Specific Techniques for Different Flow Categories”, Springer – Verlag, 1988.
9. Bose, T.K., “Numerical Fluid Dynamics” Narosa Publishing House, 1997

TRIBOLOGY IN DESIGN
(Effective from the academic year 2019-2020 onwards)

CODE: 19RME301

COURSE OBJECTIVES
1. To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.
2. To select proper grade lubricant for specific application.
3. To understand the principles of lubrication, lubrication regimes,
4. To understand the theories of hydrodynamic and the advanced lubrication techniques.
5. To introduce the concept of surface engineering and its importance in tribology.
6. To understand the behavior of Tribological components.

COURSE OUTCOMES
At the end of this course students will be able to
1. Explain the topography of the surfaces.
2. Discuss about the theory of sliding friction.
3. Elaborate in detail about the wear mechanism and various surface treatments, also able to explain about the international standards followed for friction and wear measurements.
4. Describe the application of various types of lubricants and explain in detail about the lubricant regimes.
5. Explain the theory of hydrodynamic and hydrostatic lubrication.
6. Understand the concepts of elasto hydrodynamics lubrication.

UNIT I
SURFACE INTERACTION AND FRICTION
Topography of Surfaces – Surface features-Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact

UNIT II
WEAR AND SURFACE TREATMENT
Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models- Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements –Laser methods – instrumentation - International standards in friction and wear measurements

UNIT III
LUBRICANTS AND LUBRICATION REGIMES
Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication-

Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

UNIT IV
THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION
Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing-Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

UNIT V
HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION
Rolling contacts of Elastic solids**-** contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication heory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape ithin and outside contact zones-Film thickness and friction calculation- Rolling bearings- stresses and deflections-Traction drives

REFERENCE BOOKS:

1. Rabinowicz.E, "Friction and Wear of materials", John Willey &Sons ,UK,1995
2. Cameron A. "Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981
3. Halling J. (Editor) – "Principles of Tribology ", Macmillian – 1984.
4. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.
5. S.K.Basu, S.N.Sengupta&B.B.Ahuja ,"Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd , New Delhi, 2005.
6. G.W.Stachowiak& A.W .Batchelor , "Engineering Tribology", Butterworth - Heinemann, UK,2005.

ADVANCED MANUFACTURING PROCESSES
(Effective from the academic year 2019-2020 onwards)

CODE: 19RME302

COURSE OBJECTIVES

1. To provide knowledge on different aspects of powder metallurgy parameters.
2. To understand the importance of principle of advanced welding processes and its application.
3. To understand the importance of advanced forming processes and its application.
4. To familiarize the students to advanced manufacturing process for processing of different materials.
5. To acquaint the student to apply the suitable rapid prototyping mechanism for industry need.
6. To provide knowledge on optimum parametric for advanced manufacturing process.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

1. Understand different aspects of powder metallurgy parameters.
2. Understand basic principle of advanced welding processes and its application.
3. Understand basic principle of advanced forming processes and its application.
4. Select the best suitable advanced manufacturing process for processing of different materials.
5. Apply the suitable rapid prototyping mechanism for industry need.
6. Select the optimum parametric for advanced manufacturing process

UNIT I
NEW MACHINING PROCESSES
(Non thermal energy) – Abrasive machining – water jet machining - ultrasonic machining – chemical machining – electro chemical machining – construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications .

UNIT II
NEWER MACHINING PROCESS
Wire cut EDM - Electro chemical machining – ECG - Electric discharge machining – construction – principle – types – control - circuits – tool design – merits, demerits & applications.

UNIT III
NEWER MACHINING PROCESS
Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam machining – construction working principle types – process parameter – derivations – problems, merits, demerits and applications.

UNIT IV
FABRICATION OF MICRO DEVICES

Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication.

UNIT V
MICROFABRICATION TECHNOLOGY
Wafer preparation – monolithic processing – moulding – PCB board hybrid & mcm technology – programmable devices & ASIC – electronic material and processing.–steriolithography SAW devices, Surface Mount Technology.

REFERENCE BOOKS:

1. Seropekelpekijian&Stevan R. Schmid- "Manufacturing process and Engineering materials" – 2003
2. "Micro senors Mems & smart devices"- Julian W.Hardner – 2002
3. Brahem T. Smith, "Advanced machining", I.F.S. UK 1989.
4. Jaeger R.C., "Introduction to microelectronic fabrication", Addison Wesley, 1988.
5. Nario Taniguchi – "Nano technology" – Oxford University Press 1996.
6. Pandey P.C. & Shan HS,"Modern Machining Processes", Standard Publishing Co.,1980
7. More Madon, "Fundamentals of Micro fabrication", CRC Press, 1997

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PHYSICS OF SOLAR ENGINEERING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME303

COURSE OBJECTIVES
1. To understand the basics of solar energy
2. To learn the origin of solar energy, tracking of the sunlight and atmospheric interaction of the solar radiation
3. To understand the working principle of the solar cells
4. To learn the working of different types of solar cells
5. To study about the different types of solar collectors
6. To learn about the energy storage systems

COURSE OUTCOMES
At the end of this course, the students will be able to
1. Know the basics of solar energy
2. Discuss about the origin of solar energy, how to track the sunlight
3. Explain the working of solar cells
4. Recognize the various types of solar cells
5. Identify the various types of solar collectors
6. Explain in brief about the energy storage systems

UNIT I
INTRODUCTION
Basics of solar energy - Brief History of solar energy utilization - Various approaches of utilizing solar energy - Blackbody radiation- Relation between radiation field energy density and radiation spectrum - Planck's formula in energy unit - Maximum spectral density - Planck's formula in wavelength unit -Wien displacement law - Stefan - Boltzmann law - Photoelectric effect - Einstein's theory of photons -Einstein's derivation of the black-body formula.

UNIT II
ORIGIN OF SOLAR ENERGY, TRACKING SUNLIGHT & ATMOSPHERIC INTERACTION
Basic parameters of the Sun - Measurement of the solar constant - The structure of the Sun - The origin of solar energy - Rotation and orbital motion of the Earth around the Sun - Solar time, sidereal time, universal standard time, local standard time - Equation of time - Intensity of sunlight on an arbitrary surface at any time - Interaction with the atmosphere - Absorption of the molecules - Air mass - Rayleigh scattering - Direct and scattered sunlight.

UNIT III
SOLAR CELLS
Formation of a pn – junction - Space charge and internal field - Quasi - Fermi levels - The Shockley diode equation - Structure of a solar cell - The solar cell equation - Fill factor and maximum power - Various electron - hole-pair recombination mechanisms - Crystalline silicon solar cells - Thin film solar cells: CIGS, Cite and a – silicon - Tandem solar cells - Dye - sensitized solar cells - Organic solar cells

UNIT IV
CONCENTRATION OF SOLAR ENERGY
Three types of imaging optics: trough or linear collectors, central receiver with heliostats, and parabolic dish concentrator with on - axis tracking- Solar thermal electricity using Stirling engine or Ranking engine - Solar photovoltaic's with concentration.

UNIT V
ENERGY STORAGE
Necessity of storage for solar energy- Chemical energy storage - Thermal energy storage - Thermal Flywheels - Compressed air- Rechargeable batteries.

REFERENCE BOOKS:

1. Duffie, J.A., and Beckman, W.A. "Solar Energy Thermal Process", John Wiley and Sons, NewYork, Jui Sheng Hsieh, Solar Energy Engineering, Prentice-Hall, 2007.
2. M. Stix, "The Sun An Introduction", Second Edition, Springer 2002.
3. Nelson, "The Physics of Solar Cells". Imperial College Press, 2003.
4. Rai, G.D., "Solar Energy Utilization", Khanna Publishers, N. Delhi, 2010.
5. Sukhatme S.P., "Solar Energy", Tata McGraw Hills P Co., 3rd Edition, 2008.
6. B.G. Streetman and S. Banerjee, "Solid State Electronic Devices", Sixth Edition, Prentice Hall, 2006.

WIND ENERGY TECHNOLOGIES
(Effective from the academic year 2019-2020 onwards)

CODE: **19RME304**

COURSE OBJECTIVES
This course enables the students to
1. Understand the basics of wind energy
2. Understand the measurement techniques
3. Discuss about the aerodynamic theory and types of wind turbines
4. Explain the working of gear coupled generator wind turbine components and their construction
5. Understand the construction and working of direct rotor coupled generator
6. Explain the controlling techniques of wind turbine

COURSE OUTCOMES
At the end of this course students will be able to
1. Explain the basics of the wind energy and its applications
2. Know how to measure the wind data and know about the various measuring instruments
3. Discuss in detail about the aerodynamic theory of wind turbines
4. Remember the working of gear coupled generator and wind turbine components
5. Explain the construction and working of direct rotor coupled generator
6. Describe the controlling technique of wind turbine

UNIT I
WIND ENERGY FUNDAMENTALS & WIND MEASUREMENTS
Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Power Content, Class of wind turbines, Atmospheric Boundary Layers, Turbulence. Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis

UNIT II
AERODYNAMICS THEORY & WIND TURBINE TYPES
Airfoil terminology, Blade element theory, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads Vertical Axis Type, Horizontal Axis, Constant Speed Constant Frequency, Variable speed Variable Frequency, Up Wind, Down Wind, Stall Control , Pitch Control, Gear Coupled Generator type, Direct Generator Drive /PMG/Rotor Excited Sync Generator.

UNIT III
GEAR COUPLED GENERATOR WIND TURBINE COMPONENTS AND THEIR CONSTRUCTION
Electronics Sensors /Encoder /Resolvers, Wind Measurement : Anemometer & Wind Vane, Grid Synchronisation System, Soft Starter, Switchgear [ACB/VCB], Transformer, Cables and assembly, Compensation Panel, Programmable Logic Control, UPS, Yaw & Pitch System : AC Drives, Safety Chain Circuits, Generator Rotor Resistor controller (Flexi Slip), Differential Protection Relay for

Generator, Battery/Super Capacitor Charger & Batteries/ Super Capacitor for Pitch System, Transient Suppressor / Lightning Arrestors, Oscillation & Vibration sensing.

UNIT IV
DIRECT ROTOR COUPLED GENERATOR (MULTIPOLE)
Excited Rotor Synch. Generator / PMG Generator, Control Rectifier, Capacitor Banks, Step Up / Boost Converter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltage and Current), Transformer, Safety Chain Circuits.

UNIT V
MODERN WIND TURBINE CONTROL & MONITORING SYSTEM
Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Wind turbines, Wind Turbine Monitoring with Error codes, SCADA & Databases: Remote Monitoring and Generation Reports, Operation &Maitenance for Product Life Cycle, Balancing technique (Rotor & Blade), FACTS control & LVRT & New trends for new Grid Codes.

REFERENCE BOOKS:

1. Freris, L.L., "Wind Energy Conversion Systems", Prentice Hall, 1990
2. Kaldellis J.K, "Stand alone and Hybrid Wind Energy Systems", CRC Press, 2010
3. Mario Garcia –Sanz, Constantine H. Houpis, "Wind Energy Systems",CRC Press 2012
4. Spera, D.A., "Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering",
5. ASME Press, 1994. 5. Duffie, A and Beckmann, W. A., "Solar Engineering of Thermal Processes", John Wiley, 1991.
6. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, 1996.
7. Twidell, J.W. and Weir, A., "Renewable Energy Sources", EFN Spon Ltd., 1983
8. John D Sorensen and Jens N Sorensen, "Wind Energy Systems", Woodhead Publishing Ltd, 2011

ADVANCED HEAT AND MASS TRANSFER
(Effective from the academic year 2019-2020 onwards)

CODE: **19RME305**

COURSE OBJECTIVES

1. To develop the ability to use conduction and radiation heat transfer concepts for various applications
2. To understand the theories of convective heat transfer.
3. To understand the basic concepts of phase change processes and mass transfer.
4. To use numerical methods for solving heat transfer based problems
5. To understand the concepts of engine heat transfer correlation
6. To understand mass transfer concepts of engine and it correlation

COURSE OUTCOMES

Students will learn

1. To understand applications of the heat transfer in various thermal application
2. To discuss thermal analysis based problems
3. To explain about turbulent forces
4. To solve numerical problems in heat transfer
5. To describe the concepts of engine heat transfer correlation
6. To explain mass transfers in engine

UNIT I
CONDUCTION AND RADIATION HEAT TRANSFER

One dimensional energy equations and boundary condition - three-dimensional heat conduction equations - extended surface heat transfer - conduction with moving boundaries - radiation in gases and vapour.Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection.

UNIT II
TURBULENT FORCED CONVECTIVE HEAT TRANSFER

Momentum and energy equations - turbulent boundary layer heat transfer - mixing length concept - turbulence model – k Є model - analogy between heat and momentum transfer – Reynolds, Colburn, Prandtl turbulent flow in a tube - high speed flows.

UNIT III
PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER

Condensation with shears edge on bank of tubes - boiling – pool and flow boiling - heat exchanger – Є -- NTU approach and design procedure - compact heat exchangers.

UNIT IV

NUMERICAL METHODS IN HEAT TRANSFER

Finite difference formulation of steady and transient heat conduction problems – discretization schemes – explicit - Crank Nicolson and fully implicit schemes - control volume formulation – steady one-dimensional convection and diffusion problems - calculation of the flow field – SIMPLER Algorithm.

UNIT V

MASS TRANSFER AND ENGINE HEAT TRANSFER CORRELATION

Mass transfer - vaporization of droplets - combined heat and mass transfers - heat transfer correlations in various applications like I.C. engines - compressors and turbines.

REFERENCEBOOKS:

1. YunusA.Cengal, "Heat and Mass Transfer – A practical Approach", 3rd edition, Tata McGraw Hill, 2007.
2. Holman.J.P, "Heat Transfer", Tata Mc Graw Hill, 2002.
3. Ozisik. M.N., "Heat Transfer – A Basic Approach", McGraw-Hill Co., 1985
4. Incropera F.P. and DeWitt. D.P., "Fundamentals of Heat & Mass Transfer", John Wiley &Sons, 2002.
5. Nag.P.K, "Heat Transfe"r, Tata McGraw-Hill, 2002
6. Ghoshdastidar. P.S., "Heat Transfer, Oxford University Press, 2004
7. Yadav, R., "Heat and Mass Transfer", Central Publishing House, 1995.

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ADDITIVE MANUFACTURING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME306

COURSE OBJECTIVES

1. To know the principle, methods, possibilities and limitations of Additive Manufacturing technologies.
2. to understand the concept of reverse engineering and cad modeling
3. To gain knowledge about the classification of liquid and solid based AM process
4. To educate the principles and application of powder based AM systems
5. To understand the concept of 3D printing
6. To educate about the case studies and application related AM process.

COURSE OUTCOMES

The students will be able to

1. Understand history, concepts and terminology of additive manufacturing
2. Apply the reverse engineering concepts for design development
3. Understand the classifications of additive manufacturing techniques
4. Understand about powder based AM systems
5. Explain the principle and applications of 3D printing
6. Understand the challenges associated with AM

UNIT I
INTRODUCTION

Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits-Applications.

UNIT II
REVERSE ENGINEERING AND CAD MODELING

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT III
LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS

Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object

Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT IV
POWDER BASED ADDITIVE MANUFACTURING SYSTEMS
Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

UNIT V
OTHER ADDITIVE MANUFACTURING SYSTEMS
Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

REFERENCES BOOKS:

1. Gibson I., Rosen D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Chua C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.
3. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
4. Liou L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2011.
5. Kamrani A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
6. Hilton P.D. and Jacobs, P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRCpress, 2005.

AUTOMOBILE SYSTEMS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME307

COURSE OBJECTIVES

1. To understand about basics of automobile system
2. To understand the theoretical concepts of Engines
3. To understand the functions and designs of shaft and drives
4. To understand the terminology and working of suspension system
5. To understand applications of electronic in automobiles
6. To understand the purpose of alternate fuels and hybrid vehicles.

COURSE OUTCOMES

The students will be able to

1. Explain about specifications of automobile system
2. Explain the engine terminologies
3. Design and develop shaft and drives
4. Explain about braking systems
5. Explain about electronic systems in automobiles
6. Gain knowledge about alternate fuels and hybrid vehicles.

UNIT I
INTRODUCTION

Passenger, commercial vehicles, types and specifications, off highway vehicles. Resistance, power and torque curve, driving force against vehicle speed, acceleration and gradeability in different gears for a typical car or truck plotted from specifications. Calculation and plotting the curves of air, rolling and gradient resistances, driving force, engine power, speed, rear axle ratio. Torque and mechanical efficiency at different vehicle speeds.

UNIT II
ENGINE BASIC THEORY

Engine types and their operation, classification, Properties of I.C. engine fuels, actual cycle, air fuel cycle, combustion charts (equilibrium), two stroke engines, four stroke engine, characteristics of engines, air capacity of engine, valve timing diagram. Flywheel, clutch, gear box types, general function and design characteristics, decoupling of power, speed and torque characteristics of power transmission system.

UNIT III
SHAFT, DRIVE, WHEELS AND TYRES

Functional and design characteristics of propeller shaft, selection criteria for material and cross section of propeller shaft, need for differential and final drive. Use of different types of wheels and tyres, specification, materials.

UNIT IV
STEERING, SUSPENSION AND BRAKES
Effort multiplication and geometry in steering, types of springs used in suspension system, need for damping. Distribution of braking force on front and rear wheels, stopping distance and braking efficiency, introduction to ABS.

UNIT V
ELECTRICAL AND ELECTRONIC AND ALTERNATE FUEL SYSTEMS
Application of electricity in automobiles, starting, charging, lighting and accessory systems. Application of basic electronic components in automobiles. Introduction to alternate fuels – LPG, CNG, Bio fuels, Alcohol fuels. Introduction to electric, hybrid and fuel cell vehicles.

REFERENCE BOOKS:

1. W H & Anglin D L, "Automotive Mechanics", Tata McGraw Hill Publishing Company, 2004.
2. Robert Bosch "Automotive Hand book", 5th edition, 2004.
3. Ganesan V , "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 2003.
4. Mathur L and Sharma R P, "Internal Combustion Engines", Dhanpat Rai Publications
5. (P), Ltd, New Delhi, 2002.
6. Heinz Heisler, "Advanced Engine Technology", SAE 1995.
7. Richard Stone, "Introduction to IC Engines", 2nd edition, Macmilan,1992.
8. Obert E F, "Internal Combustion Engine analysis and Practice", International Text Book Co., Scranton, Pennsylvania, 1988.
9. John B Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill International Editions, 1988.

LEAN MANUFACTURING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME308

COURSE OBJECTIVES

1. To study the various concept lean manufacturing (LM).
2. To understand the tools and methodologies in LM system
3. To understand the concepts of value stream mapping
4. To understand the principles of manufacturing and optimization technology to improve production
5. To study various cases based on assembly line
6. To understand the process involves in implementing lean

COURSE OUTCOMES

The students will be able to

1. Explain about lean manufacturing
2. Apply lean manufacturing tools in industries
3. Identify the scenarios in value stream mapping
4. Apply optimization techniques in industries related problems
5. Solve production related issues
6. implement lean manufacturing in industries

UNIT I
INTRODUCTION TO LEAN MANUFACTURING

Objectives of lean manufacturing-key principles and implications of lean manufacturing- traditional Vs lean manufacturing. Lean Manufacturing Concepts: Value creation and waste elimination- main kinds of waste- pull production-different models of pull production-continuous flow-continuous improvement / Kaizen- worker involvement -cellular layout- administrative lean.

UNIT II
LEAN MANUFACTURING TOOLS AND METHODOLOGIES

Standard work -communication of standard work to employees -standard work and flexibility -visual controls-quality at the source- 5S principles -preventative maintenance-total quality management-total productive maintenance -changeover/setup time -batch size reduction -production leveling.

UNIT III
VALUE STREAM MAPPING

The as-is diagram-the future state map-application to the factory simulation scenario-line balancing -Poke Yoke -Kanban – overall equipment effectiveness.

UNIT IV
JUST IN TIME MANUFACTURING
Introduction - elements of JIT - uniform production rate - pull versus push method- Kanban system - small lot size - quick, inexpensive set-up - continuous improvement. Optimised production technology. One-piece flow: Process razing techniques – cells for assembly line – case studies.

UNIT V
IMPLEMENTING LEAN
Road map-senior management Involvement-best practices. Reconciling lean with other systems: Toyota production system-lean six sigma-lean and ERP-lean with ISO9001:2000.

REFERENCE BOOKS:

1. Askin R G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.
2. Michael L George, David T Rowlands, Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2004.
3. Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", Productivity and Quality Publishing Pvt Ltd, 2002.
4. Kenichi Sekine, "One-Piece Flow", Productivity Press, Portland, Oregon, 1992.
5. Alan Robinson "Continuous Improvement in Operations", Productivity Press, Portland, Oregon, 1991.
6. Joseph A De Feo, William W Bearnard , "Juran Institute's Six Sigma Break Through and Beyond", Tata McGraw Hill Edition, New Delhi, 2004.
7. Richard B Chase F Robert Jacobs and Nicholas J Aquilano, "Operations Management for Competitive Advantage", McGraw Hill/Irwin; Tenth Edition, 2003.
8. Poke - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992.

SURFACE ENGINEERING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME309

COURSE OBJECTIVES

1. To impart knowledge in the friction aspects of machine components
2. To understand the material properties which influence the tribological characteristics of Surfaces
3. To understand the principle and classifications of corrosion.
4. To understand the purpose of surface treatment.
5. To understand procedure and classification involves in surface coating
6. To understand the important and classification of engineering materials

COURSE OUTCOMES

The students will be able to

1. Gain knowledge about friction and its application
2. Explain about wear behavior of materials
3. Recognize types of corrosion and its control procedures
4. Apply surface treatment on material surface
5. Apply surface coating based on the applications of material
6. Describe about the engineering materials and its applications

UNIT I
FRICTION

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact

UNIT II
WEAR

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Laws of wear – Theoretical wear models – Wear of metals and non metals - International standards in friction and wear measurements

UNIT III
CORROSION

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors

UNIT IV
SURFACE TREATMENTS
Introduction – Surface properties, Superficial layer – Changing surface metallurgy – Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings

UNIT V
ENGINEERING MATERIALS
Introduction – Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology Nano Tribology.

