DEPARTMENT OF BIOTECHNOLOGY

FACULTY OF ARTS, SCIENCE AND HUMANITIES

UG PROGRAM (CBCS) – B.Sc., Biotechnology

(2020–2021 Batch and Onwards)

Course code	Name of the course	Objectives and Outcomes		Instruction hours / week			Credit(s)	Marks			Category	Page. No.
		PEO's	PO's	L	T	P		CIA	ESE	Total		
SEMESTER - I												
20LSU101	Language - I	I	a	04	00	00	4	40	60	100	AEC	05
20ENU101	English - I	I	a	04	00	00	4	40	60	100	AEC	08
20BTU101	Introduction to Biotechnology	I	a, b	04	00	00	4	40	60	100	CC	09
20BTU102	Biochemistry and Metabolism	I	a, b	04	00	00	4	40	60	100	CC	11
20BTU103	Chemistry -I	I	a	04	00	00	4	40	60	100	Allied	13
20BTU111	Introduction to Biotechnology Practical	I	a, b	00	00	03	2	40	60	100	CC	15
20BTU112	Biochemistry and Metabolism Practical	I	a, b	00	00	03	2	40	60	100	CC	16
20BTU113	Chemistry Practical- I	I	a	00	00	04	2	40	60	100	Allied	17
Semester total				**20**	**00**	**10**	**26**	**320**	**480**	**800**		
SEMESTER - II												
20LSU201	Language - II	I	a	04	00	00	4	40	60	100	AEC	18
20ENU101	English - II	I	a	04	00	00	4	40	60	100	AEC	21
20BTU201	General Microbiology	I	c, d	04	02	00	6	40	60	100	CC	22
20BTU202	Chemistry - II	I	c, d	04	01	00	5	40	60	100	Allied	24
20BTU211	General Microbiology Practical	I	c, d	00	00	04	2	40	60	100	CC	26
20BTU212	Chemistry Practical- II	I	a	00	00	04	2	40	60	100	Allied	27
20AEC201	Environmental Studies	I	c, d	03	00	00	3	40	60	100	AEC	28
Semester total				**20**	**02**	**08**	**26**	**320**	**480**	**800**		

Course code	Name of the course	Objectives and Outcomes		Instruction hours / week			Credit(s)	Marks			Category	Page. No.
		PEO´s	PO´s	L	T	P		CIA	ESE	Total		
SEMESTER - III												
20BTU301	Cell Biology	II	e, f	04	00	00	4	40	60	100	CC	30
20BTU302	Genetics	II	e, f	04	00	00	4	40	60	100	CC	32
20BTU303	Molecular Biology	I	c, d	04	00	00	4	40	60	100	CC	34
20BTU304A	Bioanalytical tools	II	e, f	03	00	00	3	40	60	100	SEC	36
20BTU304B	I.P.R., & Entrepreneurship											38
20BTU311	Cell Biology Practical	II	e, f	00	00	04	2	40	60	100	CC	39
20BTU312	Genetics Practical	II	e, f	00	00	04	2	40	60	100	CC	40
20BTU313	Molecular Biology Practical	II	e, f	00	00	04	2	40	60	100	CC	41
20BTU314A	Bioanalytical tools Practical	II	e, f	00	00	03	1	40	60	100	SEC	42
20BTU314B	I.P.R., & Entrepreneurship Practical											43
Semester total				15	00	15	22	320	480	800		
SEMESTER - IV												
20BTU401	Immunology	II,IV	e,f,g,h	04	00	00	4	40	60	100	CC	49
20BTU402	Bioprocess Technology	II,IV	e,f,g,h	04	00	00	4	40	60	100	CC	46
20BTU403	Recombinant DNA Technology	II,IV	e,f,g,h	04	00	00	4	40	60	100	CC	47
20BTU404A	Plant physiology	II,IV	e,f,g,h	03	00	00	3	40	60	100	SEC	49
20BTU404B	Animal physiology											51
20BTU411	Immunology Practical	II,IV	e,f,g,h	00	00	04	2	40	60	100	CC	53
20BTU412	Bioprocess Technology Practical	II,IV	e,f,g,h	00	00	04	2	40	60	100	CC	54
20BTU413	Recombinant DNA Technology Practical	II,IV	e,f,g,h	00	00	04	2	40	60	100	CC	55
20BTU414A	Plant physiology Practical	II,IV	e,f,g,h	00	00	03	1	40	60	100	SEC	56
20BTU414B	Animal physiology practical											57
Semester total				15	00	15	22	320	480	800		