REFERENCE BOOKS:

1. G.W.Stachowiak& A.W .Batchelor , “Engineering Tribology”, Butterworth-Heinemann, UK, 2005.
2. Rabinowicz.E, “Friction and Wear of materials”, John Willey &Sons ,UK,1995
3. Halling, J. (Editor) – “Principles of Tribology”, Macmillian – 1984.
4. Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.
5. S.K.Basu, S.N.Sengupta&B.B.Ahuja, “Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005.
6. Fontana G., “Corrosion Engineering”, McGraw Hill, 1985

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INDUSTRIAL ROBOTICS & EXPERT SYSTEMS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME310

COURSE OBJECTIVES

1. Learn about the types of robots used in material handling systems.
2. Understand the use of vision systems in automation systems.
3. Gain knowledge on the different methods of material handling.
4. Apply knowledge about choosing sensors for robotics.
5. To design the methods of Robot Programming
6. To design robots in various industrial application.

COURSE OUTCOMES

The Student will be able to

1. Differentiate the various types of Industrial Robots and their architecture.
2. Apply the concepts of image processing for robotic inspection systems.
3. Analyze the applications of robots in various industrial application.
4. Design and fabricate simple grippers for pick and place application.
5. Identify the right Robot for a given industrial application.
6. Select the right material handling system for a given application

UNIT 1
INTRODUCTION AND ROBOT KINEMATICS

Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT-II
ROBOT DRIVES AND CONTROL

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT-III
ROBOT

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT-IV
ROBOT CELL DESIGN AND APPLICATION
Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial applications of Robots.

UNIT-V
ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS
Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

TEXT BOOK:

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing,Vision and Intelligence”, Mc Graw Hill, 1987.

REFERENCE BOOKS:

1. Yoram Koren,” Robotics for Engineers’ Mc Graw-Hill, 1987.
2. Kozyrey, Yu. “Industrial Robots”, MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering-An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R.” Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, “Industrial Robotics Technology, Programming and Applications”, Mc Graw-Hill, Int. 1986.
6. Timothy Jordanides et al, “Expert Systems and Robotics”, Springer-Verlag, NewYork, May 1991.

ADVANCED THERMODYNAMICS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME311

COURSE OBJECTIVES

1. Identify the unique vocabulary associated with thermodynamics.
2. Explain the basic concepts of thermodynamics like system, properties, equilibrium, pressure, specific volume, temperature, zeroth law of thermodynamics, temperature measurement and temperature scales.
3. Calculate thermodynamic properties using tables of thermodynamic properties and analyze the processes on T-v diagrams to solve advanced engineering problems.
4. State and apply the first law of thermodynamics for closed and open systems undergoing different thermodynamic processes.
5. Evaluate the performance of steam power plants, refrigeration plants and their components using the first law of thermodynamics for open systems
6. Apply the inequality ofClausius and establish the property entropy of a system.

COURSE OUTCOMES

1. To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.
2. To identify and formulate power production based on the fundamentals laws of thermal engineering.
3. To instill upon to envisage appropriate experiments related to heat engines.
4. To investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.
5. To appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.
6. To communicate effectively the concepts of internal combustion engines and try to think beyond curriculum in alternative sources of energy.

UNIT I
AVAILABILITY ANALYSIS AND THERMODYNAMIC PROPERTY RELATIONS

Reversible work - availability - irreversibility and second – law efficiency for a closed system and steady – state control volume. Availability analysis of simple cycles. Thermodynamic potentials. Maxwell relations. Generalized relations for changes in entropy - internal energy and enthalpy - generalized relations for Cp and CV Clausius Clayperon equation, Joule – Thomson coefficient.Bridgeman tables for thermodynamic relations.

UNIT II
REAL GAS BEHAVIOUR AND MULTI – COMPONENT SYSTEMS

Different equations of state – fugacity – compressibility - principle of corresponding States - Use of generalized charts for enthalpy and entropy departure - fugacity coefficient,Lee – Kesler generalized three parameter tables. Fundamental property relations for systems of variable composition. Partial molar properties.Real gas mixtures - Ideal solution of real gases and liquid - activity - equilibrium in multi phase systems - Gibbs phase rule for non – reactive components.

UNIT III
CHEMICAL THERMODYNAMICS AND EQUILIBRIUM
Thermochemistry - First law analysis of reacting systems - Adiabatic flame temperature – entropy change of reacting systems - Second law analysis of reacting systems - Criterion for reaction equilibrium.Equilibrium constant for gaseous mixtures - evaluation of equilibrium composition.

UNIT IV
STATISTICAL THERMODYNAMICS
Microstates and Macrostates - thermodynamic probability - degeneracy of energy levels - Maxwell – Boltzman, Fermi – Diarc and Bose – Einstein statistics - microscopic interpretation of heat and work, evaluation of entropy, partition function, calculation of the Macroscopic properties from partition functions.

UNIT V
IRREVERSIBLE THERMODYNAMICS
Conjugate fluxes and forces - entropy production Onsager's reciprocity relations - thermo – electric phenomena, formulations.

TEXT BOOKS:

1. Kenneth WarkJt.m, Advanced Thermodynamics for Engineers, McGrew – Hill Inc., 1995.
2. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Cons, 1988.
3. Holman, J.P., Thermodynamics, Fourth Edition, McGraw – Hill Inc., 1988.

REFERENCE BOOKS:

1. Smith, J.M. and Van Ness., H.C., Introduction to Chemical Engineering Thermodynamics, Fourth Edition, McGraw – Hill Inc., 1987.
2. Sonntag, R.E., and Van Wylen, G, "Introduction to Thermodynamics, Classical and StatisticalThemodynamics", Third Edition, John Wiley and Sons, 1991.
3. Sears, F.W. and Salinger G.I., "Thermodynamics, Kinetic Theory and StatisticalThermodynamics", Third Edition, Narosa Publishing House, New Delhi, 1993.
4. DeHotf, R.T., "Thermodynamics in Materials", Science, McGraw – Hill Inc., 1993. Rao,Y.V.C.,
5. "Postulational and Statistical Thermodynamics", Allied Publisher Limited, New Delhi, 1999.

ADVANCED INTERNAL COMBUSTION ENGINEERING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME312

COURSE OBJECTIVES

1. To make familiar with the design and operating characteristics of engines
2. To understand the basic principles of combustion
3. To gain knowledge in the principles of SI engine combustion
4. To understand the concepts of CI engine system
5. To understand the basic concepts of gas turbine combustion and the latest technologicaladvances in low temperature combustion
6. To design the alternate fuels.

COURSE OUTCOMES

1. Given an engine design specification, predict performance and fuel economy trends
2. Apply basic concepts in the design of combustion systems
3. Able to design SI engine system
4. Develop an understanding of real-world diesel engine design issues
5. Develop an ability to optimize future engine design for better fuel economy,
6. Develop an ability to optimize performanceand emissions.

UNIT I
SPARK IGNITION ENGINES

Spark ignition Engine mixture requirements – Fuel – Injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – factors affecting knock – Combustion chambers.

UNIT II
COMPRESSION IGNITION ENGINES

States of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers –Fuel spray behaviour – spray structure, spray penetration and evaporation – air motion – Introduction to Turbo charging.

UNIT III
POLLUTANT FORMATION AND CONTROL

Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, NOx, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps – Methods of measurements and Introduction to emission norms and Driving cycles.

UNIT IV
ALTERNATIVE FUELS
Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications.

UNIT V
RECENT TRENDS
Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition – Measurement techniques – laser Doppler, Anemometry.

TEXT BOOK

1. K.K. Ramalingam, "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.

REFERENCE BOOKS

1. R.B.Mathur and R.P. Sharma, "Internal combustion Engines".
2. V. Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.
3. Duffy Smith, "Auto fuel Systems", The Good Heart Willox Company, Inc., 1998

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REFRIGERATION SYSTEMS DESIGN
(Effective from the academic year 2019-2020 onwards)

CODE:19RME313

COURSE OBJECTIVES
1. To provide a fundamentals of refrigeration systems
2. To accustom with various methods of production of cold with refrigeration systems
3. To impart knowledge about applications of refrigeration systems
4. To familiarize with industrial protocols, regulations in the field in refrigeration.
5. To design refrigeration system with respect to surroundings.
6. To design thermo Electric Refrigeration and Air Refrigeration cycles.

COURSE OUTCOMES
Students will be able to
1. Understand the principles and remember the applications of refrigeration systems
2. Analyze performance of vapor compression refrigeration system
3. Study the working principles of vapor absorption, thermoelectric, steam jet refrigerationsystem.
4. Create capacity to compute heating / cooling load
5. Create the eco-friendly refrigerants.
6. demonstrate an understanding of the engineering and operation of vaporcompression and possibly heat-driven refrigeration systems and evaporative cooling systems andunderstand contemporary issues of ozone depletion and global warming potential with respect torefrigeration systems.

UNIT I
REFRIGERATION CYCLES - ANALYSIS
Development of Vapor Compression Refrigeration Cycle from Reverse Carnot Cycle- conditions for high COP-deviations from ideal vapor compression cycle,MultipressureSystems, Cascade Systems-Analysis.

UNIT II
MAIN SYSTEM COMPONENTS
Compressor- Types,performance, Characteristics of Reciprocating Compressors, Capacity Control, Types of Evaporators & Condensers and their functional aspects, Expansion Devices and their Behavior with fluctuating load.

UNIT III
REFRIGERANTS

Classification of Refrigerants, Refrigerant properties, Oil Compatibility, Environmental Impact-Montreal / Kyoto protocols-Eco Friendly Refrigerants. Different Types of Refrigeration Tools , Evacuation and Charging Unit , Recovery and Recycling Unit , Vacuum Pumps.

UNIT IV
SYSTEM BALANCING & CONTROLS
Estimation of Cooling Load, System Equilibrium and Cycling Controls, Electric Circuits in-Refrigerators, Window A/C, Types of motors, Relays.

UNIT V
OTHER REFRIGERATION CYCLES
Vapor Absorption Systems-Aqua Ammonia &LiBr Systems, Steam Jet Refrigeration Thermo Electric Refrigeration and Air Refrigeration cycles.

TEXT BOOKS:

1. Dossat R.J., Principles of refrigeration, John Wiley, S.I. Version (2001).
2. Stoecker W.F., Refrigeration and Air conditioning, McGraw-Hill Book Company, 1989.

REFERENCE BOOKS:

1. Jordan and Priester , Refrigeration and Air conditioning 1985.
2. Goshnay W.B., Principles and Refrigeration, Cambridge, University Press, 1985.
3. Langley , Billy C., ‘Solid state electronic controls for HVACR’ pentice-Hall 1986.

COMPOSITE AND POLYMER MATERIALS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME314

COURSE OBJECTIVES

1. Explain the behavior of constituents in the composite materials
2. Enlighten the students in different types of reinforcement
3. Develop the student's skills in understanding the different manufacturing methods available for composite material.
4. Illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.
5. To design the liquid state fabrication methods
6. To apply the knowledge about recycling of PMC

COURSE OUTCOMES

Upon completion of this course the student will be able to

1. Explain the mechanical behavior of layered composites compared to isotropicmaterials.
2. Apply constitutive equations of composite materials and understand mechanicalbehavior at micro and macro levels.
3. Determine stresses and strains relation in composites materials.
4. Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of fibre-reinforced composite products.
5. Analyse the elastic properties and simulate the mechanical performance of compositelaminates; and understand and predict the failure behaviour of fibre-reinforced composites
6. Apply knowledge of composite mechanical performance and manufacturing methods to a composites design project

UNIT I
PROPERTIES OF POLYMERS

Chemistry and Classification of Polymers – Properties of Thermo plastics – Properties of Thermosetting Plastics – Applications – Merits and Disadvantages.

UNIT II
PROCESSING OF POLYMERS

Extrusion – Injection Moulding – Blow Moulding – Compression and Transfer Moulding – Casting – Thermo Forming General Machining properties of Plastics – Machining Parameters and their effect – Joining of Plastics – Mechanical Fasteners – Thermal bonding – Press Fitting.

UNIT III
INTRODUCTION TO FIBRES AND COMPOSITE MATERIALS
Fibres – Fabrication, Structure, properties and applications - Glass, Boron, carbon, organic, ceramic and metallic fibers whiskers– Matrix materials structure – polymers, – metals and ceramics – Physical and chemical properties.

UNIT IV
PROCESSING OF POLYMER MATRIX COMPOSITES
Open mould process, bag moulding, compression moulding with BMC and SMC filament winding – pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC's – Carbon Matrix Composites - Interfaces – Properties – recycling of PMC.

UNIT V
PROCESSING OF METAL MATRIX COMPOSITES AND CERAMIC MATRIX COMPOSITES
Solid state fabrication techniques – diffusion bonding – powder metallurgy techniques plasma spray, chemical and physical vapour deposition of matrix on fibres Chemical vapour infiltration – Sol gel – liquid state fabrication methods – infiltration – squeeze, casting – rheo casting – compocasting - Interfaces properties– application of MMC and ceramic matrix composites.

REFERENCE BOOKS:

1. Krishnan K Chawla, "Composite Materials Science and Engineering", International Edition, Springer, 2006
2. Harold Belofsky, "Plastics, Product Design and Process Engineering", Hanser Publishers, 2002.
3. Bera.E and Moet.A, "High performance polymers", Hanser Publishers, 2001.
4. Rauwendaal,C., "Polymer extrusium", Hanser publishers, 2000.
5. Rosatao, D.V. "Blow moulding",HandBook, Hanser Publishers, 1989.
6. Seamour, E.B. "Modern Plastics Technology", Prentice Hall, 2002
7. Mallick, P.K. and Newman.S., "Composite Materials Technology", Hanser Publishers, 2003

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ADVANCES IN CASTING AND WELDING PROCESSES
(Effective from the academic year 2019-2020 onwards)

CODE:19RME315

COURSE OBJECTIVES

1. To familiarize the students to apply various design considerations in casting, gating and risering.
2. To develop an understanding of casting metallurgy like solidification, shrinkage and degasification.
3. To explain about the recent trends in casting.
4. To understand the concept foundry layout and pollution control in foundry.
5. To study and acquire knowledge of welding metallurgy and design aspects of welding
6. To provide an overview of recent trends in welding and various welding methods.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Apply suitable design considerations in casting, gating and risering.
2. Identify the effect of solidification, shrinkage and degasification.
3. Select the type of casting process.
4. Work with various foundry layouts and pollution control.
5. Identify the effect of metallurgy in welding and design aspects.
6. Select the type of welding method and recent trends.

UNIT I
CASTING DESIGN

Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering

UNIT II
CASTING METALLURGY

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

UNIT III
RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT

Shell moulding, precision investment casting, CO_2moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes.

Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT IV
WELDING METALLURGY AND DESIGN
Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

UNIT V
RECENT TRENDS IN WELDING
Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

REFERENCE BOOKS:

1. ASM Handbook, Vol 15, "Casting", 2004
2. ASM Handbook vol.6, "Welding, Brazing & Soldering", 2003
3. Parmer R.S., "Welding Engineering and Technology", Khanna Publishers,2002
4. Srinivasan N.K., "Welding Technology", Khanna Tech Publishers, 2002
5. Heineloper& Rosenthal, "Principles of Metal Casting", Tata McGraw Hill, 2000.
6. Jain P.L., "Principles of Foundry Technology",TataMcGrawHill Publishers, 2003
7. Carrry B., "Modern Welding Technology", Prentice Hall Pvt Ltd., 2002
8. Iotrowski – "Robotic welding – A guide to selection and application" – Society of Mechanical Engineers, 1987.
9. Schwariz, M.M. – "Source book on innovative welding processes" – American Society for Metals (OHIO), 1981
10. Cornu.J. "Advanced welding systems" – Volumes I, II and III, JAICO Publishers,1994.
11. Lancaster.J.F. – "Metallurgy of welding" – George Alien & Unwin Publishers, 1980

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MANUFACTURING SYSTEMS ENGINEERING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME316

COURSE OBJECTIVES

1. To explain the principles of manufacturing systems and manufacturing models.
2. To understand the concept of various flow shop systems.
3. To provide knowledge on different types of layouts and cellular systems.
4. To expose the students to know about flexible manufacturing and inspection systems.
5. To explain the construction features of different types of material handling systems.
6. To provide knowledge on material storage and retrieval systems.

COURSE OUTCOMES

Upon completion of this course, the students will be able to

1. Explain the principles and types of manufacturing systems and models.
2. Discuss about the constructional features of flow shop systems.
3. Describe the construction of layouts, layout planning and design procedures, cellular and group technology.
4. Illustrate the concept of flexible manufacturing and inspection systems.
5. Describe the constructional features of various material handling systems.
6. Explain about material storage and retrieval systems.

UNIT I
MANUFACTURING SYSTEMS AND MODELS

Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building.

UNIT II
FLOW SHOP SYSTEMS

Assembly lines - reliable serial systems - approaches to line balancing – largest candidate rule, kilbridge& wester method, ranked positional weight heuristic, COMSOAL, – sequencing mixed models. Transfer lines and general serial systems – paced lines with & without buffers, unpaced lines.

UNIT III
FACILITY LAYOUT AND CELLULAR SYSTEMS

Types of layouts – advantages, limitations, systematic layout planning, layout design procedures - quadratic assignments approach, graph theoretic approach, robotics and automated assembly.

Cellular Systems- Group technology – coding schemes – assigning machines to groups – production flow analysis, binary ordering algorithm, single pass heuristic, similarity coefficient method.

UNIT IV
FLEXIBLE MANUFACTURING SYSTEMS
System components – planning and control hierarchy – system design, system setup, scheduling and control – flow shop scheduling, job shop scheduling, Flexible inspection systems.

UNIT V
MATERIAL HANDLING AND STORAGE
Material handling principles, equipment – conveyor analysis, AGV systems, Warehousing – warehouse components, analysis of storage and retrieval systems, carousal storage systems, Introduction to Material handling and storage software.

REFERENCE BOOKS:

1. Ronald G Askin, "Modeling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc,1993.
2. Viswanatham N and Narahari Y "Performance Modeling of Automated Manufacturing Systems", Prentice Hall Inc.,1992.
3. Mengchu Zhou, "Modeling, Simulation and Control of Flexible Manufacturing Systems: A Petri Net Approach", World Scientific Publishing Company Pvt. Ltd., 2000.
4. Jean Marie Proth and XiaolanXie, "Petri Nets: A Tool for Design and Management of Manufacturing Systems", John Wiley and Sons, New York,1996.
5. Brandimarte P and Villa A, "Modeling Manufacturing Systems" Springer Verlag, Berlin, 1999

SUPPLY CHAIN MANAGEMENT
(Effective from the academic year 2019-2020 onwards)

CODE:19RME317

COURSE OBJECTIVES

1. Toknowthe objectives of supply chain management and supply chain network design.
2. To impart knowledge, need for inventorymanagement.
3. To expose the students to know about strategic alliance.
4. To understand the role of distribution in supply chain and various strategies followed.
5. To expose the students to know about the customer value and global supply chains.
6. Toknow about the various information technologies needed for SCM.

COURSE OUTCOMES

On completion of this course, students will learn about

1. Basics and objectives of SCM and supply chain network design
2. Understand the need for inventorymanagement
3. Describe about the various strategicalliance.
4. Illustrate the role of distribution in supply chain.
5. Explain about the various issues in the internationalSCM.
6. Get knowledge in information technology involved inSCM.

UNIT I
INTRODUCTION AND SUPPLY CHAIN NETWORK DESIGN

Definition, house of supply chain – customer satisfaction, integration, coordination - decision phases in a supply chain, objectives of SCM, examples of supply chains, supply chain drivers, supply chain performance measures. SUPPLY CHAIN NETWORK DESIGN- Data collection – data aggregation, transportation modes and rates, mileage estimation, warehouse costs, warehouse capacity, potential warehouse locations, service level requirements and future demand. Network design in the supply chain – factors influencing the network design, framework for network design decisions, models for facility location and capacity allocation – capacitated plant location model, gravity location model, allocating demand to production facilitates, simultaneous location of plants and warehouses – impact of uncertainty on network design.

UNIT II
INVENTORY MANAGEMENT AND STRATEGIC ALLIANCE

Single warehouse inventory model - cycle inventory – economies of scale to exploit fixed costs, quantity discounts, short term discounting, multi-echelon inventory, example problems. managing uncertainty – safety inventory in the supply chain –safety level estimation, impact of supply uncertainty, impact of aggregation, impact of replenishment policies, managing safety inventory in multi echelon supply chain, managing safety inventory in practice – product availability – optimal level, affecting factors, supply chain contracts – risk pooling – examples. value of information – Bullwhip effect, information and supply chain technology. STRATEGIC ALLIANCE - Framework for strategic alliance - 3PL and 4PL – retailer-supplier partnerships – distribution integration – procurement and outsourcing – benefits, make/buy decisions, E-Procurement, supplier relationship management – supplier scoring and assessment, supplier selection and contracts – E-Business and the supply chain. design for logistics- Reverse logistics –Cases in Paper industry – Furniture industry – supplier integration into new product development – mass customization.

UNIT III
DISTRIBUTION NETWORK DESIGN AND STRATEGIES
Role of distribution in supply chain – distribution network design – factors influencing distribution network design. push strategy – pull strategy – Kanban replenishment systems, types, implementation, and push–pull strategy – demand driven strategy – impact of internet on supply chain strategy. distribution networks in practice – direct shipment, cross docking, warehousing, transshipment.

UNIT IV
CUSTOMER VALUE AND GLOBAL SUPPLY CHAINS
Customer value – dimensions, strategic pricing, customer value measures, information technology and customer value – customer relationship management. global supply chains – introduction, driving factors, risks and advantages, issues, regional differences in logistics.

UNIT V
INFORMATION TECHNOLOGY FOR SCM
Goals – standardization – infrastructure – interface devices, communications, databases, system architecture – system components – integrating the supply chain information technology - DSS for supply chain management.

REFERENCE BOOKS:

1. Simchi – Levi Davi, Kaminsky Philip and Simchi-Levi Edith, “Designing and Managing the Supply Chain”, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2003.
2. Chopra S and Meindl P, “Supply Chain Management: Strategy, Planning, and Operation”, Prentice Hall India Pvt. Ltd, New Delhi, 2007.
3. Robert B Handfield and Ernest L Nichols, “Introduction to Supply Chain Management”, Prentice Hall, Inc. New Delhi, 1999.
4. Sahay B S, “Supply Chain Management”, Macmillan Company, 2000.
5. David Brunt and David Taylor, “Manufacturing Operations and Supply Chain Management : The Lean Approach”, Vikas Publishing House, New Delhi, 2001.
6. Hartmud Stadler and Christoph Kilger, “Supply Chain Management and Advanced Planning: Concepts, Models, Software”, Springer-Verlag, 2000.

7. David F Ross, "Introduction to E-Supply Chain Management", CRC Press, 2003

ENGINEERING METALLURGY
(Effective from the academic year 2019-2020 onwards)

CODE:19RME318

COURSE OBJECTIVES

1. To impart knowledge on special steel and their types.
2. To understand the types and properties of age hardenable alloys.
3. To impart knowledge on dielectric materials.
4. To familiarize on selection of semiconductor materials.
5. To learn about the biomaterials.
6. To impart knowledge on intelligent materials.

COURSEOUTCOMES

Learners should be ableto

1. Identify the special steel and their types.
2. Describe the types and properties of age hardenable alloys.
3. Explain the various dielectric materials for suitable applications.
4. Identify and select suitable semiconductor materials.
5. Understand the fundamentals of biomaterials.
6. Describe about the intelligent materials.

UNIT I
SPECIAL STEEL

High strength low alloy (HSLA) steel, Dual phase steel, Duplex stainless steel, TRIP steel, Maraging steel, High speed steel, Stainless steel: ferritic, austenitic and martensitic. Precipitation & dispersion hardenable materials,

UNIT II
AGE HARDENABLE ALLOYS

Al-Cu alloys, Al-Fe-V-Si alloys. Super alloys: Ni, Fe and Co based super alloys, Ti based alloys & their thermo mechanical treatment, Nano materials: Synthesis, properties and applications. ; Non-structural materials: Dielectric materials; dielectric constant and polarization, linear dielectric materials, capacitors and insulators, non-linear dielectrics, pyro, piezo and ferro-electrics properties;

UNIT III
SEMICONDUCTOR

Direct and indirect band gap, band diagrams, applications of semiconductors, degenerate and non-degenerate semiconductors, extrinsic and intrinsic semiconductors. Superconducting materials, Optical &Photoionic materials, electron-hole-recombination.

UNIT IV
BIOMATERIALS
Property requirements for biomaterials, concept of biocompatibility, important biometallicalloys; Ti based, stainless steel. Intelligent materials.

TEXT BOOKS

1. W.F. Smith, "Principles of Materials Science and Engineering",McGraw Hill, New York (1994).
2. W.D. Callister, "An Introduction Materials Science & Engineering", John Wiley & Sons (2007).

REFERENCE BOOKS

1. V. Raghavan, "Material Science and Engineering", Prentice Hall of India, 2004.
2. R.Sharma, Sharma, "Heat Treatment: Principles and techniques", Prentice Hall of India, (2004).

INDUSTRIAL SAFETY
(Effective from the academic year 2019-2020 onwards)

CODE:19RME319

COURSE OBJECTIVES

1. To acquaint the student with the need and awareness of the safetyconcepts
2. To understand the importance of various safety techniques involved in industrialsector
3. To introduce the concepts of accident zone and prepare reports related toit.
4. To equip them with skills to conduct basic safety inspections using strategies that theyhave developed
5. To develop an understanding ofsafetymonitoring.
6. To understand the effects of chemical hazards and overview of factories act.

COURSE OUTCOMES

At the end of the course, student will be able to

1. Understand the need and awareness of the safetyconcepts
2. Understand the various safety techniques involved in industrialsector
3. Record and investigate the accident zone and prepare reports related toit.
4. Conduct basic safety inspections using strategies that theyhave developed
5. Identify and demonstrate working of safetymonitoring
6. Train about the education and training based onsafety and factories act

UNIT I
SAFETY CONCEPT
Evolution of modern safety concept- safety policy - Safety Organization - Safety Committee - budgeting for safety. Safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign

UNIT II
CONCEPT OF AN ACCIDENT
reportable and non reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – cost of accident. Machine Guarding, Guarding of hazards

UNIT III
SAFETY

Machine Guarding types and its application – Safety in welding and Gas cutting – Safety in Manual and Mechanical material handling Safety in use of electricity

UNIT IV
TOXICITY

TLV- Types of Chemical Hazards-Occupational diseases caused by dust, fumes, gases, smoke and solvent hazards- control measures Fire triangle- Types of fire - first aid firefighting equipment – flammability limit- LPG safety Overview of factories act 1948 – OHSAS-18000

REFERENCE BOOKS:

1. "Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982
2. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973
3. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.
4. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.
5. John Ridley, "Safety at Work", Butterworth & Co., London, 1983.

PRODUCT DESIGN AND TOOLING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME320

COURSE OBJECTIVES

These course objectives will enable the students

1. To understand modern product development processes.
2. To understand and explain the concept of Industrial design and robust design concepts.
3. To understand the concept of Design for manufacture and assembly.
4. To understand the legal factors, social issues, engineering ethics related to product design
5. To prepare primary designs taking into consideration ergonomics and aesthetic aspects of the product.
6. To understand the concept of Concurrent engineering, rapid prototyping.

COURSE OUTCOMES

At the end of the course, the students will

1. Understanding modern product development processes.
2. Understanding and explain the concept of Industrial design and robust design concepts.
3. Understanding the concept of Design for manufacture and assembly.
4. Understanding the legal factors, social issues, engineering ethics related to product design
5. Preparing primary designs taking into consideration ergonomics and aesthetic aspects of the product.
6. Understanding the concept of Concurrent engineering, rapid prototyping.

UNIT I
INTRODUCTION

Need for IPPD-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement

UNIT II
CONCEPT GENERATION, SELECTION AND TESTING

Plan and establish product specifications. Task - Structured approaches - clarification – search externally and internally-Explore systematically - reflect on the solutions and processes – concept selection - methodology - benefits. Implications - Product change - variety – component standardization - product performance - manufacturability – Concept Testing Methodologies.

UNIT III
PRODUCT ARCHITECTURE
Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV
INDUSTRIAL DESIGN
Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinementmanagement of the industrial design process - technology driven products - user - driven products - assessing the quality of industrial design.

UNIT V
DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT
Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project-project execution.

TEXT BOOK:

1. "Product Design and Development", Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.2012

REFERENCE BOOKS:

1. "Concurrent Engineering/Integrated Product Development". Kenneth Crow, DRM Associates, 6/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book 11

2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin,Homewood, 1992
3. Stuart Pugh, "Total Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, Neyourk,NY,1991, ISBN 0-202-41639-5

POWDER METALLURGY
(Effective from the academic year 2019-2020 onwards)

CODE:19RME321

COURSE OBJECTIVES
These course objectives will enable the students

1. To introduce the field of Powder Metallurgy and engineering applications; from historical background to contemporary advanced applications
2. To introduce and explain basic methodologies and techniques for metal powder production
3. To describe important powder characteristics, and related characterization techniques.
4. To explain basic shaping and consolidation technologies applied in powder metallurgy and preparation necessary powder mixtures necessary to them.
5. To explain sintering phenomena and related sintering technologies
6. To provide information on secondary operations applied in powder metallurgy and introduce some of contemporary powder metallurgy engineering applications.

COURSE OUTCOMES
At the end of the course, the students will

1. Introducing the field of Powder Metallurgy and engineering applications; from historical background to contemporary advanced applications
2. Introduce and explain basic methodologies and techniques for metal powder production
3. Describing important powder characteristics, and related characterization techniques.
4. Explaining basic shaping and consolidation technologies applied in powder metallurgy and preparation necessary powder mixtures necessary to them.
5. Explaining sintering phenomena and related sintering technologies
6. Providing information on secondary operations applied in powder metallurgy and introduce some of contemporary powder metallurgy engineering applications.

UNIT I
INTRODUCTION

scope of powder metallurgy, characterization of metal powders, physical properties-particle size and shape determination, technological properties-apparent density, tap density, green density, sintered density, flow rate etc.

UNIT II
POWDER MANUFACTURING
reduction, electrolysis, and atomization processes. Compaction and consolidation: Diecompaction and other advanced consolidation techniques like hot pressing (HP), hot iso-static pressing (HIP), spark plasma sintering (SPS) etc.

UNIT III
SINTERING
solid and liquid state sintering, sintering mechanisms. Sintering furnaces and sintering atmospheres. Sintering theory and the influence of different processing conditions, wetting and surface diffusion.

UNIT IV
POWDER METALLURGY PRODUCTS
Bearing, filters, friction parts, hard metals, refractory metals, contact materials, magnetic materials, structural parts, and dispersion strengthened materials.

TEXT BOOKS:

1. R.M.German, “Powder Metallurgy Science”, 2nd edition- Metal Powder Industries Federation, Princeton, NewJersey, 1994.
2. M.N. Rahaman, “Ceramic Processing and Sintering”, Marcel Dekker, New York, 1995.
3. G. Goetzel, “Treatise on Powder Metallurgy”, Interscience Publishers, New York, 1952.

REFERENCE BOOKS:

1. G.S. Upadhyaya, “Powder Metallurgy Technology”, Cambridge International Science Publishing, 1997.
2. A.K. Sinha, “Powder Metallurgy”, DhanpatRai Publication, 2006.

SMART MANUFACTURING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME322

COURSE OBJECTIVES
These course objectives will enable the students

1. To learn the components of smart manufacturing system
2. To understand the automated production lines in smart manufacturing system
3. To study the efficiency and effectiveness of smart manufacturing system
4. To understand the existing IoT and Cloud architectures
5. To design an IoT system with cloud infrastructure
6. To implement a prototype of the IoT/cloud system design

COURSE OUTCOMES
At the end of the course, the students will

1. Learn the components of smart manufacturing system
2. Understand the automated production lines in smart manufacturing system
3. Study the efficiency and effectiveness of smart manufacturing system
4. Understand the existing IoT and Cloud architectures
5. Design an IoT system with cloud infrastructure
6. Implement a prototype of the IoT/cloud system design

UNIT I
INTRODUCTION

Overview, and components of manufacturing systems, Design, operation, and control of manufacturing systems.

UNIT II
TYPES OF MANUFACTURING SYSTEMS
Single station cells, manual assembly lines, automated production lines, transfer lines, analysis automated assembly systems.

UNIT III
PERFORMANCE OF MANUFACTURING SYSTEM
Productivity, quality, reliability, agility, responsiveness, sustainability, utilization & availability, flexibility, reconfigurability, resiliency, efficiency and effectiveness of manufacturing system, metrics and key performance indicators.

UNIT IV
GROUP TECHNOLOGY AND CELLULAR MANUFACTURING
Flexible manufacturing systems, changeable manufacturing systems, Just-In-Time and lean production, automation. Agile/demand driven manufacturing, Quick response manufacturing, world class manufacturing and holonic manufacturing systems.

UNIT V
COMPUTER INTEGRATED MANUFACTURING
Enterprise Integration (ISA-95 and other standards), Digital Manufacturing and smart manufacturing systems.

TEXTBOOKS:

1. M. P. Groover, “Automation, Production systems and Computer Integrated Manufacturing”. 3rd edition, Pearson Education, 2015. ISBN: 978-9332549814.
2. N. Singh, “Systems Approach to Computer Integrated Design and Manufacturing”, 1st edition, Wiley India, 2011. ISBN: 978-8126530410.

REFERENCE BOOKS:

1. G. Chryssolouris, “Manufacturing Systems: Theory and Practice”. 2nd edition, Springer, 2006. ISBN: 978-1441920676.
2. W. J. Hopp, M. L. Spearman, “Factory Physics”, 3rd edition, Waveland Press, 2011.
3. E. Turban, L. Volonino, “Information Technology for Management: Transforming Organizations in the Digital Economy”, 7th edition, Wiley India Private Limited, 2010. ISBN: 978-8126526390.

4. R. Askin and C. Standridge, "Modeling and Analysis of Manufacturing Systems", 1st edition, John Wiley, 1992. ISBN: 978-0-471-51418-3.

CRYOGENIC ENGINEERING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME323

COURSE OBJECTIVES

These course objectives will enable the students

1. To provide the knowledge of evolution of low temperature science
2. To provide knowledge on the properties of materials at low temperature
3. To familiarize with various gas liquefaction and refrigeration systems
4. To provide design aspects of cryogenic storage and transfer lines
5. To Understand the cryogenic metallurgy and its medical applications
6. To Understand the cryogenic insulation and its applications

COURSE OUTCOMES

At the end of the course, the students will

1. Learn the knowledge of evolution of low temperature science
2. Provide the knowledge on the properties of materials at low temperature
3. Familiarize with various gas liquefaction and refrigeration systems
4. Provide design aspects of cryogenic storage and transfer lines
5. Understand the cryogenic metallurgy and its medical applications
6. Understand the cryogenic insulation and its applications

UNIT I
CRYOGENIC SYSTEMS

Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve - Joule Thomson Effect.

UNIT II
LIQUEFACTION CYCLES
Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle, Collins Cycle, Dual Pressure Cycle, Helium Regrigerated Hydrogen Liquefaction Systems. Critical components in Liquefaction Systems, Introduction to air separation.

UNIT III
CRYOGENIC REFRIGERATORS
J.T. Cryocoolers, Stirling Cycle Refrigerators, G.M. Cryocoolers, Pulse Tube Refrigerators, Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators ; Storage and transfer of Cryogenic liquids, Design of storage vessels.

UNIT IV
CRYOGENIC INSULATION
Multi-layer insulation, Vacuum insulation etc. Applications: Applications of cryogenic in Space Programmes, Superconductivity, Cryo Metallurgy, Medical applications.

TEXT BOOKS:

1. K. D.Timmerhaus and T.M. Flynn, “Cryogenic Process Engineering”, Plenum Press, 1989.
2. R. F. Barron, “Cryogenic Systems”, McGraw Hill, 1985.
3. R.B.Scott, “Cryogenic Engineering”, Van Nostrand and Co., 1962.

REFERENCE BOOKS:

1. H. Weinstock, “Cryogenic Technology”, 1969.
2. 2.R.W. Vance, “Cryogenic Technology”, John Wiley & Sons, Inc., New York, London.

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APPLIED ELASTICITY & PLASTICITY
(Effective from the academic year 2019-2020 onwards)

CODE:19RME324

COURSE OBJECTIVES
These course objectives will enable the students

1. To explain the stress, strain, torsion and bending properties.
2. To Calculate and determine the stress, strain and deflection of solid body that subjected to external and internal load.
3. To understand different methods that used to analyse stress and strain in solid body.
4. To apply various principles to solve problems in a practical situation and compare its solution with that obtained by solid mechanics approach.
5. To examine different yield criteria in diverse failure situations.
6. To explain the theory of plasticity to manufacturing.

COURSE OUTCOMES
At the end of the course, the students will

1. Apply the concepts of stress, strain, torsion and bending and deflection of bar and beam in engineering field
2. Calculate and determine the stress, strain and deflection of solid body that subjected to external and internal load.
3. Enable to design the optimum dimension of the body in a variety of situations where specific properties are required.
4. Relates the basic theory of elasticity and plasticity with application of solid mechanics.
5. Provides an understanding how the stress-strain characteristics affect ultimate failure of materials.

6. Able to relate theory of plasticity to design tooling in manufacturing instead of using 'thumb rule'.

UNIT I
ANALYSIS OF STRESS
Introduction, Stress components at an arbitrary plane, Principal stresses, Stress invariants, Construction of Mohr's circle, Differential equation of equilibrium, Plane stress problem, Boundary conditions; Analysis of Strain: Introduction, Principal strains, Strain deviator and its invariants, Plane strain problem, Compatibility conditions.

UNIT II
STRESS-STRAIN RELATIONS
Introduction, Generalized Hooke's law, Stress-strain relations for isotropic and orthotropic materials, Displacement equations of equilibrium; Two Dimensional Problems inElasticity.

UNIT III
STRESS FUNCTION
Solution by polynomials, Saint-Venant's Principle, Concentrated force acting on a beam, Effect of circular holes on stress distribution of a plate, Thick-walled cylinder Subjected to internal and external pressure, Rotating disks of uniform thickness.

UNIT IV
TORSION
Introduction, Torsion of general prismatic bars, Torsion of circular and elliptical bars, Torsion of equilateral triangular bars, Membrane analogy, Torsion of a thin-walled tubes, Torsion of a thin-walled multiple-cell closed section, Torsion or rolled sections.

UNIT V
INTRODUCTION TO PLASTICITY
Introduction, Nonlinear stress-strain behavior, Theories of failure, Criterion of yielding, Strain hardening postulates, Rule of plastic flow.

TEXT BOOKS:

1. "Theory of Elasticity" – S P Timoshenko and J N Goodier, McGraw Hill.
2. "Computational Elasticity" – M Ameen, Narosa Publishing House.

REFERENCE BOOKS:

1. "Advanced Mechanics of Solids" – L S Srinath, Tata McGraw-Hill
2. "Theory of Plasticity" – J Chakrabarty, Elsevier Butterworth-Heinemann
3. Advanced Mechanics of Materials – A P Boresi and R J Schmidt, John Wiley & Sons, Inc.

NON-TRADITIONAL PARAMETER IN DESIGN
(Effective from the academic year 2019-2020 onwards)

CODE:19RME325

COURSE OBJECTIVES

1. To learn about fatigue and its controlling factors.
2. To learn about creep and combined stresses.
3. To study about thermo-elasticity concept.
4. To study about thermal stress and deflection in beams.
5. To study about estimation of the strain energy in mechanical elements.
6. To study about buckling and bending phenomenon in columns, struts and beams.

COURSE OUTCOMES

At the end of the course, students will be able to

1. Demonstrate understanding of various design considerations.
2. Illustrate basic principles of design.
3. Design machine elements for static as well as dynamic loading.
4. Design machine elements on the basis of strength/ rigidity concepts.
5. Use design data books in designing various components.
6. Acquire skill in preparing production drawings pertaining to various designs.

UNIT I
DESIGN FOR FATIGUE

Fatigue under normal conditions, controlling factors in fatigue, Design for fatigue.

UNIT II
FRACTURE THEORIES OF STRENGTH AND WORKING STRESS
Temperature and creep stress strain properties, creep in tensor, creep in bending, members, Subjected to creep and combined stresses, Basic modes fracture.

UNIT III
FORMULATION AND SOLUTION OF TWO DIMENSIONAL THERMO ELASTIC PROBLEMS
Basic problems in Thermo-elasticity, circular disc and cylinder with radial temperature distribution.

UNIT IV
THERMAL STRESS AND DEFLECTION IN BEAMS
Thermal stress and deflection in beams- introduction-problems.

TEXT BOOKS:

1. J.M. Lessels. “Resistance of Materials” - (Ch.6, 7, 8 and 11).
2. J.Marie, “Mechanical Behavior of Engineering Materials” - (Chap.7 and 8).
3. Boley and Weiner, “Theory of thermal stresses” - John Wiley. (Chap. 4, 8, 9 and 10).

VACUUM TECHNOLOGY
(Effective from the academic year 2019-2020 onwards)

CODE:19RME326

COURSE OBJECTIVES

1. Understand vacuum system operation.
2. Understand basic vacuum components and their functions.
3. Select and size components for typical applications.
4. Carry out systematic troubleshooting of vacuum control systems.
5. To study about leak detection and detectors.
6. To study about the application of vacuum technology.

COURSE OUTCOMES

At the end of the course, students will be able to

1. Apply basic vacuum principles such as the behavior of gas and behavior of a vacuum system while evaluating a pump down.
2. Consider basic mechanisms and characteristics of vacuum system components such as pumps, valves and gauges while troubleshooting.
3. Perform basic operations of a vacuum system such as measuring pressure correctly, venting a vacuum system, a rough pump down.
4. Perform basic operations of a high vacuum pump down with correct valving sequence.
5. Perform simple maintenance of vacuum systems including installation or replacement of various pipes, fittings, valves, gauges, and simple pumps.
6. Perform vacuum trouble-shooting including leak isolation and detection.

UNIT I
BASIC THEORY
Gas kinetic theory, pressure, conductance, gas flow regimes, vapour pressure, pumping speed, throughput. Gas surface interactions: physisorption, chemi-sorption, condensation.

UNIT II
VACUUM PUMPS
Mechanical, diffusion, molecular drag, turbo molecular, cryopumps, ion pumps - general working principles, operating regimes.

UNIT III
VACUUM INSTRUMENTATION
Vacuum gauges, gas regulators, flow meters, residual gas analyzers, interpretation of data.

UNIT IV
DESIGN CONCEPTS
Materials, chambers, components, joins, seals, valves. Overall system design and integration. ; Problem Solving: Leak detection and detectors, gas signatures.

UNIT V
VACUUM APPLICATIONS
Freeze drying, packaging, vacuum coating, microelectronics, particle accelerators, distillation, metallurgical processes, television and X-ray tubes, cryogenic insulation, space simulation.

TEXT BOOKS:

1. V.V. Rao, T.B. Ghosh, K.L. Chopra, "Vacuum Science and Technology", Allied Publishers Ltd., New Delhi(1998).
2. A. Roth, "Vacuum Technology", North Holland Publishing Company, Amsterdam (1976).

REFERENCE BOOKS:

1. M. H. Hablanian, M. H. Hablanian, H. H. Hablanian, "High-vacuum Technology: A Practical Guide", SecondEdition, Crc Press, 1997.
2. A.D. Tripathi A. Gupta Ac, "Ultra High Vacuum Techniques", Allied Publishers Private Limited, 2002.