Course code	Name of the course	Objectives and Outcomes		Instruction hours / week			Credit(s)	Marks				Page. No.
		PEO´s	PO´s	L	T	P		CIA	ESE	Total		
SEMESTER - V												
20BTU501	Plant & Animal Biotechnology	III, IV	i, j	04	00	00	4	40	60	100	CC	58
20BTU502 A	Bioinformatics	III, IV	i, j	04	00	00	4	40	60	100	DSE	60
20BTU502 B	Genomics and Proteomics											62
20BTU503A	Plant diversity - I	III, IV	i, j	04	00	00	4	40	60	100	DSE	64
20BTU503B	Animal diversity - I											65
20BTU504A	Evolutionary Biology	III, IV	i, j	03	00	00	3	40	60	100	DSE	67
20BTU504B	Basics of Forensic Science											69
20BTU511	Plant & Animal Biotechnology Practical	III, IV	i, j	00	00	04	2	40	60	100	CC	71
20BTU512A	Bioinformatics Practical	III, IV	i, j	00	00	04	2	40	60	100	DSE	72
20BTU512B	Genomics and Proteomics Practical											73
20BTU513A	Plant diversity - I Practical	III, IV	i, j	00	00	04	2	40	60	100	DSE	74
20BTU513B	Animal diversity - I practical											75
20BTU514A	Evolutionary Biology Practical	III, IV	i, j	00	00	03	1	40	60	100	DSE	76
20BTU514B	Basics of Forensic Science practical											77
Semester total				**15**	**00**	**15**	**22**	**320**	**480**	**800**		
SEMESTER - VI												
20BTU601	Environmental Biotechnology and Management	III, IV	k, l	04	00	00	4	40	60	100	CC	78
20BTU602A	Plant diversity - II	III, IV	k, l	04	00	00	4	40	60	100	DSE	80
20BTU602B	Animal diversity - II											81
20BTU603A	Molecular Diagnostics	III, IV	k, l	03	00	00	3	40	60	100	DSE	82
20BTU603B	Biostatistics											84

20BTU611	Environmental Biotechnology and management Practical	III, IV	k, l	00	00	04	2	40	60	100	CC	85
20BTU612A	Plant diversity - II Practical	III, IV	k, l	00	00	04	2	40	60	100	DSE	86
20BTU612B	Animal diversity - II practical											87
20BTU613A	Molecular Diagnostics Practical	III, IV	k, l	00	00	03	1	40	60	100	DSE	88
20BTU613B	Biostatistics Practical											89
20BTU691	Project – *Viva Voce*	III, IV	k, l	00	00	08	6	40	60	100	CC	90
ECA / NCC / NSS / Sports / General interest etc.,										Good		
Semester total				**11**	**00**	**19**	**22**	**280**	**420**	**700**		
Grand Total				**90**	**00**	**90**	**140**	**1880**	**2820**	**4700**		

AEC: Ability Enhancement Courses, CC: Core Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Elective, ECA: Extra Curricular Activities, NCC: National Cadet Corps; NSS: National Social Service; Employability courses – Theory,

Department of Biotechnology (FASH)
B.Sc. Biotechnology (2020 Batch)
List of Electives

Skill Enhancement Elective Courses – Theory		
Semester	**Subject code**	**Subject**
III	20BTU304A	Bio -Analytical Tool
	20BTU304B	I.P.R., Entrepreneurship
IV	20BTU404A	Plant Physiology
	20BTU404B	Animal Physiology
Skill Enhancement Elective Courses - Practical		
Semester	**Subject code**	**Subject**
III	20BTU314A	Bio -Analytical Tool Practical
	20BTU314B	I.P.R., Entrepreneurship Practical
IV	20BTU414A	Plant Physiology Practical
	20BTU414B	Animal Physiology Practical

Discipline Specific Elective Courses-Theory		
Semester	**Subject code**	**Subject**
V	20BTU502A	Bioinformatics
	20BTU502B	Genomics and Proteomics
	20BTU503A	Plant Diversity - I
	20BTU503B	Animal Diversity - I
	20BTU504A	Evolutionary Biology
	20BTU504B	Basics of Forensic Science
VI	20BTU602A	Plant Diversity - I
	20BTU602B	Animal Diversity - I
	20BTU603A	Molecular Diagnostics
	20BTU603B	Biostatistics

Discipline Specific Elective Courses-Practical		
Semester	**Subject code**	**Subject**
V	20BTU512A	Bioinformatics Practical
	20BTU512B	Genomics and Proteomics Practical
	20BTU513A	Plant Diversity - I Practical
	20BTU513B	Animal Diversity - I Practical
	20BTU514A	Evolutionary Biology Practical
	20BTU514B	Basics of Forensic Science Practical
VI	20BTU612A	Plant Diversity - I Practical
	20BTU612B	Animal Diversity - I Practical
	20BTU613A	Molecular Diagnostics Practical
	20BTU613B	Biostatistics Practical

PROGRAMME OUTCOMES (POs)

a) Graduates will acquire in-depth understanding of basic concept, knowledge about biochemistry and cell organelles, their functions for applied field, allied subject and life skills.

b) The students will be able to discuss the metabolic aspects of biomolecules.

c) The Graduates will gain the technical capability of handling, isolating and identifying various organisms from different sources.

d) Understanding and better knowledge of the causes, types and control methods for environmental pollution by the students.

e) The student will be able to discuss the mechanisms associated with gene expression system in prokaryotes and eukaryotes.

f) Understand the role of different types of cells, effectors and effectors mechanisms in immune-technology by the students.

g) Develop skills associated with screening of industrially important strains, various aspects of bioprocess technology and rDNA technology by the graduates.

h) The student will be able to understand the production of enzymes from different sources and enzyme characterization and kinetic actions in living organisms.

i) The student will be able to understand the production of transgenic plants and animals for human and environmental welfare.

j) Understand the basic concepts and modern knowledge of bioinformatics by graduates.

k) Apply the knowledge and skills gained from molecular aspects should be useful in developing new innovations in different life forms by the graduates.

l) The student will be able design, solve the application-oriented problem in biotechnological field through project-based learning.

PROGRAMME SPECIFIC OUTCOMEs (PSOs)

To enable the student to emerge as:

m) Proficiency to work on biotechnological concepts and interdisciplinary areas of science and technology towards product and process development for industrial and academic research applications.

n) An expert in Biotechnology and allied fields (medical, microbial, agricultural, environmental, plant and animal) for utilizing the practical skills to address biotechnological challenges.

o) Proficiency to demonstrate entrepreneurial and leadership skills with life-long learning

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

To impart the following PEOs to the students of Under-graduates in Biotechnology:

PEO I : To obtain detailed information about the fundamentals of Biotechnology, allied subjects and life skills.

PEO II : To provide information about the molecular methods which involved in cellular processes of living systems such as microbes to higher order organisms for applied aspects. To address the emerging need for skilled scientific manpower with research ethics involving organisms.

PEO III : To impart the basics and current molecular tools in the areas of Molecular Diagnostics, Fermentation Technology, Plant, Animal & Environmental Biotechnology are included to train the students for man power development and also sensitize them to scope for research. The practical subjects will provide information about the careers in the industry and applied research where biological system is employed.