VIBRATION ANALYSIS & DIAGNOSTICS
(Effective from the academic year 2019-2020 onwards)

CODE:19RME327

COURSE OBJECTIVES

1. To understand the Fundamentals of Vibration and its practicalapplications.
2. To understand the working principle and operations of various vibrations Measuringinstruments.
3. To understand the importance of vibrationisolation.
4. To understand the various Vibration controlstrategies.
5. To equip them with skills to solve mathematically a multi-degree freedom system and continuoussystem.
6. To give exposure to the various experimental methods used for vibrationanalysis.

COURSE OUTCOMES
At the end of the course, students will be able to

1. Develop mathematical model to represent dynamic system.
2. Estimate natural frequency of mechanical element / system.
3. Analyze vibratory response of mechanical element / system.
4. Estimate parameters of vibration isolation system.
5. Control the vibrations to the acceptable level using basic vibration principles.
6. Handle the vibration measuring instruments.

UNIT I
FORCED VIBRATION SYSTEM
Forced vibration with non harmonic and transient excitation of single degree freedom systems, Fourier analysis, Response to arbitrary loading (Duhamel's Integral), Impulse response, Mechanical shock, Parametric Excitation.

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UNIT II
MULTI-DEGREE FREEDOM SYSTEMS
Two degree Freedom System, Multi-degree Freedom systems, modal analysis, Matrix iteration Method, Transfer matrix Method, Myklestadt-Prohl Method, Rayleigh's minimum principle, Stodola's Method, Hoizer's Method.

UNIT III
VIBRATIONS OF CONTINUOUS SYSTEMS
Vibrations of Continuous systems governed by wave equation and Euler Bernoulli equation, strings, membranes, rods, beams.

UNIT IV
VIBRATION ANALYSIS AND VIBRATION MONITORING
Experimental Methods in Vibration Analysis, industrial applications – rotors and other systems, vibration standards, vibration monitoring.

TEXT BOOKS:

1. P. Srinivasan, "Mechanical Vibration analysis" – 2nd Ed., TMH.1995
2. J.G. Rao &K.Gupta, "Introductory course on Theory and Practice of Mechanical Vibrations", – New Age Publication, 1995.

REFERENCE BOOKS:

1. L. Meirovitch, "Elements of Vibration Analysis", Tata McGraw Hill, Second edition, 2007.
2. W. T. Thomson, "Theory of Vibration with Applications", CBS Publ., 1990.

DESIGN OF MATERIAL HANDLING EQUIPMENT
(Effective from the academic year 2019-2020 onwards)

CODE:19RME328

COURSE OBJECTIVES

1. To provide students with the basic concepts related to the interactions between the production system parameters and their impact on materials handling systems design.
2. To provide students with methods for the generation of plant layouts.
3. To provide students with information on materials handling systems design for various aspects of the manufacturing and service industry.
4. To study about the design of cranes and structural components.
5. To study about the design of belt conveyors.
6. To study about design of bucket and swing tray elevators.

COURSE OUTCOMES

At the end of the course, students will be able to

1. Describe and determine the effect of product, process, and schedule design parameters on plant layout and materials handling systems design.
2. Identify the characteristics of product and process layouts and their needs in terms of materials handling.
3. Develop and analyze plant layouts using manual and computer aided software methodologies.
4. Identify and select various types of material handling equipment.
5. Design material handling systems for a variety of scenarios pertaining to manufacturing and service industry.
6. Apply modern trends in the design of material handling devices.

UNIT I
INTRODUCTION
Development of material handling technology, design objectives, salient features of design, classification and characteristics of materials, types of industrial transport, classification and working principles of materials handling devices.

UNIT II
DESIGN OF CRANES AND STRUCTURAL COMPONENTS
Design of structural components, i.e. trolley, main girder, auxiliary truss, platform truss, end carriage and mechanical components i.e. wire rope, drum, pulley system, crane hook, brakes and drives of electric overhead traveling crane, stability and luffing motion of jib crane, conveyors, layout.

UNIT III
DESIGN OF BELT CONVEYORS
Design of components of belt conveyors, capacity and power requirement of screw conveyors, design of apron, gravity, roller and vibratory conveyors, hydraulic conveyors, layout, industrial installation, elevators,

UNIT IV
DESIGN OF BUCKET AND SWING TRAY ELEVATORS
Design of bucket and swing tray elevators, steel mill cranes, working principles and operations of various types of stripper, charger, ladle and soaking pit cranes, modern trends in the design of material handling devices.

TEXT BOOKS:

1. N.Rudenko, “Material handling equipments”, MIR publishers, 2nd Ed.
2. T. K. Roy, “Mechanical handling of materials”, Asian Books, 2004.

REFERENCE BOOKS:

1. A. Spivakovsky, “Conveyors and related equipments” –MIR Publishers.
2. M.P. Alexandrov, “Materials handling equipment” –MIR Publishers.

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INTELLIGENT INDUSTRIAL AUTOMATION AND ITS APPLICATION
(Effective from the academic year 2019-2020 onwards)

CODE:19RME329

COURSE OBJECTIVES

1. The main objectives of the industry automation system introduction is lesser influence of human factor to technological process;
2. Improved production reliability;
3. Increased production speed and quality;
4. Prevention of emergency situations;
5. Improved production control.
6. Automated process control system (APCS)

COURSE OUTCOMES

1. Student will understand about industry automation system introduction is lesser influence of human factor to technological process;
2. Student will understand about Improved production reliability
3. Increased production speed and quality;
4. Prevention of emergency situations;
5. Improved production control.
6. Student will understand about Automated process control system (APCS)

UNIT I
INTRODUCTION TO INDUSTRIAL AUTOMATION
Intelligent Systems, Hydraulic Actuators for Industrial Automation, Principles and Strategies of Automation, BasicElements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. (SLE: Analysis of Transfer Lines)

UNIT II
MATERIAL HANDLING AND IDENTIFICATION TECHNOLOGIES
Overview of Material Handling Systems,Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods. (SLE: Material Identification Methods)

UNIT III
AUTOMATED MANUFACTURING SYSTEMS
Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation. Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools,Inspection Principles and Practices, Inspection Technologies. (SLE: Usage of SPC tools using excel or Minitab).

UNIT IV
CONTROL TECHNOLOGIES IN AUTOMATION
Industrial Control Systems, Process Industries VersusDiscrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms. Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADASystems& RTU. Distributed Control System: Functional Requirements, Configurations & some popularDistributed Control Systems. (SLE: Display Systems in Process Control Environment.)

UNIT V
AUTOMATION AND INDUSTRIAL CONTROL APPLICATIONS
Electric Drives, Sensors and Vision used for automation, Trajectory planning, Automation Algorithm, Programming and flow control for automation. Modeling and Simulation for Plant Automation: Introduction, need for system Modeling,Building Mathematical Model of a Plant, Modern Tools & Future Perspective. Industrial Control Applications: Cement, Thermal, Water Treatment & Steel Plants. (SLE: Cases Studies minimum one for Cement, Thermal, Water Treatment & Steel Plants applications).

TEXT BOOK:

1. Automation, "Production Systems and Computer Integrated Manufacturing",M.P.Groover, Pearson Education.5th edition, 2009.

REFERENCE BOOKS:

1. "Computer Based Industrial Control"- Krishna Kant, EEE-PHI,2nd edition,2010
2. "An Introduction to Automated Process Planning Systems"- Tiess Chiu Chang & Richard A. Wysk.
3. "Performance Modeling of Automated Manufacturing Systems",-Viswanandham, PHI, 1st edition, 2009.
4. G.S. Hegde, "A Textbook on Industrial Robotics", University Science Press, Second Edition 2008, ISBN 978-81-318-051803

SOFT COMPUTING FOR INTELLIGENT MANUFACTURING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME330

COURSE OBJECTIVES

1. To introducing the fundamental theory and concepts of computational intelligence methods.
2. In particular neural networks,
3. To understand the Fuzzy systems
4. Genetic algorithms and their applications.
5. To understand the area of machine intelligence,
6. vision sensors condition monitoring of manufacturing systems.

COURSE OUTCOMES

1. To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
2. To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems.
3. To understand the fuzzy logic control and other machine intelligence applications of fuzzy logic.
4. To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.
5. To understand the Genetic algorithms and their applications in the area of machine intelligence
6. To understand the vision sensors Condition monitoring of manufacturing systems

UNIT I
INTRODUCTION

Foundations: Stochastic processes; Principal component analysis; Learning theory; Generalization and regularization;

UNIT II
FUZZY LOGIC
Fuzzy set theory, fuzzy rule and fuzzy reasoning, fuzzy relation, fuzzy inference system, fuzzy modeling, Sugneo type fuzzy system; Supervised learning network:

UNIT III
BACK PROPAGATION LEARNING ALGORITHM
Back propagation learning algorithm, Back propagation multi layered perceptron, method for speeding of back propagation, Radial basis function network, Summary; Unsupervised learning: Competititve learning network, Kohenberg self organisng network, LVQ, Hebbian learning, Hopefield network, ART Network;

UNIT IV
ROLE OF SENSORS IN MANUFACTURING AUTOMATION
Operation principles of different sensors - electrical, optical, acoustic, pneumatic, magnetic, electrooptical and vision sensors Condition monitoring of manufacturing systems - principles - sensors for monitoring force, vision, vibration, acoustic, temperature, current and noise, selection of sensors and monitoring techniques ;

UNIT V
APPLICATION OF SOFT COMPUTING TO FAULT DIAGNOSIS AND FAILURE ANALYSIS
Online Tool wear monitoring in turning, drilling, milling operation, Online Dimensional deviation detection in turning, Online roughness evaluation of EDM, ECM process, online measurement of hole straightness in a LBM.

TEXT BOOK:

1. A. Kaufmann and M. M. Gupta, “Introduction to fuzzy arithmetic theory and application”, International Thomson computer press, 1st edition (1991)

REFERENCE BOOKS:

1. S Haykin, “Neural Network”, PHI, 2004
2. G. Onwubolu, E. Butterworth, “Mechatronics Principle and Application”, Heinnmen Pub.

GAS TURBINES AND JET PROPULSION
(Effective from the academic year 2019-2020 onwards)

CODE:16RME331

COURSE OBJECTIVES

1. Students will establish understanding of propulsion systems in aircraft that are essential to graduate engineers.
2. Students are intended to work in aircraft system/component manufacturing/maintenance environments.
3. Students should be able to describe and appreciate the key aeronautical engineering features of the context in which the relevant industry operates.
4. Jet Propulsion, Gas Turbine, Engine Types, Performance, Turbojet and Turbofan Engines, Designs of Compressor, Combustor, and Turbines.
5. Centrifugal fans blowers and compressors.
6. Students will understand the working of various parts of gas turbines.

COURSE OUTCOMES

1. Students will gain skills in problem solving for aircraft propulsion systems, in particular gas turbine engines.
2. Students will gain ability to carry out a cyclic analysis of a gas turbine engine, including turbofan.
3. Students will be able to determine the applicability of a given propeller system for a given aircraft.
4. Students will understand the working of various parts of gas turbines.
5. Students will understand important factors affecting combustion chamber design
6. Students will understand Gas turbine rotors and stresses

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UNIT I
INTRODUCTION
Application, shaft power gas dynamics –Compressibility effect, steady one dimensional compressible flow of a perfect gas in a duct, isentropic flow in a constant area duct with friction, normal shock waves, oblique shock wave, isentropic two dimensional, supersonic expansion and compression.

UNIT II
CENTRIFUGAL FANS BLOWERS AND COMPRESSORS
Principle of operations, work done and pressure rise, slip factor, diffusers, compressibility effects, non dimensional qualities for plotting compressor characteristics. Bray ton cycle, regeneration and reheating cycle analysis ; Axial flow fans and compressors

UNIT III
DESIGN AND PERFORMANCE
Elementary theory, degree of reaction, three dimensional flow, simple design methods, blade design, calculation of stage performance, overall performance, and compressibility effects. Performance characteristics.

UNIT IV
COMBUSTION SYSTEM
Form of combustion, important factors affecting combustion chamber design, combustion processes, combustion chamber performance, practical problem. ; Axial flow turbines: elementary theory, vortex theory, choice of blade profile, pitch and chord ; estimation of stage performance, he cooled turbine.

UNIT V
PREDICTION OF PERFORMANCE OF SIMPLE GAS TURBINES
Component characteristic, off design shaft gas turbine, equilibrium running gas generators, off design o free turbine and jet engine, methods of displacing the equilibrium, running line, incorporation of variable pressure losses, methods of improving part load performance, matching procedure for twin spool engines, behavior of gas turbine. Gas turbine rotors and stresses.

TEXT BOOKS:

1. J.E Lee, “Theory and design of stream and gas turbine”.
2. Cohen & Rogers, “Gas Turbines”

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ALTERNATIVE FUELS FOR IC ENGINES
(Effective from the academic year 2019-2020 onwards)

CODE:19RME332

COURSE OBJECTIVES

1. Study on the fuel system interaction with alternative fuels. Fuels considered should include both proposed fuels as neat fuels and as various types of blends. Questions include
2. Filtering of neat/blends fuels
3. Injection pump operation/control
4. Injector operation/control
5. Fuel solution stability and chemical stability within injection systems including high pressures, temperatures and return flow.
6. Fuel deposits formation in tank, filters, pump and injectors. This also includes deposits influence on spray/combustion.

COURSE OUTCOMES

1. Student will understand about Filtering of neat/blends fuels
2. Student will understand about Injection pump operation/control
3. Student will understand about Injector operation/control.
4. Study on the transport system implications from types of alternative fuels.
5. This includes the powertrain as well as the vehicle configuration.
6. Simulation capability for the systems at various levels to be considered.

UNIT I
ALTERNATE FUELS

Estimation of petroleum reserve - Need for alternate fuel - Availability and properties of alternate fuels – general use of alcohols - LPG - Hydrogen - Ammonia, CNG and LNG - Vegetable oils and Biogas – Solar – Merits and demerits of various alternate fuels ;

UNIT II
PROPERTIES OF ALCOHOLS AND CNG
Properties, alcohols and gasoline blends, performance in SI engine. Methanol and gasoline blends - Combustion characteristics in engines - emission characteristics - Enginemodifications ; Availability of CNG, properties, modification required to use in engines - performance and emission characteristics of CNG using LPG in SI & CI engines.

UNIT III
ENGINE MODIFICATION AND PERFORMANCE
Performance and emission for LPG – Hydrogen – Storage and handling, performance and safety aspects ; Various vegetable oils for engines – Single and dual fuel use – Engine modifications - SVO - Esterification - Performance in engines - Performance and emission characteristics ;

UNIT IV
LAYOUT OF AN ELECTRIC VEHICLE
Layout of an electric vehicle - Advantage and limitations - Specifications - System component.

UNIT V
VEHICLE SYSTEM
Electronic control system - High energy and power density batteries - Hybrid vehicle - Solar powered vehicles.

REFERENCE BOOKS:

1. M. Dayal, “Energy today & tomorrow”, I & B Horishr India, 1982.
2. Nagpal, “Power Plant Engineering”, Khanna Publishers, 1991.
3. “Alcohols and motor fuels progess in technology”, Series No.19, SAE Publication USA 1980 SAE PaperNos. 840367, 841156, 841333, 841334
4. “The properties and performance of modern alternate fuels” - SAE Paper No.841210. SAE Handbook

AIRCRAFT AND ROCKET PROPULSION
(Effective from the academic year 2019-2020 onwards)

CODE:19RME333

COURSE OBJECTIVES

1. Students will establish understanding about gas turbine engine,
2. Thermodynamics of propulsion system, working principles of gas turbine engine
3. Calculation of stage performance and overall performance
4. Limitations of hybrid rockets, Relative advantages of liquid rockets
5. Principles of multistage rocket,
6. Working principles of turbojet cycle

COURSE OUTCOMES

1. Student will understand about Engine performance parameters and Working principles of ideal ramjet cycle
2. Student will understand about working principles of gas turbine engine.
3. Student will understand about Rocket system and aerodynamics of rockets
4. Student will understand about Calculation of stage performance and overall performance
5. Student will understand about working principles of multistage rocket
6. Student will understand about Limitations of hybrid rockets, Relative advantages of liquid rockets

UNIT I
GAS TURBINE ENGINE
Introduction, Rocket system and aerodynamics of rockets, Fundamentals of gas turbine engines, Illustration of working principles of gas turbine engine.

UNIT II

PROPULSION SYSTEM AND OPERATING PRINCIPLE

Thermodynamics of propulsion system, Engine performance parameters, The ramjet cycle, Working principles of ideal ramjet cycle, The turbojet cycle, Working principles of turbojet cycle, Non-ideal turbojet cycle, Axial flow fans and compressors.

UNIT III

CALCULATION OF PERFORMANCE

Polytrophic efficiency of compression, Calculation of stage performance and overall performance, Working principles of turbofan cycle.

UNIT IV

ROCKET PERFORMANCE

Introduction and working principles of multistage rocket, Solid propellant rockets, Liquid propellant rockets ,Thrust control in liquid rockets Cooling in liquid rockets.

UNIT V

HYBRID ROCKETS

Limitations of hybrid rockets, Relative advantages of liquid rockets over solid rockets.

REFERENCE BOOKS:

1. G.C. Oates, “Aerothermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.
2. W.W. Bathie, “Fundamentals of Gas Turbine”s- John Wiley & Sons, 1984.
3. M.L. Mathur, and R.P. Sharma, “Gas Turbine Jet and Rocket Propulsion”, Standard Publishers and Distributors,Delhi, 1988.
4. P.G. Hill, “Mechanics and Thermodynamics of Propulsion”- Addison Wesley, 1970.
5. S.M. Yahya, “Fundamentals of Compressible Flow” - John Wiley, New York, 1982.
6. A.K. Mohanty, “Fluid Mechanics” - Prentice Hall, New Delhi, 2003.

ENERGY CONSERVATION AND MANAGEMENT
(Effective from the academic year 2019-2020 onwards)

CODE:19RME334

COURSE OBJECTIVES

1. To bring out knowledge on Energy Conservation
2. To impart knowledge in the domain of energy conservation.
3. To facilitate a clear conceptual understanding of technical aspects of energy conservation
4. To bring out knowledge on various Energy Sources.
5. To inculcate knowledge and skills about assessing the energy efficiency
6. To facilitate a clear conceptual understanding of commercial aspects of energy conservation

COURSE OUTCOMES

On completion of this course, the students will be able to exhibit

1. Understand the significance and procedure for energy conservation
2. Understand causes and remedies for global energy issues.
3. Opportunity to know the conceptual knowledge of the technology associated with energy conservation
4. Capability to integrate various options of sources from environment regarding energy conservation
5. Knowledge of existing and upcoming industrial utility and energy management theory
6. Skill to identify and learn fields problem in a multi-disciplinary frame

UNIT I

ENERGY SOURCES
Classification and characterization of fuels (fossil and bio-fuel), conversion and utilization, environmental and economic issues, optimum use of energy resources,

UNIT II
BOILERS, ICE and GAS TURBINES
Thermodynamic cycles, Principles of thermal energy conversion in boilers, internal combustion engines and gas turbines, cogeneration and combined cycle power generation.

UNIT III
ENERGY MANAGEMENT
Fuel cells and MHD technology, solar, wind and nuclear power, utilization of industrial heat, Energy management in industry.

UNIT IV
POLLUTION CONTROL
Environmental and economic evaluation advanced pollution control technology.

TEXT BOOKS:

1. R. Gold Stick and A. Thumann, "Principles of Waste Heat Recovery", PHI, 1986.
2. D. Y. Goswami, F. Kreith, "Energy Conversion"- CRC Press, 2007
3. V. Kadambi, and M. Prasad, "Introduction to energy conversion turbo machinery: Energy conversion cycle"-Wiley Eastern, New Delhi, 1974,

SUPERCONDUCTING MATERIALS, MAGNETS AND DEVICES
(Effective from the academic year 2019-2020 onwards)

CODE:19RME335

COURSE OBJECTIVES

1. To provide basic knowledge of superconductivity
2. To observe two of the fundamental properties of superconductors.
3. Describe the main features of a superconductor
4. To deliver emphasis is made on qualitative description, providing basic science background
5. To learn Electricity and magnetism are fundamentally related.
6. To explain how electricity and magnetism work together in electric motors and generators

COURSE OUTCOMES

On completion of this course, the students will be able to:

1. Phenomenological describe the phenomenon of super conduction
2. Explain how superconductors behave in magnetic fields
3. Distinguish between perfect conduction and perfect diamagnetism
4. Explain how observation of a persistent current can be used to estimate an upper limit on the resistivity of a superconductor, and perform calculations related to such estimates
5. Explain why the magnetic flux through a superconducting circuit remains constant, and describe applications of this effect
6. Describe some applications of superconductors in Power Engineering

UNIT I
SUPERCONDUCTORS

Thermal, electrical and magnetic properties of materials at low temperature, Basic properties of superconductors; Type I and Type II superconductors; Tunneling phenomena. Critical current densities and critical magnetic fields of type II superconductors

UNIT II
TECHNIQUES OF PREPARATION OF SUPERCONDUCTING MATERIALS
Magneto-thermal instabilities in type II superconductors; Concept of flux pinning mechanisms. Techniques of preparation of superconducting materials of type NbTi, Nb3Sn, V3Ga and ceramic superconductors in the form of wires and tapes; Stabilization criteria.

UNIT III
SUPERCONDUCTING COIL DEVICES
Superconducting magnets, persistent current switches; Basic concepts of superconducting bearings, motors and energy storage devices. Superconducting thin film devices: negative resistance devices.

UNIT IV
WEAK LINK DEVICES
Weak link devices including SQUIDS and their applications; infrared detectors.

TEXT BOOK:

1. T.H.K Frederking, S.W.K Yuan, "Cryogenic-Low Temperature Engineering & Applied Sciences", Yutopian Enterprises (December 15, 2005).

REFERENCE BOOKS:

1. C. David, SG David, "Handbook of Superconducting Materials" Volume 2, Taylor & Francis Group 2005.
2. Asner, M. Fred, "High Field Superconducting Magnets", Oxford University Press, USA.