PEO IV : To make the graduates of Biotechnology to learn and to adopt in a competitive world of technology update 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)	(j)	(k)	(l)	(m)	(n)	(o)
PEO I	×	×	×	×											
PEO II					×	×	×	×							
PEO III									×	×	×	×			
PSO IV											×	×	×	×	×

SEMESTER - I

கற்பகம் உயர்கல்வி கலைக்கழகம்
தமிழ்த்துறை

பகுதி – I, **தமிழ், தாள் 1 முதல் பருவம் 20LSU101** 4-H,4-C

(இளநிலல அறிவியல் பட்ட வகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

பாடத்திட்டப் பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், ஆய்வுநோக்கையும் மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப் பயன் விளைவு

- இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
- கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
- தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.
- வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
- சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண் அக/எழுத்து	மொத்தம்	மதிப்பீடு
ஒன்று	I	4	3	40 / 60	100	4

தாள்கள் வரிசையும் தேர்வுச் செயல்திட்டமும்
பகுதி–I தமிழ்
இளநிலைப் பட்ட அறிவியல் வகுப்புகள்

கற்பகம் உயர்கல்வி கலைக்கழகம்

தமிழ்த்துறை

பகுதி – I தமிழ்ப் பாடத்திட்டம் (2020-2021)

பகுதி - I, **தமிழ், தாள்** 1 **முதல் பருவம்**

20LSU101 4-H, 4-C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

அலகு - I : **தமிழ் இலக்கிய வரலாறு** - I (8 **மணிநேரம்**)

முச்சங்க வரலாறு-சங்க இலக்கியத்தொகுப்பு-பாட்டும் தொகையும்-சங்கஇலக்கியச் சிறப்பியல்புகள்-சங்கம் மருவிய காலம்-பதினெண்கீழ்க்கணக்கு நூல்கள்- திருக்குறள்-நாலடியார்-நான்மணிக்கடிகை- பழமொழிநானூறு - பிற்கால அறஇலக்கியங்கள்-கொன்றைவேந்தன்-நீதிநூல்- காப்பியங்கள்-தமிழில் காப்பிய இலக்கணம்- தமிழில் பெருங்காப்பியங்களும் சிறு காப்பியங்களும்-சிலம்பும் மேகலையும்.

அலகு – II: **சங்க இலக்கியம்** (12 **மணிநேரம்**)

அ). எட்டுத்தொகை

நற்றிணை : கொண்டல் மாமழை - குறிஞ்சி - தலைவன் – 140

குறுந்தொகை : வாரார் ஆயினும், வரினும் -முல்லை- தலைவி – 110

ஐங்குறுநூறு : மருதம் -தோழி -வேட்கைப்பத்து: வாழிஆதன் வாழி அவனி – 6

பதிற்றுப்பத்து : சிதைந்தது மன்ற – 27

பரிபாடல்: பரிபாடல்: பரிபாடல் திரட்டு-மதுரை நகர்ச்சிறப்பு - உலகம் ஒரு நிறையாத்தான்-6, மாயோன் கொப்பூழ்-7, செய்யாட்கு இழைத்த-9, கார்த்திகை காதில்-10, ஈவாரைக் கொண்டாடி-11.

கலித்தொகை : பாலைக்கலி- செவிலி - எறித்தரு கதிர்தாங்கி-9

அகநானூறு : அன்னை அறியினும் அறிக - தோழி – நெய்தல் – 1

புறநானூறு : யாதும் ஊரே யாவருங் கேளிர் -பொதுவியல்- 192

ஆ). பத்துப்பாட்டு: நெடுநல்வாடை – கார்காலச் சிறப்பு : வையகம் பனிப்ப -1-70

s

அலகு – III : **அற இலக்கியம்** (10 **மணிநேரம்**)

1. திருவள்ளுவர்- திருக்குறள்- வான்சிறப்பு-அன்புடைமை-பண்புடைமை- ஒழுக்கமுடைமை-அறிவுடைமை- பொறையுடைமை-நட்பு-வாய்மை வினைத்திட்பம்-ஆள்வினை உடைமை- கல்வி-காலமறிதல்- சான்றாண்மை
   முதலான அதிகாரங்களிலிருந்து தேர்ந்தெடுத்த 20 குறள்கள்.
2. முன்றுறையரையனார் - பழமொழி நானூறு 5 பாடல்கள்
   உணற்கு இனிய, பரந்த திறலாரை, நெடியது காண்கிலாய், இனி யாரும், உரைசான்ற ஒளவையார் – கொன்றை வேந்தன் (1- 50 பாடல்கள்)

அன்னையும் பிதாவும் - புலையும் கொலையும் களவும் தவிர்

- வேதநாயகம்பிள்ளை – நீதிநூல் - (5 பாடல்கள்)

சின்னவோர் பொருள், கடவுளை வருந்தி, எப்புவிகளும், வைத்தவர், ஈன்றவர்

அலகு – IV : காப்பிய இலக்கியம் (10 மணிநேரம்)

(அ). சிலப்பதிகாரம்

மங்கல வாழ்த்துப் பாடல்: (21-29)- நாக நீள் நகரொடு-கண்ணகி என்பாண் மன்னோ .வழக்குரை காதை, (48-56) – நீர்வார் கண்ணை-புகா ரென்பதியே .

வஞ்சின மாலை: (5-34) – வன்னிமரமும் - பிறந்த பதிப் பிறந்தேன்.

நடுகற் காதை: (207-234) – அருத்திற லரசர் - மன்னவ ரேறென்,.

வாழ்த்துக்காதை: (9) – என்னேயிஃ தென்னே - மீவிசும்பிற் றோன்றுமால்.

(ஆ). மணிமேகலை

பசியின் கொடுமை: பாத்திரம் பெற்ற காதை:

'போதி நீழல்' – 'பெருகியதன்றோ' , 'ஆற்றுநர்க்களிப்போர்' – 'நல்லறம் கண்டனை' (73-98).

சிறைக்கோட்டம் அறக்கோட்டமாக்கிய காதை: மாவண் கிள்ளிக்கு காவலன் உரைத்தவை: 'பைஞ்சேறு மெழுகாப் பசும்பொன் மண்டபத்து – அரவோர்க் காக்கினன் அரசாள் வேந்தன்' (116-163).

அலகு- V : அடிப்படை இலக்கணமும் பயன்பாட்டுத்தமிழும் - I (8 மணிநேரம்)

எழுத்து, சொல், பொருள் இலக்கணம்

அ). முதல் மற்றும் சார்பெழுத்துகள்- பெயர், வினை, இடை, உரிச்சொல் முதலான அடிப்படை இலக்கண விளக்கப் பயிற்சிகள் அகத்திணை மற்றும் புறத்திணை இலக்கணம்.

ஆ). கடிதப்பயிற்சி

1. தன்விவரக் குறிப்புடன் வேலை வேண்டி விண்ணப்பம் எழுதுதல்
   பல்கலைக்கழகப் பன்னாட்டுக்கருத்தரங்கச் செய்தியை நாளிதழில்
2. வெளியிட வேண்டி நாளிதழின் பதிப்பாசிரியருக்குக் கடிதம்
3. கருத்தரங்கப் பங்கேற்புக்கு அனுமதிக் கடிதம்
4. பல்கலைக்கழக விழாவுக்குத் தலைமையேற்க வேண்டி, மாவட்ட ஆட்சியருக்கு விண்ணப்பம்
5. கல்விகடன் வேண்டி வங்கிமேலாளருக்கு விண்ணப்பம்
6. வசிப்பிடத்திற்கு அடிப்படை வசதி வேண்டி வட்டாட்சியருக்கு விண்ணப்பம்
7. தேசியவிருது பெற்ற நண்பனுக்குப் பாராட்டுக் கடிதம்
8. தேர்த்திருவிழாவைக் கொண்டாட, உறவினருக்கு அழைப்புக் கடிதம்.