AIR SEPARATION AND INDUSTRIAL GASES
(Effective from the academic year 2019-2020 onwards)

CODE:19RME336

COURSE OBJECTIVES

1. To introduce the working principles of three basic methods to achieve low temperature
2. To define fundamentals of mass transfer and analyse mass transfer in two-phase fluid systems
3. To understand properties of cryogenic liquids and solids, refrigeration technologies
4. To Comprehend gas separation and gas purification system
5. To discuss air liquefaction process, industrial gas separation
6. To understand the varying clinical picture created by the gases, based on their physical properties and toxicity

COURSE OUTCOMES

On completion of this course, the students will be able to:

1. Possess basic knowledge of cryogenics.
2. Understand the applications of classical thermodynamics to different cryogenic technologies, gas separation and purification system.
3. Understand the measurement equipment and basic experimental skills, in particular of cryogenic heat transfer.
4. Design experiences for practical cryogenic systems requiring significant consideration of thermodynamics cycles.

5. Knowledge of various chemical engineering separation processes
6. Ability to Select appropriate separation technique for intended problem

UNIT I
PRINCIPLES OF DIFFUSION AND MASS TRANSFER
Fick's Law of Diffusion, Molecular diffusion in fluids, mass transfer coefficients in laminar and turbulent flow; mass, heat and momentum transfer analogies.

UNIT II
INTRODUCTION TO CRYOGENIC GAS SEPARATION AND PURIFICATION SYSTEMS
Principles of absorption, adsorption, condensation and rectification. Adsorption equilibria; types of adsorbant; adsorption/desorption cycles; PSA, TSA; steady state and dynamic adsorption; concept of break point and mass transfer zone; design of fixed bed adsorption system for gas separation and purification.

UNIT III
PHASE EQUILIBRIA AND PHASE RULE
equilibrium stage operation; X-Y, T-X,Y and H-X,Y diagrams and their use; design of rectification columns; different tray assemblies; types of column assemblies for cryogenic rectification;

UNIT IV
GAS SEPARATION
Gas separation using membranes. Linde single column and double column for air separation. Production of argon and rare gases; Air separation processes for different product mixtures. Processes for production of CO_2 , N_2O and C_2H_2, Helium and Hydrogen.

TEXT BOOKS:

1. R. E. Treybal, “Mass Transfer Operations”, Mc Graw-hill Education(Asia), 2003.
2. K.D.Timmerhaus and T.M.Flynn, “Cryogenic Process Engineering”, Plenum Press, 1989.

REFERENCE BOOKS:

1. R.F. Barron, “Cryogenic Systems”, McGraw Hill, 1985.

FUEL CELL TECHNOLOGY
(Effective from the academic year 2019-2020 onwards)

CODE:19RME337

COURSE OBJECTIVES

1. To know essential material for the hydrogen economy
2. To know details of fuel cell technology, in particular the opportunities for using hydrogen
3. To expose the students to the fundamental knowledge required in the development of fuel cell technology
4. To learn hydrogen production technologies with and without CO2 production as a by product
5. To Discuss the design philosophy and challenges to make this power plant economically feasible.
6. To learn how fuel cells are used for every day purposes: road, water and air transport vehicles, portable and stationary use.

COURSE OUTCOMES

On completion of this course, the students will be able to:

1. Have the general knowledge of Fuel Cells as a promising technology in the context of clean power sustainability and alternative fuels for shipping.
2. Know different specific developments on Fuel Cells which are available today.
3. Identify different areas of fuel cell technology.
4. Have the knowledge of production of electricity cleanly and efficiently by using fuel cell
5. Defend the significance of fuel cell technology in the new global energy scenario.
6. Distinguish the expectances of hydrogen as a fuel and energy vector in the context of renewable energy.

UNIT I
INRODUCTION
Overview of current fuel cell technology. Operating principles, fundamental thermodynamics and electrochemistry.

UNIT II
TYPES OF FUEL CELLS AND APPLICATIONS
Proton exchange membrane fuel cells; components; performance; testing. Micro fuel cells. High temperature fuel cells. Modelling of transport phenomena in fuel cells.

UNIT III
HYDROGEN PRODUCTION AND STORAGE.
Fuel cell systems and ancillaries. Overview and status of various fuel cell technologies. Fundamentals: fuel cell thermodynamics; electrode kinetics; performance and efficiency; transport processes.

UNIT IV
FUELLING ISSUES
Proton Exchange Membrane Fuel Cells (PEMFCs). Solid Oxide Fuel Cells (SOFCs). Fuelling issues. Fuel cell systems and applications.

TEXT BOOK:

1. A.V. Da Rosa, 2005, "Fundamentals of Renewable Energy Processes", Elsevier academic press.

REFERENCE BOOKS:

1. W. Vielstich, A. Lamm and H.A. Gastieger, 2003, "Handbook of Fuel Cells", vol. 1-4, John Wiley.
2. G. Hogen ed. 2003, "Fuel Cell Technology Handbook", crc press.

MICRO-MACHINING AND PRECISION ENGINEERING
(Effective from the academic year 2019-2020 onwards)

CODE:19RME338

COURSE OBJECTIVES

1. To Study of various micro machining processes
2. Explain about various materials and technologies
3. To introduce latest topics in Manufacturing like micro machining and smart materials
4. To impart knowledge in the increasing quality concepts of parts, accuracy requirement of machine tools
5. To inculcate specialized knowledge and skill in machining processes using the principles and methods of engineering analysis and design.
6. To explain the principles of manufacturing processes that contribute to the achievement of high precision

COURSE OUTCOMES

On completion of this course, the students will be able to:

1. Aware of different techniques used in micro and nano manufacturing
2. Learn in-depth idea of the conventional techniques used in micro manufacturing
3. sIdentify/control the appropriate process parameters, and possible defects of manufacturing processes
4. Understand the principles of various micro and nano manufacturing methods.
5. Understand nano measuring and positioning systems.
6. Discover the principles applied to the production of modern high-precision machinery

UNIT I

INTRODUCTION TO MICROMACHINING TECHNOLOGIES

Introduction to micromachining technologies, bulk micromachining, LIGA, Surface Micromachining, Characterization of micro-machining, Tool making, Micromachinability of materials.

UNIT II

DIAMOND MICRO-MACHINING

Machining principles, diamond turning, diamond grinding, accuracy and dimensional control, molecular dynamics simulation of the atomic processes in micro-machining, principles of molecular dynamics, atomistic forces of chip formation and surface generation, future trends in ultrahigh speed machining.

UNIT III

MICROELECTRO DISCHARGE MACHINING

Principles of micro-EDM, micro-EDM by Die-sinking and WEDG, micro-WEDM, micro-WEDG, micro-ECM, Principles of micro-turning, micro-drilling and micro-milling, hybrid micro-machining method, on-line measurement by machine vision and integrated probe.

UNIT IV

ABRASIVE MICROMACHINING AND MICRO GRINDING

Abrasive micromachining mechanisms, micro-grinding mechanism, micro-machining rate, micro-machining cooling media. ; Laser micromachining: Principles of laser material removal, laser micro-drilling, laser micro-adjustment, laser surface structuring, laser micro-cutting.

UNIT V

MICRO-MACHINING BY FINISHING TECHNIQUES

Micro-lapping, micro-machining, magneto-abrasive micromachining and finishing (MAF), ELID Grinding. ; Measuring Techniques in micro-machining: stylus instruments, scanning tunneling microscopes, atomic force microscope, measurement of micromoles and slots using optical method, vibro-scanning method, elastic transmission method, computer aided measurement testing and diagnostics, surface integrity and other related measurements.

TEXT BOOKS:

1. J. M. Geough, “Micro-machining of Engineering Materials”, Edited by Marcel Dekker, 2002
2. R.W. Johnstone, M. Parameswaran, “An introduction to surface-micromachining”, Kluwer Academic Publishers, 2004

REFERENCE BOOKS:

1. N. P Mahalik. “Micro-manufacturing and nano-technology”, edited by, Springer Publication, 2006.
2. M. P. Groover, “Automation, Production Systems and Computer-Integrated Manufacturing”, 2003.

FACULTY OF ENGINEERING

DEGREE OF DOCTOR OF PHILOSOPHY
IN
BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

(REGULAR PROGRAMME)

CURRICULUM & SYLLABI
(2019 -2020)

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KARPAGAM ACADEMY OF HIGHER EDUCATION

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FACULTY OF ENGINEERING

DEGREE OF DOCTOR OF PHILOSOPHY IN BIOTECHNOLOGY (Ph.D)

REGULAR PROGRAMME

REGULATIONS (2019)

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KARPAGAM ACADEMY OF HIGHER EDUCATION

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FACULTY OF ENGINEERING

DOCTOR OF PHILOSOPHY (Ph.D.)

REGULATIONS 2019

These regulations are effective from the academic year 2019-2020 and applicable to the candidates admitted to Ph.D. during 2019-2020 and onwards.

I. ELIGIBILITY CRITERIA

First class or 55% marks (50% marks for SC/ST), in M.Tech degree in Biotechnology or in related disciplines.

II. MODE OF SELECTION

The guidelines as given in the Regulations for M.Phil.,/ Ph.D., of Karpagam Academy of Higher Education are applicable.

III. PROGRAMME STRUCTURE AND RESEARCH WORK

Upon successful completion of the degree, the candidate will be conferred with the degree of Doctor of Philosophy (Ph.D.) in Biotechnology under the Faculty of Engineering.

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PART – I COURSE WORK SYLLABUS FOR Ph.D COURSE IN BIOTECHNOLOGY (2019-2020)

SL.NO	TITLE OF THE COURSE	NO. OF SUBJECT	C	EXAM. HRS	MARKS
1	PAPER I	01	4	3	100
2	PAPER II	01	4	3	100
3	PAPER III	01	4	3	100
	TOTAL	03	12	9	300

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PART – I COURSE WORK SYLLABUS FOR Ph.D COURSE IN BIOTECHNOLOGY (2019-2020)

SUB.CODE	TITLE OF THE COURSE	CREDITS	EXAM HRS	MARKS
PAPER - I (COMPULSORY)				
19RBTE101	Research Methodology and Pedagogy	4	3	100
PAPER - II (ANY ONE)				
19RBTE201	Advances in Biotechnology	4	3	100
19RBTE202	Clinical Biochemistry	4	3	100
19RBTE203	Instrumental methods of Analysis in Bio-technology	4	3	100
19RBTE204	Biophysics and Structural Biology	4	3	100
19RBTE205	Advances in Plant Genetic Engineering	4	3	100
PAPER - III (ANY ONE)				
19RBTE301	Advances in Microbial Technology	4	3	100
19RBTE302	Bioprocess Modelling and Simulation	4	3	100
19RBTE303	Molecular Modeling and Drug Designing	4	3	100
19RBTE304	Nanobiotechnology	4	3	100
19RBTE305	Environmental Biotechnology	4	3	100
19RBTE306	Pharmaceutical Biotechnology	4	3	100
19RBTE307	Advanced Systems Biology	4	3	100
19RBTE308	Advances in Cancer Biology	4	3	100
19RBTE309	Advanced Drug Delivery Systems	4	3	100
19RBTE310	Cell Culture Techniques	4	3	100

19RBTE101 **Research Methodology and Pedagogy** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

1. To impart the knowledge in concept of applied and basic research.
2. To familiarize with basic of research and the research process.
3. To extend the knowledge in questionnaire design, survey and data sources.
4. To understand the sampling techniques and its usage.
5. To describe the concepts of statistics and probability designs.
6. To enrich the knowledge in writing a good research report.

Course Outcomes

1. Explain the concept of applied and basic research.
2. Construct the basic of research and the research process.
3. Summarize the questionnaire design, survey and data sources.
4. Perform the sampling techniques and its usage.
5. Discuss the concepts of statistics and probability designs.
6. Illustrate the steps in writing a good research report.

UNIT – I

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Need for theoretical frame work –Research Strategies – Ethics – code of conduct for research – Health and Safety - IPR.

UNIT – II

Research Events – Networks – Outreach Activities – Best Research Practices – Quality Assurance for Research – Journal Critiques - Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables – Validity testing of scales – Reliability concept in scales being developed – Stability Measures.

UNIT – III

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and non-probabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size.

UNIT – IV

Introduction to Statistics – Probability Theories - Conditional Probability, Poisson Distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi-Square Test, Association of Attributes - t-Test –ANOVA- Standard deviation - Co-efficient of variations. Co-relation and Regression Analysis. Purpose of the written report - Concept of audience - Basics of written reports. Research Report: Types of reports- contents - styles of reporting - steps in drafting reports - editing the final draft - Evaluating the final draft.

UNIT - V

Objectives and roll of higher education – important characteristics of an effective lecture – Quality teaching and learning – lecture preparation – characteristics of instructional design – Methods of teaching and learning : large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing demonstration, Brain Storming, Case Discussion, assignment, methods of evaluation – Self Evaluation, student evaluation, Diagnostic testing and remedial teaching – Question Banking – Electronic media in education: e-learning researches – web based learning.

SUGGESTED READINGS:

1. Cooper, D. R., Schindler, P. S., & Sun, J. (2006). Business research methods (Vol. 9). New York: McGraw-Hill Irwin.
2. Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.
3. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
4. McBurney, D. H., & White, T. L. (2009). Research methods. Cengage Learning.
5. Ticehurst, G.W. & Veal, A.J. (2000). Business Research Methods, Managerial approach. Pearson Education.
6. Kumar Ranjit. (2005). Research Methodology. 2nd Edition. Pearson Education.
7. Thietart, R. A. (2001). Doing management research: a comprehensive guide. Sage.

19RBTE201 **Advances in Biotechnology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

1. To understand the production of transgenic plants.
2. To outline the general bioprocess plant design.
3. To study the geneotypic frequencies in population.
4. To discuss the different biological databases.
5. To acquire knowledge in protein sequence and structure.
6. To illustrate the case studies in advanced biotechnology

Course outcomes

1. Explain the production of transgenic plants.
2. Demonstrate the general bioprocess plant design.
3. Discuss the geneotypic frequencies in population.
4. Analyse the different biological databases.
5. Apply the knowlege in protein sequence and structure analysis.
6. Perform the case studies in advanced biotechnology

UNIT – I

Production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, drought and other abiotic stress resistance; quality parameters: nutraceuticals, edible vaccines, Applications of gene pyramiding and RNAi technology.

UNIT – II

General Bioprocess plant design information, design facilities for cleaning of process equipment used in bioprocess industries, Utilities for biotechnology production plants, Bioprocess validation, Safety considerations, Process economics. Process technology of: clavulanic acid, macrolides, and lipases production.

UNIT – III

Population vs individual; Dynamics of population; Gene and genotypic frequencies; Hardy-Weinberg equilibrium; Homeostasis- genetic and developmental; Co-adapted and integrated gene pool. Approach to equilibrium under random mating-single autosomal locus with two alleles; Single sex-linked locus; Two pairs of autosomal linked and unlinked loci; Linkage as a cause of correlation; Population mean and variance under different situations; Estimation of number of loci governing a metric trait; Average effect, average effect of gene substitution.

UNIT – IV

Types of biological data, Biological Databases: Nucleic acid and protein sequence and protein structure databases, Bioinfo tools DNA sequence analysis (DSA) Sequence annotations and sequence analysis - Phylogeny of gene (blast, fasta, HMMer) and residue conservation. Primer design and Tm Calculation, DNA Restriction pattern analysis. Protein sequence and structure insights (PSSI): X-ray, NMR, Comparative modeling, ab initio, threading methods. Structure refining techniques Energy minimization approaches (Steepest descent, Conjugate gradient etc), Basis of Molecular dynamics simulations and its application

UNIT – V

Case study on fast and accurate development and production of vaccines and drugs; Case study on tissue engineering and personalized therapies in regenerative medicine.

SUGGESTED READINGS

1. Chrispeels, M.J., & Sadava, D.E. (2003). Plants Genes and Crop Biotechnology, 2nd Edition, American Society of Plant Biologists, Jones and Bartlett Publishers, USA.
2. Buchanan, B. B., Gruissem, W., & Jones R. L. (2015). Biochemistry and Molecular Biology of Plants, 2nd Edition, American Society of Plant Biologists, USA.
3. Crow, J. F., & Kimura, M. (2070). An Introduction to Population Genetics Theory. Harper & Row.
4. Falconer, D. S., & Mackay, T. F. C. (2004). An Introduction to Quantitative Genetics. 4th Edition, Longman.
5. Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis. 2nd Edition, CSHL Press.
6. Baxevanis. & Ouellette, F. B. F. (2004). Bioinformatics: a practical guide to the analysis of genes and proteins. 3rd Edition, John Wiley.
7. Pevsner, J. (2015). Bioinformatics and Functional Genomics. 3rd Edition, Wiley-Liss.
8. Various research and review journals like Nature Biotechnology, Current Opinion, Trends and Annual Reviews

19RBTE202 **Clinical Biochemistry** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To understand the diagnosis and monitoring of different diseases.
- To analyze the level of different biomolecules.
- To understand the molecular basis of diseases and its diagnostics techniques.
- To describe the techniques used in clinical chemistry.
- To discuss the molecular basis of tumour cell
- To acquire knowledge about infectious diseases.

Course outcomes

- Outline the diagnosis and monitoring of different diseases.
- Summarize the level of different biomolecules.
- Discuss the molecular basis of diseases and its diagnostics techniques.
- Explain the techniques used in clinical chemistry.
- Elaborate the molecular basis of tumour cell
- Conclude the different infectious diseases.

UNIT- I

Use of enzymes in the diagnosis and monitoring of myocardial infarction, liver diseases, pancreatic diseases and kidney diseases. Normal and abnormal serum values of the enzymes and their significance, acid and alkaline phosphatase, SGOT, SGPT, α-amylase, LDH, creatine kinase, troponin T, cystatin C.

UNIT- II

Normal and abnormal constituents of blood, glucose, urea, uric acid, creatinine, bilirubin, and proteins. Lipid profile and its significance. Blood groups, Rh factor compatibility and blood transfusion. Hemoglobinopathies: anaemia, thalassemia, sickle cell anemia.

UNIT III

Types of jaundice, molecular basis and biochemical assessment, viral hepatitis, alcoholic hepatitis, cirrhosis. Cardiac diseases: Ischemic heart disease, angina pectoris, myocardial infarction. Cardiac profile tests, atherosclerotic plaques. Biochemical and other techniques used in clinical chemistry ELISA, RIA, IRMA. Noninvasive techniques used in clinical practice, sonography, X-ray, MRI, CT Scan, ECG.

UNIT IV

Molecular basis – cell cycle checkpoints, carcinogenesis, oncogenes, tumor suppressor genes, benign and malignant, metastasis, tumor markers and tumor staging.

UNIT V

Infectious diseases at the outset of 21st century like AIDS, SARS, and Dengue. Inborn errors of metabolism, metabolic disorders: diabetes, dyslipidemia, Phenylketonuria.

SUGGESTED READINGS:

1. Benjamin, E. (2015). Immunology – A Short Course, 7th Edition. Wiley – Liss Inc.
2. Roitt, M. I. (2015). Essential Immunology. 13th Edition. Wiley.
3. Farmer, R.D.T., & Miller, D.L. (2083). Lecture notes on Epidemiology and Community Medicines. 2nd Edition. Oxford, Blackwell Scientific, Blackwell Mosby.
4. Weir, D. (2078). Handbook of Practical Immunology (Vol. 2, 3 & 5). 3rd Edition. Wiley Blackwell.
5. Stites, D. P., & Terr, A. I. (2094). Basic and Clinical Immunology. 8th Edition.Prentice-Hall International.
6. Cheremisinoff, P. N., & Ferrante, L. M. (2091). Biotechnology: Current Progress (Vol. 1). Technomic Publishing Co. Inc.
7. Dey, N. C. & Dey, T. K. (2007). Medical Bacteriology and AIDS. New Central Book Agancy (P) Ltd.

19RBTE203 Instrumental methods of Analysis in Bio-technology 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To explain the concepts of chromatography.
- To discuss the instrumentation of various microscopes.
- To understand the concept and instrumentation of protein separation techniques.
- To acquire knowledge in different methods of electrophoresis.
- To describe the principles and application of Spectroscopic methods.
- To outline the molecular biology techniques and its applications.

Course Objectives

- Describe the concepts of chromatography.
- Outline the instrumentation of various microscopes.
- Explain the concept and instrumentation of protein separation techniques.
- Discuss the different methods of electrophoresis.
- Elaborate the principles and application of Spectroscopic methods.
- Illustrate the molecular biology techniques and its applications.

UNIT-I
Chromatography – adsorption, affinity, partition (GLC, GC, HPLC, TLC, RPC)

UNIT- II.
Microscopic identification of various microorganisms; phase contrast and confocal microscopy: SEM-TEM microscopy.

UNIT III
Protein Separation – Extraction, Precipitation and differential solubilisation, ultracentrifugation; Electrophoresis of proteins and nucleic acids - 1D & 2D Gels, pulse -field electrophoresis; capillary electrophoresis; western blotting; gel documentation. Different methods of electrophoresis for proteins, nucleic acids, small molecular weight compounds and immunoprecipitates.

UNIT IV

Introduction to principles and applications of Spectroscopic methods UV-Vis, IR, Fluorescence, Optical Rotatory Dispersion, Circular Dichroism, Photo acoustic Infrared, NMR, Electron Spin Resonance, mass spectrometry; Fluorescence Activated Cell Sorting.

UNIT V

DNA Purification, PCR-based analysis; DNA fingerprinting; DNA sequencing.

SUGGESTED READINGS:

1. Clarence, H. S (2093). Methods of Biochemical Analysis: Bioanalytical Instrumentation, Volume 37, 1. John Wiley & Sons.
2. Rouessac, F., & Rouessac, A. (2013). Chemical analysis: modern instrumentation methods and techniques. John Wiley & Sons.
3. Tkachenko, N. V. (2006). Optical spectroscopy: methods and instrumentations. Elsevier.

19RBTE204 **Biophysics and Structural Biology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To describe the fundamentals of biophysics.
- To iilustrate principle and mechanism of different biomolecular structure determination techniques.
- To analyze the structure of proteins.
- To study different Structural implications.
- To acquire knowledge in radiation biology.
- To summarize the biomedical applications.

Course Outcomes

- Outline the fundamentals of biophysics.
- Elaborate the principle and mechanism of biomolecular structure determination techniques.
- Illustrate the structure of proteins and tell its significance.
- Explain the different structural implications.
- Discuss the concept of radiation biology.
- Explain the biomedical applications.