20ENU101 **ENGLISH I** **4H –4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To train students to acquire proficiency in English.
- To explore different genres of literature and learning grammar.
- To provide aesthetic pleasure through literature.
- To inculcate moral values through literature.
- To develop ethical values.
- To give basic grammar knowledge.

Course Outcome

The learners will be able to,

1. Develop the knowledge of interpersonal skills.
2. Establish and maintain social relationships.
3. Genres of literature will give moral values of life.
4. Develop communication skills in business environment.
5. Communication skills will get developed.
6. Develop to have language competence.

UNIT - I: **Grammar**

Types of Sentences, Subject and Predicate, Parts of Speech, Tenses and preposition and Articles

UNIT – II: Interpersonal Skills

Greetings & Introduction- Giving & Denying Permission- Telephone Etiquette- Oral Presentation – Plan, PowerPoint Presentation- Preparation of Speech- Audience psychology- Secrets of Good Delivery

UNIT - III: **Communication Exercise**

Importance of Business Language- Words often Confused- Words often Misspelt-Common Errors in English- Charts and Pictorial Writing.

UNIT - IV: LSRW Skills

Listening- Listening and its types, Basic Listening Lessons

Speaking- Basics of speaking, Regular English, Business English, Interview English

Reading- Reading and its purposes, Types of Reading, Reading Techniques

Writing- Types of Writing, Components of Writing, Language and Style with accordance to the contexts

UNIT - V: Literature

Prose: Let's Do What India Needs from Us - Dr. A.P.J. Abdul Kalam

Poem: A Prayer for My Daughter - W.B. Yeats

Short Story: Sparrows- K. Ahmad Abbas

SUGGESTED READINGS:

1. Haines Simon,2015 Advanced Skills, A resource Book of Advanced- Level Skill Activities.
2. Hewings Martin,2013Advanced Grammar in Use, Cambridge University Press.

SEMESTER - I

20BTU101 INTRODUCTION TO BIOTECHNOLOGY 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To provide clear understanding on the scope, concepts and applications of biotechnology.
- To gain better knowledge in various Biotechnology disciplines.
- To develop the biotechnological approaches to improve the human and environmental welfare.
- To know the Biosafety issues in biotechnology.
- To train instrumentation principles and procedures.
- To understand the various applications in biotechnology.

Course Outcomes

The learners will be able to,

1. Gain knowledge on the fundamental concepts of Biotechnology.
2. Acquire skills on different fields of Biotechnology and its applications.
3. Attain knowledge on biological techniques to develop biotechnology products.
4. Apply the Good Laboratory practices.
5. Handle the fundamental instruments in biotechnological laboratory.
6. Acquire skills on Bioethanol, Biodiesel production.

UNIT - I Introduction

Historical development of biotechnology. Scope of biotechnology. Basic concepts of biotechnology. Definition and descriptions of important terminology in biotechnology. New trends in biotechnology.

UNIT- II Branches of Biotechnology

Study of various branches of Biotechnology (Colors of Biotechnology); Plant, Animal, Microbial, Clinical, Industrial, Environmental, Marine, Nano, Agriculture Biotechnology

UNIT- III Biosafety and Good Laboratory Practices

Introduction – Biosafety issues in biotechnology, Biological Safety Cabinets, Primary Containment for Biohazards. Biosafety Levels - Levels of Specific Microorganisms, Infectious Agents and Infected Animals. Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP). Solid and liquid measurement – Unit and scales.

UNIT- IV Bioinstrumentation

Basic fundamental instruments in biotechnological laboratory- pH meter, centrifuge, weighing balance, micropipette, hot air oven, incubator, laminar air flow chamber, autoclave, magnetic stirrer, vortex mixture, light microscope, colorimeter, UV vis Spectrophotometer and PCR

UNIT- V Applications of Biotechnology

Role of biotechnology in medicine, industry, agriculture, livestock improvement and environment. Bioactive / therapeutic compounds, Single cell protein, Synthetic products, Bioethanol, Biodiesel, Biomolecular electronics, Biosensors, Tissue engineering and devices, Biocement. Recombinant proteins. List of Genetically Modified crops.

SUGGESTED READINGS:

1. Dhami, P.S., Srivastava, H.N. and Chopra, G., (2008). A Textbook of Biology, Pradeep Publications
2. Godbey W T (2014) An Introduction to Biotechnology, First Edition, Academic Press, USA.
3. Roberts, M. and Ingram, N. (2001) Biology, 2nd Edition, Nelson Thomas Ltd., UK
4. Saltzman WM. (2009). Biomedical Engineering Bridging Medicine and Technology (ISBN-13: 9780521840996)
5. Smith J. E., (2006). Biotechnology, 3rd Edition, Cambridge University Press
6. Starr, C., Evers C. A., Starr L. (2010) Concepts of Biology, First Edition, Cengage Learning India Pvt. Ltd.
7. William J. Thieman (2018) Introduction to Biotechnology (4th Edition) 3rd Edition. Pearson, USA

SEMESTER - I

20BTU102 BIOCHEMISTRY AND METABOLISM 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To provide clear understanding on the underlying principles, structures and functions of bio molecules.
- To acquire fundamental knowledge about the anabolism and catabolism in living organisms.
- To obtain the facts of metabolism and its disorders in the living system.
- To implement experimental protocols, and adapt them to plan and carry out simple investigations.
- To expose the students to a wide range of careers that combine biology, plants and medicine.
- To understand the principles that govern the structures of macromolecules and their participation in molecular recognition.

Course Outcomes

The learners will be able

1. To acquire knowledge on the structure, functional relationship of proteins, nucleic acid, carbohydrates and their roll in various biological processes.
2. To know about the role of various enzymes in metabolic process.
3. To quench the in-depth concepts of metabolism related disorders.
4. To know how genes are transmitted between generations, and how and when errors can arise.
5. To plan and safely perform fundamental techniques in molecular and cellular biology.
6. To get awareness of the ethical aspects of molecular science

UNIT- I Protein and Aminoacid:

Amino acids & Proteins**:** Structure, properties and function of Amino acids and Protein, Amino acid and protein classification. Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

UNIT-II Carbohydrates and Metabolism:

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions; Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle.

UNIT-III Enzymes:

Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, Role of: NAD+, NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions. Photosynthesis – Photosystem I and II. Hormonal regulation and metabolism.

UNIT-IV Lipids:

Structure and functions – Classification, nomenclature and properties of fatty acids, essential fatty acids. Structure, functions and Metabolism of Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. ß-oxidation of fatty acids, Digestion, Absorption, and Transport of Lipids, Lipid metabolism disorders - Atherosclerosis.

UNIT-V Nucleic acids:

Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, Biologically important nucleotides, Amino acid Metabolism, Nucleotide metabolism, Double helical model of DNA structure, A, B & Z – DNA, denaturation and renaturation of DNA, DNA and RNA metabolism.

SUGGESTED READINGS:

1. Berg JM, Tymoczko JL, and Stryer L. (2011). Biochemistry. 7th edition. Newyork: W.H. Freeman & Company.
2. Buchanan B, Gruissem W, and Jones R. (2015). Biochemistry and Molecular Biology of Plants. 2nd edition. American Society of Plant Biologists.
3. Hopkins WG, and Huner P.A. (2008). Introduction to Plant Physiology. 4nd edition. John Wiley & Sons.
4. Murray RK, Bender DA, Botham KM, and Kennelly P.J. (2018). Harper's illustrated Biochemistry. 31th edition. London: McGraw-Hill Medical.
5. Nelson DL, and Cox MM. (2017). Lehninger: Principles of Biochemistry. 7th edition. New York: W.H. Freeman and Company.
6. http://172.16.25.76/course/view.php?id=1607.