UNIT-1

Scope and definition of Biophysics. Biophysics at macroscopic, microscopic level and at the molecular level. Biophysical Chemistry: structure of atoms, molecules; energy, structure of atoms and molecules, elementary quantum mechanics, stereochemistry, molecular orbitals & chirality.

Unit-II

Diffusion, sedimentation, electrophoresis, separation techniques, Biomolecular structure determination using X-ray diffraction, electron microscopy, IR - Raman and laser spectrometry, UV-visible spectroscopy, CD, ORD, NMR, model building, computer simulation and graphics.

Unit-III

Structure of proteins. nucleic acids; membranes, action of other biologically important molecules and molecular assemblies like ribosomes, nucleosomes; functional significance of structure. CONFORMATIONAL ANALYSIS: Van der Waals radii of atoms (equilibrium separation between non covalently bonded atoms) –contact distance criteria; Noncovalent forces determining biopolymer structure; dispersion; forces; electrostatic interactions; van der Waals interactions; hydrogen bonds; hydrophobic interactions; distortional energies; description of various interactions by potential functions; principles of minimization of conformational energy.

UNIT-IV

Structural implications of the peptide bond; rigid planar peptide unit; cis and trans configuration; conformations of a pair of linked peptide units; torsion angles phi and psi -steric hindrance; hardsphere approximation; allowed and disallowed conformations; Ramachandran Diagram; conformational maps for glycine and other natural amino acids; conformationally constrained amino acids and their importance.

UNIV-V

Radiation Quantities; units and definitions; Radiation measurement; Radiation Biology of Normal tissue system; Biological effects of ionizing radiation; structural changes in chromosomes; Gene mutation; metabolism and biological effects of radionuclide; Radiation hazards; Evaluation control and regulatory aspects of radiological safety; disposal of radioactive waste; Physics of laser - different types of lasers - biomedical applications –CT scan - ultra sonography. NMR Imaging – Principles – Applications.

SUGGESTED READINGS

1. Pattabhi, V & Gautham, N (2008). Biophysics: 2nd Revised Edition, Alpha Science International Ltd.
2. Alpen, E. L. (2097). Radiation biophysics. Academic Press.
3. Attwood, T.K. & Parry-Smith, D.J (2001). Introduction to Bioinformatics, 1st Edition, Benjamin Cummings.
4. Gautham, N. (2006) Bioinformatics – Data bases and Algorithms, 1st Edition, Narosa Publications.
5. Stout, G. H. (2089). L. H, Jensen," X-Ray Structure Determination-A Practical Guide".
6. Hammond, C. (2015) .The Basics of Crystallography & Diffraction, 4th Edition, IUCr – Oxford University Press.

19RBTE205 **Advances in Plant Genetic Engineering** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To understand the basic concepts in rDNAtechnology.
- To understand the concept of transgenic plants.
- To outline the concepts of genetic engineering involved in plant corps.
- To explain about the Molecular farming of plants.
- To perform the Field studies with transgenic crops.
- To summarize the case studies on the development of genetically modified ornamental plants

Course Outcomes

- Discuss the knowledge on the basics of rDNAtechnology.
- Outline the concept of transgenic plants.
- Elaborate the concepts of genetic engineering involved in plant corps.
- Discuss the Molecular farming of plants.
- Summarize the Field studies with transgenic crops.
- Compile the case studies on the development of genetically modified ornamental plants

UNIT I

General overview of transgenic plants; vector construction; Recent developments in plant transformation strategies; Role of antisense and RNAi-based gene silencing in crop improvement; Regulated and tissue-specific expression of transgenes for crop improvement; Gene stacking; Pathway engineering; Marker-free transgenic development strategies; High throughput phenotyping of transgenic plants.

UNIT II

Genetic control of plant growth and development; Genetic engineering in crop plants against insects/pests and abiotic stresses (Cold, temperature, submergence, salinity and drought) Engineering food crops for quality, Genetically engineered pollination control, Induction of male sterility in plants.

UNIT III

Molecular farming of plants for applications in veterinary and human medicine systems:

Boosting heterologous protein production in transgenics, Rapid production of specific vaccines, High-yield production of therapeutic proteins in chloroplasts.

UNIT IV

Field studies with transgenic crops; Environmental issues associated with transgenic crops; Food and feed safety issues associated with transgenic crops; Risk assessment of transgenic food crops.

UNIT-V

Case studies on the development of genetically modified ornamental plants, peptide hormone in plants, plant derived vaccines, secondary metabolites production (artemisinin, paclitaxel and scopolamine) and advancement of biolistic in the improvement of plant growth.

SUGGESTED READINGS

1. Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants. John Wiley & Sons.
2. Lewin, B. (2008) Gene IX. Peterson Publications, Panima.
3. Malacinski, G. M. (2005). Essentials of molecular biology. Jones & Bartlett Learning.
4. Nelson, D. L., & Cox, M. M. (2012). Absolute Ultimate Guide for Lehninger Principles of Biochemistry. WH Freeman and Company, New York, NY.
5. Baker, T. A., Watson, J. D., Bell, S. P., Gann, A., Losick, M. A., & Levine, R. (2008). Molecular biology of the gene. Benjamin-Cummings Publishing Company.
6. Christou, P., & Klee, H. (2004). Handbook of plant biotechnology (No. LC-0239). John Wiley and Sons.

19RBTE301 Advances in Microbial Technology 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To illustrate the basic concepts of bioprocessing technology.
- To explain the immobilization of enzymes and cells.
- To discuss the current advances in production of bioproducts.
- To understand the production of non-microbial origin products
- To outline the concept of probiotics and applications of new tools of biotechnology.
- To perform the case study on the application of microbial technology

Course Outcomes

- Explain the basic concepts of bioprocessing technology.
- Elaborate the immobilization of enzymes and cells.
- To discuss the current advances in production of bioproducts.
- Discuss the production of non-microbial origin products
- Enumerate the concept of probiotics and applications of new tools of biotechnology.
- Criticize the case study on the application of microbial technology

UNIT I

Fermentative metabolism and development of bioprocessing technology, processing and production of recombinant products; isolation, preservation and improvement of industrially important microorganisms.

UNIT II

Immobilization of enzymes and cells; Batch, plug flow and chemostat cultures; Computer simulations; Fed-batch and mixed cultures; Scale-up principles; Downstream processing etc.

UNIT III

Current advances in production of antibiotics, vaccines, and biocides; Steroid transformation; Bioreactors; Bioprocess engineering; Production of non-microbial origin products by genetically engineered microorganisms.

UNIT IV

Concept of probiotics and applications of new tools of biotechnology for quality feed/food production; Microorganisms and proteins used in probiotics; Lactic acid bacteria as live vaccines; Factors affecting delignification; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Single cell protein, Bioinsecticides; Biofertilizers; Recent advances in microbial biotechnology.

UNIT V

Case study on the application of microbial technology used in bioremediation of urban polluted river; Microbial EOR technology; Culture free detection and identification of unknown RNA viruses; Case study on the genetic epidemiology with MiSeq.

SUGGESTED READINGS:

1. Barredo, J. L. (Ed.). (2005). Microbial processes and products(Vol. 18). Humana Press.
2. Glazer, A. N., & Nikaido, H. (2007). Microbial biotechnology: fundamentals of applied microbiology. Cambridge University Press.
3. Perlman, D. (Ed.). (2079). Microbial Technology: Microbial Processes. Elsevier.
4. Braun,V., & Gotz, F.(2002). Microbial Fundamentals of Biotechnology. Wiley-VCH
5. Saunders, V. A. (2012). Microbial genetics applied to biotechnology: principles and techniques of gene transfer and manipulation. Springer Science & Business Media.
6. Harzevili, F. D., & Chen, H. (Eds.). (2014). Microbial Biotechnology: Progress and Trends. CRC Press.
7. Shukla, P. (Ed.). (2017). Microbial Biotechnology: An Interdisciplinary Approach. CRC Press.

19RBTE302 **Bioprocess Modeling and Simulation** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To understand the Modeling approaches for Biological systems
- To study the mass transfer concepts in bioprocess.
- To illustrate the modeling of different bioreactors.
- To acquire knowledge in linear and non linear systems
- To perform case study of recombinant protein production.
- To discuss the advanced modeling techniques in bioprocess.

Course Outcomes

- Explain the Modeling approaches for Biological systems
- Interpret the mass transfer concepts in bioprocess.
- Elaborate the modeling of different bioreactors.
- Describe the linear and non linear systems using MATLAB.
- Compile the case study of recombinant protein production.
- Outline the advanced modeling techniques in bioprocess

UNIT I

Modeling Principles, model development from first principles. Modeling approaches for Biological systems – structured and unstructured systems; Compartment models; Deterministic and stochastic approaches for modeling structured systems.

UNIT II

External mass transfer, Internal diffusion and reaction within biocatalysts, derivation of finite model for diffusion-reaction systems, dimensionless parameters from diffusion-reaction models, the effectiveness factor concept, case studies; oxygen diffusion effects in a biofilm, biofilm nitrification

UNIT III

Bioreactor modelling: Ideal and non-ideal bioreactors; Stirred tank models; characterization of mass and energy transfer distributions in stirred tanks, Tower Reactor Model; Flow modeling, bubble column flow models, mass transfer modeling, structured models for mass transfer in tower reactors, process models in tower reactors, airlift models,

UNIT IV

Study of linear systems, linearization of non-linear systems; Simulation of linear models using MATLAB; Parameter estimation and sensitivity analysis; Steady state and unsteady state systems; stability analysis; Case study of recombinant protein production.

UNIT V

Advanced modeling techniques such as fuzzy logic, neural network, hybrid systems and fuzzy logic systems; case studies.

SUGGESTED READINGS:

1. Bequette, B. W. (2098). 'Process Dynamics: Modeling, Analysis and Simulation'. Prentice-Hall.
2. Elnashaie, S. S., & Garhyan, P. (2003). Conservation equations and modeling of chemical and biochemical processes. CRC Press.
3. Dunn, I. J. (2005). 'Biological Reaction Engineering: Dynamic Modeling Fundamentals with Simulation'. Wiley-VCH.

19RBTE303	**Molecular Modeling and Drug Designing**	**4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**

End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To explain the concepts of molecular Simulation Techniques.
- To interpret the molecular dynamics methods for the integration of dynamical equations
- To acquire knowledge in molecular mechanics
- To discuss the rational basis of drug designing.
- To describe the computer based tools for drug designing.
- To analyse the molecular modeling in drug design.

Course outcomes

- Elaborate the concepts of molecular Simulation Techniques.
- Illustrate the molecular dynamics methods for the integration of dynamical equations
- Explain about molecular mechanics
- Outline the rational basis of drug designing.
- Discuss the computer based tools for drug designing.
- Explain the molecular modeling in drug design.

UNIT-1

Introduction to molecular Simulation Techniques-Monte Carlo Methods-Metropolis Monte Carlo Algorithm, Flow calculations in Metropolis Monte Carlo Algorithm with examples- Ising Lattice, Gibbs Ensemble Monte Carlo Simulations. Molecular Dynamics Methods-different methods for the integration of Dynamical Equations, Molecular Dynamics of rigid non linear poly atomic molecules in other ensembles, Structural information from M.D.

UNIT-II

Molecular mechanics, Energy minimization, intra molecular interactions, Physicochemical parameters in drug design Ionization constants, chelation, solubility and partition Co- efficient. Over view of Molecular Descriptors.

UNIT-III

Rational basis of drug designing, criteria for synthesizing drugs, Drug designing approaches-Phamacophore based drug design- lead and target tissues, lead finding and lead optimization, action and reaction, Structure based drug design process of Structure based design, Receptor based design-drug designing using known receptor structure, design of energy inhibitors.

UNIT-IV

Overview of computer based tools for drug designing- Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools, scoring and Docking mode, QSAR principles and Methods in drug designing. Current research in drug designing- a case study.

UNIT – V

Molecular Modelling in drug design: A Case study - Antiviral and Anticancer drug discovery, Recent Advances in the molecular simulation of Drug discovery process, molecular dynamics in personalized medicines.

SUGGESTED READINGS:

1. Leach, A. R. (2001). Molecular Modelling, Principles and application. 2nd Edition. Prentice Hall.
2. Krogsgaard, L. (2002). Text Book of Drug Design and Discovery. Taylor & Francis, London.
3. Walsh, G. (2003). Biopharmaceuticals-Biochemistry and Biotechnology. Wiley.
4. Scolnick, J. (2001). Drug Discovery and Design. Academic Press, London.
5. Cohen, N. C. (2096). Guidebook on Molecular Modeling in Drug Design. 1st Edition. Academic Press, San Diego.

19RBTE304 **Nanobiotechnology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To explain basic knowledge on nanoscience and nanotechnology.
- To explain the types of nanomaterials.
- To demonstrate the different lithography techniques..
- To discuss the methods for the measurement of nanomaterials.
- To explain the properties of DNA and motor proteins.
- To outline the properties of nanocarriers.

Course Outcomes

- Explain the basics of nanoscience and nanotechnology.
- Compile and compare the different types of nanomaterials.
- Discuss the different lithography techniques..
- Elaborate the methods for the measurement of nanomaterials.
- Outline the properties of DNA and motor proteins.
- Summarize the properties of nanocarriers.

UNIT I

Introduction to Nanoscience and Nanotechnology; Milestones in Nanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales.

UNIT II

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Biosynthesis of nanomaterials.

UNIT III

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

UNIT IV

Properties of DNA and motor proteins; Lessons from nature on making nanodevices; Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires; Nanofluidics to solve biological problems.

UNIT V

Properties of nanocarriers; drug delivery systems used in nanomedicine; Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology.

SUGGESTED READINGS:

1. Niemeyer, C. M., & Mirkin, C. A. (Eds.). (2004). Nanobiotechnology: concepts, applications and perspectives (Vol. 1). John Wiley & Sons.
2. Shoseyov, O., & Levy, I. (Eds.). (2008). Nanobiotechnology: bioinspired devices and materials of the future. Springer Science & Business Media.
3. Rosenthal, S. J., & Wright, D. W. (Eds.). (2005). NanoBiotechnology protocols (Vol. 1). Totowa: Humana Press.
4. Singh, D. K. (2008). Fundamentals of manufacturing engineering. CRC Press.
5. Clarke, A., Eberhardt, C. N., & Eberhardt, C. (2002). Microscopy techniques for materials science. Woodhead Publishing.

19RBTE305 **Environmental Biotechnology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To understand the overview of ecological system
- To explain the types of pollution and its control measures.
- To discuss the modes of biological treatment methods for wastewater
- To acquire knowledge about industrial waste management.
- To describe the molecular tools for environmental management.
- To outline the alternate source of energy.

Course Outcomes

- Explain the ecological system and other biological reactions to protect the environment.
- Describe the types of pollution and its control measures.
- Elaborate the modes of biological treatment methods for wastewater
- Outline the process for industrial waste management.
- Illustrate the molecular tools for environmental management.
- Summarize the available alternate source of energy.

UNIT I

Microbial flora of soil, Ecological adaptations, Interactions among soil microorganisms, biogeochemical role of soil microorganisms. Biodegradation, Microbiology of degradation and its mechanism, Bioaugmentation, Biosorption, Bioleaching, Bioremediation- Types of Bioremediation, Bioreactors for Bioremediation, Metabolic pathways for Biodegradation for specific organic pollutants.

UNIT II

Pollution- Sources of pollutants for Air, Water (ground water, marine), Noise, Land and its characteristics- Pollution control and management- Environmental monitoring & sampling, Physical, chemical and biological methods and analysis- Air pollution- control and treatment strategies. Modes of Biological treatment methods for wastewater- aerobic digestion, anaerobic digestion, Anoxic digestion, the activated sludge process, Design and modeling of activated sludge processes, Aerobic digestion, Design of a trickling biological filter, Design of anaerobic digester.

UNIT III

Industrial waste management- Dairy, Paper & Pulp, Textile, leather, hospital and pharmaceutical industrial waste management, e-waste- radioactive and nuclear power waste management- Solid waste management.

UNIT IV

Molecular biology tools for Environmental management, rDNA technology in waste treatment, Genetically modified organisms in Waste management, Genetic Sensors, Metagenomics, Bioprospecting, Nanoscience in Environmental management, Phytoremediation for heavy metal pollution, Biosensors development to monitor pollution.

UNIT V

Alternate Source of Energy, Biomass as a source of energy, Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biofuels, Biomineralization, Bioethanol and Biohydrogen, Bioelectricity through microbial fuel cell, energy management and safety.

SUGGESTED READINGS

1. Chakrabarty K.D., Omen G.S., (2090). Biotechnology And Biodegradation, Advances In Applied Biotechnology Series (Vol.1). Gulf Publications Co. London.
2. Eddy, M. (2091). Wastewater engineering: treatment, disposal and reuse. 2nd Edition. McGraw-Hill, New York, USA.
3. Forster, C. F., & Waste, D.A.J., (2087). Environmental Biotechnology. Ellis Harwood Halsted Press.
4. Bailey, J. E. & Ollis, D. F., (2086). Biochemical Engineering Fundamentals. 2nd Ed. Mc Graw Hill, New York.
5. Scragg Alan. (2005). Environmental Biotechnology. Longman.
6. Old R.W., & Primrose, S.B., (2006). Principles of Gene Manipulation and Genomics. 7th Edition. Blackwell Science Publication. Cambridge.
7. Bruce E. Rittmann, Eric Seagren, Brian A. Wrenn & Albert J. Valocchi, Chittaranjan Ray, Lutgarde Raski. (2091). In-situ Bioremediation. 2nd Edition. Nayes Publication. U.S.A.

19RBTE306 **Pharmaceutical Biotechnology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100 Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To understand the foundation and advanced information on biopharmaceutical aspects in relation to drug development.
- To describe the classification of dosage forms.
- To understand the basics of pharmacokinetics.
- To analyze the advanced drug delivery systems.
- To explain the different classes of therapeutics,
- To acquire knowledge in different immune components.

Course Outcomes

- Compile the foundation and advanced information on biopharmaceutical aspects in relation to drug development.
- Explain the classification of dosage forms.
- Elaborate the basics of pharmacokinetics.
- Illustrate the advanced drug delivery systems.
- Describe the different classes of therapeutics,
- Outline the role of different immune components.

UNIT I

History of pharmaceutical industry, Drugs discovery and Development phases; Drugs and Cosmetics ACT and regulatory aspects; Definition: Generics and its advantages; Biogenerics and Biosimilars; The role of patents in the drug industry; Protein-based biopharmaceuticals; International Non-proprietary Names (INN) nomenclature system biosimilars regulation

UNIT II

Definition of Dosage forms, Classification of dosage forms (solid unit dosages – Tablets, capsules; liquids – solutions, lotions, suspension etc; semi-solid – ointments, creams, gel, suppositories, etc; Parenterals, Aerosols etc), Introduction to pharmacokinetics and pharmacodynamic principles (factors affecting the ADME process); bioavailability, bioequivalence.

UNIT III

Advanced drug delivery systems – controlled release, transdermals, liposomes and drug targeting. Approaches to the characterization of biosimilars; Problems in characterizing biologics (Types of biologic, Peptides, Non-glycosylated proteins, Glycosylated proteins, Monoclonal antibodies); Equivalence issues; Post-translational modifications; Effect of micro heterogeneity.

UNIT IV

Understanding principles of pharmacology, pharmacodynamics Study of a few classes of therapeutics like laxatives, antacids and drugs used in peptic ulcers, drugs used in coughs and colds, analgesics, contraceptives, antibiotics (folate inhibitors, protein synthesis inhibitors, DNA inhibitors), hormonal agonists and antagonists.

UNIT V

Erythropoietin, Insulin, Somatotropin, Interleukin-2, Interferon Granulocyte- macrophage CSF, Factor VIIa, Factor IX, Factor VIII, Tissue plasminogen activator, Monoclonal antibodies and engineered Mabs

SUGGESTED READINGS:

1. Thomas, G. (2011). Medicinal chemistry: an introduction. John Wiley & Sons.
2. Katzung B.G,(2012) 'Basic and Clinical Pharmacology', 12th Edition., PHI.
3. Ramabhadran, T. V. (2005). Pharmaceutical design and development: a molecular biology approach. CRC Press.
4. Barker, E. L. (2006). Goodman & Gilman's The Pharmacological Basis of Thera-peutics. Pharmaceutical Research, 20(4), 564-565.
5. Niazi, S. K. (2002). Handbook of biogeneric therapeutic proteins: regulatory, manufacturing, testing, and patent issues. CRC Press.
6. Ho, R. J. (2013). Biotechnology and biopharmaceuticals: transforming proteins and genes into drugs. John Wiley & Sons.
7. Brahmankar, D. M., & Jaiswal, S. B. (2005). Biopharmaceutics and pharmacokinetics: A treatise. Vallabh prakashan.

19RBTE307 **Advanced Systems Biology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To understand the basic concepts in systems modeling.
- To explain about kinetic modeling of biochemical reactions.
- To discuss about flux balance analysis.
- To explain the use of various networks in system biology.
- To formulate knowledge in experimental system biology.
- To acquire knowledge in tools and database for modeling.

Course Outcomes

- Explain the basic concepts in systems modeling.
- Outline the kinetic modeling of biochemical reactions.
- Illustrate the flux balance analysis.
- Elaborate the use of various networks in system biology.
- Describe the process in experimental system biology.
- Outline the different tools and database for modeling.

UNIT I

Introduction to Systems Biology, Systems level understanding of biological systems. Basic concepts in Systems modeling, Networks and graph theory: Basic properties of Network: Degree, average degree and degree distribution. Adjacency matrix, eighted and unweighted networks, Bipartite network, Paths and distances, Random Networks: Erdos-Renyi model, Small-world effect, clustering coefficient, Scale-free networks: Power laws, Hubs, ultra-small property, degree exponent, The Barabasi-Albert Model. Degree correlations: assortativity and disassortativity.

UNIT II

Kinetic modeling of biochemical reactions, describing dynamics with ODEs, rate equations, deriving a rate equation, incorporating regulation of enzyme activity by effectors, E-cell platform and erythrocyte modeling.

UNIT III

Introduction to Flux balance analysis, Construction of stoichiometric matrices, Constraint based models. Network basics, examples of mathematical reconstruction of transcriptional networks and signal transduction networks.

UNIT IV

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models.

UNIT V

Tools and databases for modeling: Pathway databases KEGG, EMP, Metacyc, Enzyme kinetics database BRENDA, Gene expression databases, Biomodels database, Basics of Systems Biology Markup Language (SBML), SBML editors.

SUGGESTED READINGS:

1. Klipp, E., Liebermeister, W., Wierling, C., Kowald, A., & Herwig, R. (2016). Systems biology: a textbook. John Wiley & Sons.
2. Alon, U. (2006). An introduction to systems biology: design principles of biological circuits. Chapman and Hall/CRC.
3. Klipp, E., Herwig, R., Kowald, A., Wierling, C., & Lehrach, H. (2008). Systems biology in practice: concepts, implementation and application. John Wiley & Sons.
4. Kitano, H. (Ed.). (2001). Foundations of systems biology (pp. 1-36). Cambridge: MIT press.
5. Alberghina, L., & Westerhoff, H. V. (Eds.). (2007). Systems biology: definitions and perspectives (Vol. 13). Springer Science & Business Media.

19RBTE308 **Advances in Cancer Biology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To explain the fundamentals of cancer biology
- To understand the different types of cancer and its properties.
- To explain the principles of carcinogenesis and its types
- To explain the cancer screening diagnostic tools.
- To outline the different types of cancer therapy.
- To analyse the advancement in cancer treatment.

Course Outcomes

- Outline the fundamentals of cancer biology
- Explain the different types of cancer and its properties.
- Discuss the principles of carcinogenesis and its types
- Iluustrate the cancer screening diagnostic tools.
- Explain the different types of cancer therapy.
- Summarize the advancement in cancer treatment.

UNIT I

Epidemiology of cancer: environmental factors: tobacco, alcohol, diet, occupational exposure, hormones; Development and causes of cancer: Types of cancer, Development of cancer, Causes of cancer, properties of cancer cells, Transformation of cells in culture; Genetic basis of cancer: Oncogenes and tumor suppressor genes, apoptosis, multiple mutations in cancer - metastasis and angiogenesis, tumor viruses- Role of virus infection and human cancer.

UNIT II

Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, X-Ray radiation – Mechanism of radiation Carcinogenesis; DNA repair mechanisms – DNA repair defects and their relationship to cancer.

UNIT III

Cancer Screening (Breast, Cervical, Colorectal, Prostate, Ovarian and Lung Cancer); Common practice of diagnostic methods, cytogenetics and molecular test, routine diagnostic test, purpose of frozen section, biopsy, endoscopy, diagnostic imaging, blood test, Proteomics and genomic approach, microarray, Discovery of metabolic biomarker; sample analysis, metabolic imaging strategies (CT, MRI, PET & SPECT); bioinformatics for metabolomics data.

UNIT IV

Different forms of therapy - Chemotherapy, Hormone therapy, Radiation Therapy, Immunotherapy, Endocrine therapy, Vaccines and immune stimulation, Gene therapy: molecular targeted therapies and anti-angiogenic therapies; Detection of Cancers; Prediction of aggressiveness of Cancer; Advances in Cancer detection.

UNIT V

Tomotherapy, robotic surgery, brachytherapy, hyperthermia, alternative treatments for cancer use of herbals and nonconventional therapies, development and synthesis of new drugs and their effects; photodynamic therapy; anti-angiogenic therapy, radio-immunotherapy, cancer stem cell therapy, stem cell transplant autologous, allogeneic, syngeneic transplant, cryotherapy, laser therapy.

SUGGESTED READINGS

1. Tannock, I. F. (2013). The basic science of oncology. 2nd edition. McGraw-Hill.
2. Knowles Margaret & Selby Peter. (2005). An Introduction To Cellular and Molecular Biology of Cancer. 4th Edition. Oxford University Press.
3. Vincent T. DeVita, Theodore S. Lawrence, Steven A. Rosenberg. (2008). Cancer: Principles & Practice of Oncology. 8th Edition. Lippincott Williams and Wilkins.
4. King R.J.B.,. (2006). Cancer Biology. 3rd Edition. Pearson Prentice Hall.
5. Bunz, F. (2008). Principles of cancer genetics (Vol. 1). New York, NY, USA: Springer.
6. Dimmock, N. J., Easton, A. J., & Leppard, K. N. (2016). Introduction to modern virology. John Wiley & Sons.
7. Edmund C Lattime, Stanton L Gerson. (2013). Gene Therapy of Cancer. Academic Press. Elsevier.

19RBTE309 **Advanced Drug Delivery Systems** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To understand the different the modes of drug delivery
- To classify the targeted drug delivery systems.
- To acquire knowledge about different polymers.
- To explain the construction of different drug delivery carriers
- To explain the mechanism of targeted drug delivery.
- To analyse the concept of nano in different drug delivery systems.

Course Outcomes

- Explain the different the modes of drug delivery
- Classify the targeted drug delivery systems.
- Tell about different polymers.
- Illustrate the construction of different drug delivery carriers
- Elaborate the mechanism of targeted drug delivery.
- Describe the concept of nano in different drug delivery systems.

UNIT I

Modes of drug delivery – Absorption Distribution Metabolism Excretion characteristics of Drugs – Kinetics of Drug delivery - controlled drug delivery - site specific drugs - barriers for drug targeting - passive and active targeting Strategies for site specific - time and rate controlled delivery of drugs - antibody based and metabolism-based drug delivery systems.

UNIT II

Classification of Targetted Drug Delivery systems - Nanoparticles surface modification – bioconjugation – PEGylation – antibodies - cell-specific targeting and controlled drug release - Multi-Functional Gold Nanoparticles for Drug Delivery - Virus Based-nanoparticles for targeted Drug Delivery systems.

UNIT III

Polymers - Classification - Polymer Micelles as Drug Carriers- Polymers nanotubes- Magnetic Nanoparticles as Drug Carriers- Dendrimers - Synthesis – Tectodendrimers - Nanoscale containers – Nanoscafold systems – Gene transfection – Carbon nanotubes in diagnosis and therapy - Liposomes for pharmaceutical and cosmetic applications - Liposomal Drug Carriers in Cancer Therapy - lipid-DNA complexes – liposomal peptide and protein drug delivery Liposomal anticancer and antifungal agents.

UNIT IV

Targeted delivery through enhanced permeability and retention – Cancer markers Folate receptors - Targeting through angiogenesis - Targeting to specific organs or tumor types - Tumor-specific targeting – Combination therapy – Neutron Capture therapy - Targeting tumor vasculature for Imaging - Delivery of specific anticancer agents: Paclitaxel, Doxorubicin,5-Fluorouracil.

UNIT V

Vascular Zip Codes and Nanoparticle Targeting – Theragnostic Metal Nanoshells Photothermally-modulated Drug Delivery Using Nanoshell-Hydrogel Composites Nanoporous Microsystems for Islet Cell Replacement - Molecularly-derived Therapeutics - Transdermal Drug Delivery using Low-Frequency Sonophoresis Nanoporous Implants for Controlled Drug Delivery- Functionalized Cyclodextrin nanoparticles.

SUGGESTED READINGS

1. Vladimir,P.Torchilin. (2006). Nanoparticulates as drug carriers. Imperial College Press.
2. Deepak Thassu., Michel Deleers., Yashwant Vishnupa. (2007). Nanoparticulate drug delivery systems. CRC Press.

19RBTE310 **Cell Culture Techniques** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

Course Objectives

At the end of this course, students will be able

- To understand the plant tissue culture and its process.
- To describe the production of primary and secondary metabolites.
- To acquire knowledge in media types and methods for cell culture.
- To explain the steps to isolate colonies and screening methods.
- To understand the concept of rDNA technology
- To discuss the advancement of stem cells and its application

Course Outcomes

- Outline the process of plant tissue culture.
- Explain the production of primary and secondary metabolites.
- List the types of media and outline the methods for cell culture.
- Describe the steps to isolate colonies and screening methods.
- Elaborate the concept of rDNA technology
- Explain the advancement of stem cells and its application

UNIT I

Design of typical plant tissue culture laboratory and its management. Sterilization methods and principles; Plant tissue culture (PTC): Media composition, phytohormones and their selective usage, cellular totipotency. Callus & suspension cultures. Plant propagation: Regeneration through meristem and callus cultures; Somatic embryogenesis; Artificial Seeds and Automation of Somatic Embryo Production. Embryo culture; Haploid plant production; Protoplast culture; Somatic hybridization; Induction & utilization of somatic variants; Cryopreservation: Storage of germplasm.

UNIT II

Principles and the technology, pharmaceutical, pigments, other natural products and beverage production; Kinetics, scale up and Characterization: optimization of physiochemical parameters. Plant secondary metabolites manipulation of different pathways (Metabolic engineering), genetic stability of production. Large scale production of secondary metabolites: Different types of reactors and their design; Biotransformation: Principle and applications; Commercialization of tissue culture technology: Concept of commercialization.

UNIT III

Media and reagents: Types, Ingredients, Physiochemical properties; Serum and its importance; Sterilization of different materials used in animal cell culture; Aseptic concepts; Maintenance of sterility; Selection, isolation and preparation of tissue (mouse and chick embryo isolation); isolation of cells by tissue disaggregation; enzymatic & mechanical methods. Viability tests and Quantitation; Sub culture; Cell lines- Characterization, maintenance and preservation, Organotypic culture; Common cell culture contaminants.

UNIT IV

Isolation of pure-colonies. Bacterial titre estimation. Growth kinetics. Culture characterization. Auxotroph culture isolation. Biochemical characterization. Antibiotic sensitivity. Bacterial recombination, Replica plating technique, Preservation methods. Screening and isolation of microorganisms, Metabolic screening, Enrichment and specific screening for the desired product. Strain improvement for the selected organism: strategies of strain improvement for primary, secondary metabolites with relevant examples. Use of UV/Chemicals, recombinant DNA technology, protoplast fusion techniques for strain improvement of primary and secondary metabolites. Selection of improved Strain/Cell line; Biology of cultured cells

UNIT V

Stem cells; Types, identification, culture and applications. Scale up studies. Concepts of tissue engineering and case studies.

SUGGESTED READINGS:

1. Bhojwani, S.S. (2096). Plant Tissue Culture: Theory and Practice. Elsevier.
2. Chawla,H.S. (2002). Introduction to Plant Biotechnology. 2nd Edition. Science Publishers Inc.
3. Roberta, H.Smith. (2013). Plant Tissue Culture. Academic Press.
4. Freshney, I. (2015). Culture of Animal Cells. 7th Edition. Wiley and sons.

5. John, R.W. (2000). 'Animal Cell Culture: A Practical Approach', 5th edition. Oxford University Press.
6. Ranga, M.M. (2007). 'Animal Biotechnology', 3rd Edition. Agrobios, India.
7. Stanbury, P.F., and Whitaker. (2016). A Principles of Fermentation Technology. Butterworth Heinmann.
8. Lansing M. Prescott. (2011). Microbiology. McGraw Hill Higher Education.

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FACULTY OF PHARMACY

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KARPAGAM ACADEMY OF HIGHER EDUCATION

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Coimbatore – 641021.

PHD SYLLABUS

2019-2020

SUB.CODE	TITLE OF THE COURSE	CREDITS	EXAM HRS	MARKS
PAPER - I (COMPULSORY)				
19PYR101	Research Methodology and Pedagogy	4	3	100
PAPER - II (COMPULSORY)				
19PYR 201	Analytical and Biological screening methods in Pharmaceutical Research	4	3	100
PAPER - III (ANY ONE)				
19PYR 301	Pharmaceutics	4	3	100
19PYR 302	Pharmaceutical Chemistry	4	3	100
19PYR 303	Pharmacology	4	3	100
19PYR 304	Pharmacognosy	4	3	100
19PYR 305	Pharmaceutical Analysis	4	3	100

19PYR101.RESEARCH METHODOLOGY AND PEDAGOGY

Course Objectives:

- To design the impart fundamental knowledge of higher education
- To illustrate the Research Processes and Methodologies that was undergone by the Research scholars
- To Explain the Research Skills like Research strategies, Ethics, Code for Research and IPR
- To Illustrate the techniques of teaching and evaluation
- To demonstrate the Essentials that was needed for the effective communication in English
- To describe the Data collection, Data Presentation Skills and Research Writing skills

Course Outcomes (CO's): On successful completion of the course the student will

1. Explain the objectives, role,social focus, curricular focus, administrative focus, drivers of change globalization in Higher Education
2. Restructure the new patterns of decision making
3. Describe the Expectations by employers, rate of knowledge growth, campus demographics and concern for community
4. Illustrate the Research strategies, Ethics, Code of conduct for Research, Health and Safety and also the IPR
5. Describe the Data collection , Modeling , Simulation , Analysis, Prototyping, Presentation Skills , Data Presentation Skills and Research Writing skills
6. Demonstrate the techniques of teaching and evaluation

Course Content:

UNIT I

HIGHER EDUCATION AN INTRODUCTION: Historical perspectives, the objectives of higher education, role of higher education-social focus, curricular focus, administrative focus, drivers of change in higher education-globalization, changing demographics, structuring of employment, technological change, demand of accountability, consumerism,. Expectations by employers, rate of knowledge growth, campus demographics, concern for community. Restructuring and new patterns of decision making.

UNIT II

RESEARCH PROCESSES AND METHODOLOGY: Introduction to Research – Research strategies – Ethics – Code of conduct for Research – Health and Safety – IPR – Research Events – Networks – Outreach Activities – Best Research practices – Quality assurance for Research – Career Management for Researchers – Research seminars – Journal critiques -.

UNIT III

EFFECTIVE RESEARCH SKILLS

Data collection – Modeling – Simulation – Analysis – Prototyping – Presentation Skills – Data Presentation Skills – Research Writing skills (For Articles, Reports, Journals and Thesis) – Creative Skills – Effective Interview Skills – Team Building Skills – Communication and Interpersonal Skills – knowledge Transfer skills – Vivo voce – Teaching and Information Skills – Effective use of Library – Survey Skills – Planning and Control Methods – Statistical Tools – Patents and Copyrights – Advanced Research Techniques and Tools.

UNIT IV

TECHNIQUES OF TEACHING AND EVALUATION

Large group techniques – lecture, seminar, symposium, panel discussion-project approaches and workshop.Small Group techniques-group discussion simulation, role playing-Buzz techniques, brain storming, case discussion and assignment…system approach in education. Individualized techniques-CAI Keller plan – PSI and programmed learning-methods of evaluation-self evaluation and student evaluation in higher education, question banking, diagnostic testing and remedial teaching.

UNIT V

ESSENTIALS FOR EFFECTIVE COMMUNICATION IN ENGLISH

Improving Vocabulary stock-general and technical vocabulary-British and American vocabulary-homophones & homonyms, idioms and phrases-Different grammatical functions of the same word-Grammar-Tenses, Voice, reported speech, Modals, spoken English structures, formal and informal-letters, project reports, descriptions, circulars, synopsis and summary writing. Listening skills for competitive exams-Reading skills-skimming and scanning – Reading journals, magazines and newspapers for comprehension.Practical use of English – conversation, seminars, individual speeches and group discussions. Reference skills-Using dictionary, thesaurus and encyclopedia effectively. Error shooting for better use of English

SUGGESTED READING BOOKS

1. Alley, Michael,(1996), 'The Craft of Scientific Writing', 3rd Edition, Springer.
2. Alley, Michael, (2003), 'The Craft of Scientific Presentations", Springer.

REFERENCE BOOKS

1. Hubbuch, Susan M.,(2005), Writing Research Papers Across the Curriculum, 5th Edition, Thompson.
2. Vedanayagam.E.G (1989),Teaching technology for college teachers New Delhi - Sterling publishers (Pvt) Ltd.
3. Kumar.K.H.(1997), Educational technology, New Delhi- New age international (Pvt) Ltd.
4. Tony Bates.A.N,(2005) Technology, e-learning and distance education, New York, Rout ledge.
5. Aggarwal. J.C. (1995), Essential of educational technology; Teaching Learning innovations in education-New Delhi- Vikas publishing house (p) Ltd.,.
6. Crow & Crow. (1998),Educational Psychology", Erusia Publishing House New Delhi.
7. M. Ashraf Rizvi.(2005),Effective technical communication, TataMcGraw Hill Co.Ltd.

Websites:
www.english4engineer.com
www.learn4good.com/language/engineer

19PYR 201.Analytical and Biological screening methods in Pharmaceutical Research

Course Objectives:

- To describe the UV-Visible, Infrared, NMRSpectroscopy instrumentation and applications
- To Interpret the Mass and NMR spectra
- To Explain the Mass Spectrometry instrumentation and applications
- To Illustrate the Chromatographic Techniques like Column, Thin Layer , Liquid and Gas chromatography techniques and applications.
- To explain the Toxicology Principles and its International guidelines
- To describe the Biological Screening methods and alternatives to animal screening procedures

Course Outcomes (CO's): On successful completion of the course the student will

1. Explain the UV-Visible, Infrared, NMRSpectroscopy instrumentation and applications
2. Interpret the Mass and NMR spectra
3. Describe the Mass Spectrometry instrumentation and applications
4. Illustrate the Chromatographic Techniques like Column, Thin Layer , Liquid and Gas chromatography techniques and applications.
5. Describe the Toxicology Principles and its International guidelines
6. Explain the Biological Screening methods and alternatives to animal screening procedures

Course Content:

UNIT – I

Spectroscopy :UV-VISIBLE Spectroscopy: Electromagnetic spectrum. Shifts and their interpretation, instrumentation and applications.INFRARED Spectroscopy: Basic principles, molecular vibrations, vibration frequency and its influencing factors, instrumentation and applications. Interpretation of IR spectra.NMRSpectroscopy: Fundamental principles of NMR, instrumentation and applications. Interpretation of NMR spectra.

UNIT – II

Spectrometry: MassSpectrometry: Basic principles and brief outline of instrumentation and applications. Ion formation and types; molecular ion, Meta stable ions, fragmentation processes.

Fragmentation patterns and fragmentation characteristics in relation to parent structure and functional groups.Interpretation of Mass spectra.

UNIT – III

Chromatographic Techniques: Classification of chromatographic methods based on mechanism of separation. Column chromatography; techniques and applications. Thin Layer Chromatography, techniques and applications. Liquid chromatography: techniques and applications. Gas chromatography: techniques and applications. Techniques and applications of coupled spectra like LC-MS and GC-MS

UNIT – IV

Toxicology: Principles of toxicity evaluations, ED_{50}, LD_{50} and TD values, International guidelines (ICH& OECD recommendations). Preclinical studies: General principles and procedures involved in acute, sub-acute, chronic, teratogenicity, mutagenicity and carcinogenicity toxicity studies.

UNIT – V

Biological Screening methods: Bioassays-Basic principles of bioassays, official bioassays, experimental models and statistical designs employed in biological evaluation and standardization. Alternatives to animal screening procedures, cell-line, patch –clamp technique, *In-vitro* models, molecular biology techniques.Enzymatic screening methods: α-glucosidase, α-amylase, DNA polymerase, nucleases, L-asparginase, lipases and peptidases.

TEXT BOOKS

1. Instrumental methods of chemical analysis by Chatwal. K, anand, 5th edition.
2. Instrumental methods of analysis by Willard, Merit, Dean, Settle.
3. Basic and clinical pharmacology by Bertram G. Katzung (International edition) lange medical book / McGraw Hill, USA 2001 8th edition
4. Pharmacology by Rang H.P, Dale MM and Ritter JM., Churchill Livingston, London, 4/e

REFERENCE BOOKS

1. Spectroscopy by B.K.Sharma

2. Fundamentals of analytical chemistry by Skoog
3. Instrumental methods of analysis by Skoog.
4. Organic spectroscopy by William Kemp
5. Organnic spectroscopy by Y.R.Sharma.
6. Spectrometric identification of organic compounds by Silverstein, Webster.
7. General and applid toxicology by B.Ballantyne, T.Marrs, P.Turner (Eds) The McMillan press Ltd, London.
8. Drug Discovery and evaluation – Pharmacological assays by H.Gerhard.Vogel, 2nd edition, Springer verlag, Berlin, Heidelberg.
9. Goodman and Gilman's The pharmacological basis of therapeutics (International edition) McGraw Hill, USA 2001 10th edition.

Websites:

- www.jpr.info.com
- www.sciencedomain.org
- www.pharmacology2000.com
- www.pharmacologycorner.com

19PYR 301. PHARMACEUTICS

Course objective

- To determine the organoleptic properties and physical properties of the different dosage forms
- To explain the Physico- chemical characteristics of new drug molecules with respect to different dosage forms
- To illustrate the Compaction and Compression of tablet Dosage form
- To demonstrate the Controlled & Novel Delivery Systems like micropartictes, nano particles , Liposomes &niosomes
- To estimate the bioavailability & bioequivalence concept & methodology
- To determine the dissolution of poorly soluble drugs and invitro dissolution testing models

Course outcome(CO's): On successful completion of the course the student will

1. Evaluate the physico- chemical characteristics of new drug molecules with respect to different dosage forms
2. Measurement of forces within the powder mass, moisture content and strength of tablets
3. Explain the concept of optimization parameters, classical optimization, statistical design and optimization methods.
4. Explain the Oral SR/CR products ,Ocular, Transmucosal, transdermal delivery Colonic delivery, Liposomes and niosomes of different dosage forms
5. Estimate the absorption rate of drugs, bioavailability and Bioequivalence methodologies.
6. Illustrate the In-vitro dissolution testing models and its In-vivo correlation

Course Content:

UNIT – I

Preformulation-Introduction- organoleptic properties- purity- particle size- shape- and surface area.Solubilisation- surfactants and its importance- temperature- pH- co-solvency; Techniques for the study of crystal properties and polymorphism. Drug-Excipients compatibility studies.Physico- chemical characteristics of new drug molecules with respect to different dosage forms.

UNIT – II

Compaction and Compression-Compaction of powders with particular reference to distribut -ion and measurement of forces within the powder mass undergoing compression including- physics of tablet compression; Effect of particle size- moisture content- lubrication etc on strength of tablets. Transducers. Concept of optimization- optimization parameters- classical optimization- statistical design- and optimization methods.

UNIT – III

Controlled & Novel delivery Systems-Concept of CR- Polymers for CR- Parentral SR products- Oral SR/CR products- Ocular- Transmucosal- transdermal delivery- Colonic delivery- Particulate CR systems – micropartictes- nano particles and Liposomes &niosomes

UNIT – IV

Bioavailability & Bioequivalence-Basic considerations- Definition- estimating absorption rate of drugs- measurement of bioavailability- Pharmacokinetic methods and Pharmacodynamic methods. Methods of enhancing bioavailability of drugs- Bioequivalence – concept & methodology

UNIT – V

Dissolution-Theory- study of various approaches to improve dissolution of poorly soluble drugs- Invitro dissolution testing models- I*nvitro* -*Invivo* correlation in brief.

TEXT BOOKS:

1. Biopharmaceutics and clinical Pharmacokinetics By Milo Gibaldi.
2. Remington's Pharmaceutical Sciences; By Mack publishing company- Pennsylvania.

REFERENCE BOOKS :

1. Pharmacokinetics; By Milo Gibaldi- Donald Perrier; Marcel Dekker- Inc.
2. Handbook of clinical Pharmacokinetics; By Milo Gibaldi and Laurie Prescott by
3. ADIS Health Science Press.
4. Biopharmaceutics and Pharmacokinetics; By Robert E. Notari.
5. Biopharmaceutics; By Swarbrick.
6. Biopharmaceuties and Pharmacokinetics- A Treatise; By D.M.Brahmankar and Sunil
7. B.Jaiswal.-VallabhPrakashanPitampura- Delhi.
8. Clinical Pharmacokinetics- Concepts and Applications; By Malcolm Rowland and
9. Thomas N.Tozer. Lea and Febiger- Philadelphia- 1995.
10. Dissolution- Bioavailability and Bioequivalence; By Abdou.H.M.- Mack Publishing
11. Company- Pennsylvania- 1989.
12. Biopharmaceutics and Clinical Pharmacokinetics- An introduction; 4th edition-
13. Revised and expanded By Robert. E. Notari- Marcel Dekker Inc- New York and Basel-1987.
14. Encyclopedia of Pharmaceutical Technology- Vol 13- James Swarbrick- James.

15. C.Boylan. Marcel Dekker Inc- New York- 1996.

WEBSITES:

- www.slideshare.net
- www.picscheme.org
- www.ijper.org

19PYR 302. PHARMACEUTICAL CHEMISTRY

Course Objectives:

- To describe the Modern concept and principles of Drug design and drug discovery
- To explainpharmacokinetic parameters in drug design
- To Illustrate techniques for preparing chiral drugs
- To explainthe synthetic strategicalanalysis.
- To analyze the recent advances in anticancer research
- To describe the Applications of UV- IR- 1H NMR- 13C NMR- MASS spectroscopic data in structural elucidation

Course Outcomes (CO's): On successful completion of the course the student will

1. Evaluate the drug target interactions, Intracellular signaling pathways and Pharmacokinetic parameters in drug design
2. Describe the Molecular Modeling, Docking, XRD, QSAR methods, Combinatorial Synthesis and Computer-Aided Drug Design.
3. Demonstrate the Techniques in preparing the chiral drugs,Enantioselective synthesis and Stereroselective synthesis
4. Explain the Synthetic strategies like Synthones for carbon-carbon bond formation
5. Illustrate the Pathophysiology of Anti-microbial activities and Recent advances in antimicrobial research.
6. Elucidate the structure of natural- synthetic and semi-synthetic by using the UV, IR, ^{1}H NMR, ^{13}C NMR, MASS spectroscopic data

Course Content

UNIT – I

Drug design & drug discovery- Modern concept and principles of Drug design - Analog design- Receptors and Enzymes as drug targets and their characterization – Drug target interactions - Intracellular signaling pathways - Pharmacokinetic parameters in drug design. Molecular Modeling – Docking - XRD - QSAR methods & Combinatorial Synthesis.Computer-Aided Drug Design (CADD).

UNIT – II

Asymmetric Synthesis- Chirality and the importance of chiral drugs- Techniques for preparing chiral drugs (chirality pool - enzymatic transformation and asymmetric synthesis).Enantioselective synthesis - Stereroselective synthesis

UNIT – III

Synthetic strategies - Introduction**-** Disconnection approach- Synthones for carbon-carbon bond formation.-Difunctional compounds- Selective functional group interconversions (FGI) - Retrosynthetic analysis.

UNIT – IV

Cytotoxic (Anti cancer) activities- Pathophysiology of Cytotoxic (Anticancer) activity-Recent advances in anticancer research - **Antimicrobial activities** - Pathophysiology of Anti microbial activities - Recent advances in antimicrobial research.

UNIT–V

Spectroscopic Analysis- Applications of UV- IR- ^{1}H NMR- ^{13}C NMR- MASS spectroscopic data in structural elucidation of natural- synthetic and semi-synthetic drugs. **Chromatographic techniques-** Applications ofTLC- HPTLC- HPLC- GCMS- LCMS

TEXT BOOKS:

1. Organic Medicinal and Pharmaceutical Chemistry by Wilson and Gisvold
2. Organic spectroscopy by William Kemp

REFERENCE BOOKS

1. Burger's medicinal chemistry drug discovery- vol. 1 sixth edition- by Donald J. Abraham. (2007)
2. Organic Medicinal and Pharmaceutical Chemistry by Wilson and Gisvold
3. Introduction to Medicinal Chemistry by G. Patrick.
4. Introduction to principles of drug design by Smith and Williams- Harwood Academy press.
5. Advanced Organic chemistry- Reaction mechanisms and structure- J. march- John Wiley and sons- N.Y
6. Medicinal Chemistry byWilliam O Foye.
7. Text book of pathology by Harsh Mohan- third edition. (1998)
8. Spectrometric Identification of organic compounds by Robert M. Silverstein- Francis X- Webster- sixth edition. (1998)
9. Instrumental methods of analysis by Skoog.
10. Organic spectroscopy by William Kemp

WEBSITES:

- www.rsc.org
- www.acs.org
- www.medicinalchemistry.org

19PYR 303. PHARMACOLOGY

Course Objectives:

- To explain the drug discovery process, Bioassays, statistical designs and statistical models employed in biological standardization.
- To employ the Preclinical and clinical models in the screening of new drugs.
- To explain the Regulations in the laboratory animal care
- To Illustrate the various International guidelines like ICH, WHO, OECD and CPCSEA
- To evaluate ED50, LD_{50} and TD values
- To describe the Pathophysiology and drug therapy of various disease disorders

Course Outcomes (CO's): On successful completion of the course the student will

1. Describe the High throughput screening and human genomics of drug discovery
2. Explain the principles of bioassays, experimental models, statistical designs and statistical models employed in biological standardization.
3. Demonstrate the Preclinical and clinical models employed in the screening of new drugs.
4. Explain the alternatives to animal screening procedures like cell-line and patch-clamp technique
5. Describe thePrinciples of toxicity evaluations like ED_{50},LD_{50} and TD values
6. Illustrate thePathophysiology and drug therapy of the various disease disorders

Course Content

UNIT – I

Drug discovery process & Bioassays: Principles- techniques and strategies used in new drug discovery. High throughput screening- human genomics of drug discovery. Basic principles of bioassays- official bioassays- experimental models- statistical designs and statistical models employed in biological standardization

UNIT - II

Preclinical and clinical models employed in the screening of new drugs such as Antifertility agents- sedatives- hypnotics- antiarrhythmic agents- cardiac stimulants- bronchodilators- antihistaminics. Antipsychotic agents- Neurodegenerative diseases- antidepressant drugs; antiparkinsoinan agents; antiepileptics; analgesics and anti-inflammatory agents; antiulcer agents; antiatherosclerotic drugs; antidiabetics; transgenic animals and other genetically prone animal models.

UNIT - III

Regulations for laboratory animal care and ethical requirements.Alternatives to animal screening procedures- cell-line- patch-clamp technique *in-vitro* and *in-vivo* models- molecular biology techniques.

UNIT – IV

Principles of toxicity evaluations- ED_{50}- LD_{50} and TD values.International guidelines (ICH /WHO/OECD/CPCSEA recommendations).

UNIT – V

Pathophysiology and drug therapy of the following disorders. Schizophrenia- anxiety- depression- epilepsy- Parkinson's- Alzheimer's diseases- migraine hypertension- angina pectoris- arrhythmias- atherosclerosis- myocardial infarction- TB- leprosy- leukemia- solid tumors- lymphomas- psoriasis- respiratory- urinary- g.i. tract infections- endocarditis- fungal and HIV infection- rheumatoid arthritis- glaucoma- menstrual disorders- menopause Pharmacogenomics – basic principles- Chronopharmacology – Principles- molecular pharmacology

TEXT BOOKS:

1. Essentials of Medical Pharmacology by K.D.Tripathi.
2. Pharmacology and Pharmacotherpeutics by Satoskar R.S and Bhandarkar S.D.

REFERENCE BOOKS:

1. Lippincott's illustrated Reviews- Pharmacology by Mycek M.J- Gelnet S.B and Perper M.M.
2. Hand book of Experimental Pharmacology by Kulkarni.S.K.
3. Fundamentals of Experimental Pharmacology by M. N. Ghosh.
4. Pharmacology by Rang. M.P. Dale- M.M- Reter J.M.
5. Goodman and Gilman's- The Pharmacological basis of therapeutics by Gillman G- Rall T.W.- Nies
6. A.I.S. and Taylor P.
7. Basic & Clinical Pharmacology by Katzung B.G.
8. Craig C.R. and Stitzel R.R- Modern Pharmacology.
9. Ghosh M. N- Fundamentals of experimental Pharmacology.
10. Katzung B.G- Basic and Clinical Pharmacology- Prentice Hall International.
11. Laurence D.R and Bennet P.N. Clinical Pharmacology Churchill Livingstone.
12. Mycek M.J- Gelnet S.B and Perper M.M- Pharmacology- Lippincott's illustrated Reviews.
13. Rang M.P- Dale M.M- Reter J.M- Pharmacology.
14. Goodman and Gilman's- The Pharmacological basis of Therapeutics.
15. S.K. Kulkarni. Hand book of Experimental Pharmacology.
16. N.Udupa and P.D. Gupta- Concepts in Chronopharmacology.

Websites:

- **www.libguides.utep.edu**
- **www.pharmacology2000.com**
- **www.pharmacologycorner.com**

19PYR 304. PHARMACOGNOSY

Course Objectives:

- To evaluate the Preparation of monograph of crude drugs
- To Interperate the data of UV, IR, NMR, 1H NMR, 13C NMR & Mass spectroscopy
- To analyze the Ayurvedic Formulations and crude drugs
- To explain the Principles and procedures of microtomy and advanced histological techniques.
- To describe the Pharmacological screening methods
- To Illustrate the Regulatory requirements for new drugs, Markers constituents and importance in crude drug standardization

Course Outcomes (CO's): On successful completion of the course the student will

1. Explain the pharmacopoeia and other guidelines like European Pharmacopoeia , BP , Ayurvedic Pharmacopoeia of India , Ayurvedic formulary of India and WHO guidelines
2. Apply the chromatographic techniques in separation and identification of natural products
3. Analyze the of Ayurvedic Formulations and crude drugs
4. Describe the Principle and procedure involved in biological test like Presence of Mycobacterium tuberculosis, Living contaminants in vaccines and toxic elements
5. Demonstrate the pharmacological screening of the drugs
6. Explain the Regulatory requirements for new drugs

Course Content:

UNIT – I

Evaluation of Drugs: Concept- considerations- parameters and methods of quality control for medicinal plant materials as per various pharmacopoeia and other guidelines. Preparation of monograph of crude drugs.Comparative study of IP- European Pharmacopoeias- BP / Ayurvedic Pharmacopoeia of India / Ayurvedic formulary of India and WHO guidelines in relation to above.

Application of chromatographic techniques in separation and identification of natural products. Only interpretation of data UV- IR- NMR- ^{1}H NMR- ^{13}C NMR & Mass spectroscopy for purification and structural elucidation of phytoconstituents. Herbal fingerprint profile of single and multicomponent herbal drugs.Stability testing of natural products.

UNIT - II

Analysis of Ayurvedic Formulations and crude drugs with references to: Identity- purity and quality of crude drugs. Determination of pesticide residues- determination of arsenic and heavy metals- detection of microorganisms- determination of microbial load in crude drugs.

Identification of aflatoxins in crude drugs.Quality assurance in herbal drug industry- concept of GMP and ISO-9000.

UNIT–III

Quantitative microscopy- including lycopodium spore method as applied to drug evaluation and pollen grain analysis. Principles and procedures of microtomy and advanced histological techniques as applied to Pharmacognosy- Principle and procedure involved in biological test for . Presence of Mycobacterium tuberculosis, Living contaminants in vaccines-Determination of toxic elements

UNIT-IV

Study of pharmacological screening methods of the following categories of drugs: Antiinflammatory- hypolipidemic- diuretics- cardiovascular- hepatoprotective- anticancer- antidiabetic- antiulcerative- antioxidant- immunomodulator- antimalarial- antimicrobial- antiallergic and antifertility drugs.

UNIT- V

Regulatory requirements for new drugs: Markers constituents- Definition- importance in crude drug standardization. Examples of Biomarkers.Standardization- quality- efficacy and safety requirements & assessment procedures for herbal medicines as per USFDA/WHO guidelines.

TEXT BOOKS :

1. Vogel- Drug Discovery and Evaluation.

2.AshutoshKar-Pharmacognosy and Pharmacobiotechnology- New Age International Publishers

REFERENCE BOOKS :

1.Dhawan- B.N.-Shrimal- R.C.- Use of Pharmalogical Techniques for the Evaluation of Natural Products- CDRI-Lucknow.

2.Ayurvedic Formulary of India.

3..Ayurvedic Pharmacopoeia of India.

4.. Indian herbal Pharmacopoeia.

5. Indian Pharmacopoeia 2007.

6. European Pharmacopoeia 6th Edn. 2008.

7. Pulok K. Mukherjee- Quality Control of Herbal drugs. An Approach to Evaluation of Botanicals.

8.Quality Control Methods for Medicinal Plant Material- WHO Headquarters- Geneva.
9.Standardization of Botanicals by V. Rajpal- Vol. I & II- Eastern Publishers- New Delhi.
10.Evans- W.C.-Trease& Evans Pharmacognosy- W.B. Saunders & Co. London.
11.WHO guidelines- Methodologies on Research for Drug Development and Evaluation of Traditional Medicines.
12.Willard- H.H.-Merrit- L.L.- Dean- J.A.- Settle P.A.- Instrumental Methods of Analysis- Van Nostrand.
13. Skoog- D.A.- Heller- F.J.-Nieman- T.A.- Principles of Instrumental Analysis- W.B Saunders.
14. Hunson- J.W.- Pharmaceutical Analysis - Modern Methods- part A & B- Marcel Dekker.
15. Schirmer- R.E.- Modern Methods of Pharmaceutical Analysis- Vol. 1- 2- Boca Raton F.L: CRC Press.
16. Mann- C.K. et al.- Instrumental Analysis- Harper & Row.
17. Jaffe- H.H.-Orchin- M.- Theory & Applications of Ultraviolet Spectroscopy- Willy.
18. Silverstein- R.M.- et al.- Spectrometric Identification of Organic Compounds- Willy.
19. Bovey- F.-Jelinski- L-Miran- P.- Nuclear Magnetic Resonance Spectroscopy-Sau: Diego Academic.
20. Stothers- J.B.- Carbon-13 NMR.Spectroscopy- Academic.
21. Gordy- W.- Theory & Applications of Electron Spin Resonance- Willy.
22. Haswell- S.J.- Atomic Absorption Spectroscopy- Elsevier.
23. Ardrey- R.E.- Pharmaceutical Mass Spectra- Pharmaceutical press- London.
24. WHO Monographs on Selected Medicinal Plants- Vol. I & II.
25. WHO Quality Control Methods of Medicinal Plant Materials.
26. WHO- International Pharmacopoeia- Vol. I-V.
27. Wilfried- M.A.-Niessen- Liquid Chromatography-Mass Spectrometry.
28. Harry- G. Brittain- Spectroscopy of Pharmaceutical Solids.
29. Indian Herbal Pharmacopoeia-Vol. 1 & 2.
30. Wallis- T.E.- Practical Pharmacognosy.
31. Gorag- Steroid Analysis in Pharmaceutical Industry.
32. Wagner's- Plant Drug Analysis-A Thin layer Chromatography- Atlas.

33. Bogers- Medicinal and Aromatic plants- Agricultural- Commercial- Ecological- Legal- Pharmacological and Social Aspects.

WEBSITES:

- www-autostream-com
- www-epharmacognosy-com
- www-science20-com

19PYR 305. PHARMACEUTICAL ANALYSIS

Course Objectives:

- To describe the Concepts and Philosophy of TQM- GMP (orange guide)- ISO-9000
- To explainthe Selection- purchase specifications- maintenance- sterilization of an area.
- To explain the Manufacturing Documents- Master Formula- Batch Formula Records- Standard operating procedure- Quality audits of manufacturing processes
- To Illustrate the concepts in the Quality control Laboratory
- To describe the Regulatory aspects of Pharmaceuticals and Bulk drug Manufacturing
- To explain the Preparation of drug sample for analysis

Course Outcomes (CO's): On successful completion of the course the student will

1. Explain about orange guide, Location, Design, Plan Layout, Construction, Maintenance and Sanitations
2. Describe about Purchase specifications, Maintenance of stores, Selection of vendors, and Controls on Raw materials.
3. Illustrateabout Manufacturing Documents, Master Formula, Batch Formula Records- Standard operating procedure and Quality audits of manufacturing processes.
4. Explain the Good Laboratory Practices andGood warehousing practice.
5. Describe about the Globalisation of Drug Industry, Export of Drugs and Import Policy
6. Explain about HPLC Method development by using different stationary phases

Course Content

UNIT - I

Concepts and Philosophy of TQM- GMP (orange guide)- ISO-9000. Organisation and personnel-responsibilities- training- hygiene.Location- Design- Plan Layout- Construction- Maintenance and Sanitations. Environmental control- Sterile areas- control of contamination. Selection- purchase specifications- maintenance- sterilization of an area (TP & STP)

UNIT – II

Purchase specifications- Maintenance of stores- Selection of vendors- Controls on Raw materials. Manufacture of and controls on dosage forms :. Manufacturing Documents- Master Formula- Batch Formula Records- Standard operating procedure- Quality audits of manufacturing processes and facilities. Standard operating procedures for various operations like cleaning- filling- drying- compression- coating-disinfection- sterilisation- membrane filtration etc.-

UNIT – III

Quality control Laboratory : Responsibilities- Good Laboratory Practices- Routine controls- Instruments-Protocols- Non-clinical testing- Controls on animal house- Application of Computers in Quality control laboratoryFinished product release : Quality review- Quality audits- Batch release document. Warehousing : Good warehousing practice- Materials- Managements. Packaging and labeling controls-line clearance- reconciliation of labels; cartons and other packaging material; types and tests assuring quality of glass and plastics

UNIT – IV

Distribution : Distribution of records- Handling of returned goods- Recovered materials and Reprocessing. Complaints and Recalls : Evaluation of complaints- Recall procedures- Related records and documents. Waste disposal- Scrap disposal procedure and records. Regulatory aspects of Pharmaceuticals and Bulk drug Manufacturing- Regulatory drug analysis. Loan License Auditing – Concepts- Auditing. Recent Amendments to drugs and cosmetics act and other relevant rules- Consumer protection- Environmental protection act- Certification and Licensing procedure. WHO Certification- Globalisation of Drug Industry- Introduction to Export of Drugs and Import Policy. Patent regime.

UNIT – V

Internal and standard addition methods Preparation of drug sample for analysis-Introduction- compatibility with the instrumental method- fundamental theories controlling preparation techniques- Specific sample preparation techniques: soxhlet extraction- Liquid-liquid extraction- solid phase extraction- solid phase micro extraction- protein precipitation methods- Ultra filtration- direct injection- methods- derivatization methods- residual sample preparation- different sample preparation methods for pharmaceutical dosage forms: tablets- capsules- ointments etc- Gas Chromatography: inlets and injectors- GC column characteristics- GC detectors- GC preventive maintenance and troubleshooting- method development process- method validation and QA Processes HPLC: Detectors- PDA- ELSD- Conductivity- UV- Refractive Index- Fluorescence- Mass- HPLC column selection and mobile phases- mobile phase additives. HPLC Method development by using different stationary phases- mechanism of interactions- HPLC preventive maintenance and troubleshooting- case studies. Calibration methods: external-

TEXT BOOKS:

1. Quality Assurance Guide by Organisation of Pharmaceutical products of India.
2. Good Laboratory Practice Regulations- 2nd Edition- Sandy Weinberg- Vo. 69-

REFERENCE BOOKS:

1. Decker Series.
2. Quality Assurance of Pharmaceuticals – A compendium of guidelines and related
3. materials – Vol. I – WHO Publications.
4. A guide to Total Quality Management – KaushikMaitra and SedhanK.Ghosh.
5. How to practice GMPs – P. P. Sharma.
6. ISO 9000 and Total Quality Management – Sadhank. G. Ghosh.
7. The International Pharmacopoeia Vol. 1-2-3-4 - 3rd Edition- General Methods of
8. Analysis and Quality specification for Pharmaceutical Substances- Excipients and
9. Dosage forms.
10. Controller of Publication- Govt. of India - Indian Pharmacopeia- Vol. I and II -
11. 1996.
12. Burn- Finiey and Godwin : Biological Standardisation- 2nd Edition- Oxford
13. University Press- London.

14. Dr. A. Patani : The Drugs and Cosmetics Act 1940- Eastern Book Company-Lucknow.

WEBSITES:

- www.jpr.info.com
- www.sciencedomain.org
- www.pharmaresearchlibrary.com