Semester – I

20BTU103 CHEMISTRY- I 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- The molecular orbital theory, preparation and properties of inorganic compounds.
- Theory of covalent bond, polar effects and stereochemistry of organic compounds.
- About important industrial chemicals like silicones, fuel gases and fertilizers and their impact on environment.
- Elements of photochemistry, chemical kinetics.
- The principle to perform the chromatography.
- About the dyes, chemotherapy and vitamins.

Course Outcomes

The learners will be able

1. The molecular orbital theory, preparation and properties of inorganic compounds.
2. Theory of covalent bond, polar effects and stereochemistry of organic compounds.
3. About important industrial chemicals like silicones, fuel gases and fertilizers and their impact on environment.
4. Elements of photochemistry, chemical kinetics and chromatography.
5. About the dyes, chemotherapy and vitamins.
6. Principles and applications of Column, Paper and Thin Layer Chromatography.

UNIT-I Chemical Bonding:

Molecular orbital theory-linear combination of atomic orbitals-bonding and antibonding molecular orbitals-energy level diagram-bond order- M.O. configuration of H_2, N_2 and F_2 molecules. Diborane: Preparation, properties and structure. $NaBH_4$: Preparation and uses. Borazole: Preparation and properties. Interhalogen compounds: ICl, BrF_3, IF_5 - preparation, properties, uses and structure. Basic properties of iodine. Compounds of sulphur: Sodium hydrosulphite- preparation, properties, uses and structure. Per acids of sulphur: Preparation, properties, uses and structure.

UNIT- II Covalent Bond and Stereoisomerism: Covalent Bond:

Orbital overlap, hybridization and geometry of CH_4, C_2H_4 and C_2H_2. Polar effects: Inductive effect-electromeric effect- mesomeric effect- steric effect- hyperconjugation. Stereoisomerism: Elements of symmetry-polarised light and optical activity-isomerism in tartaric acid-racemisation- resolution-geometrical isomerism of maleic and fumaric acids-keto-enol tautomerism of acetoacetic esters.

UNIT-III Industrial Chemistry:

Silicones: Synthesis, properties and uses. Fuels gases: Natural gas-water gas-semi water gas-carbureted water gas-producer gas- oil gas (Manufacturing details not required).Fertilizers: NPK fertilizer-ammonium sulphate-urea-superphosphate of lime-triple superphosphate- potassium nitrate- ammonium nitrate. Pollution: Water, air and soil pollution-sources and remedies-acid rain-ozone hole- greenhouse effect.

UNIT-IV Elements of Photochemistry, Chemical Kinetics and Chromatography:

Elements of Photochemistry: Photochemical laws-Beer Lambert's law-Grotthuss-Draper law-Stark-Einstein law (statement only). Chemical Kinetics: Rate-order-molecularity-pseudo first order reactions-zero order reactions-determination of order of reaction-measurement of order and rates of reactions-effect of temperature on reaction rate-energy of activation. Chromatography: Principles and applications of Column, Paper and Thin Layer Chromatography.

UNIT- V Dyes, Chemotherapy and Vitamins: Dyes:

Terms used chromophore, auxochrome, bathachromic shift and hypsochromic shift- classification of dyes– based on chemical structure and application-one example each for azo, triphenylmethane, vat and mordant dyes- preparation.

Chemotherapy: Preparation, uses and mechanism of action sulpha drugs- preparation and uses of prontosil, sulphadiazine and sulphafurazole-structure and uses of pencillins and Chloromycetin. Vitamins: Diseases caused by the deficiency of vitamins A, B_1, B_2, C and D-sources of these vitamins.

SUGGESTED READINGS:

1. Bahl A, and Bahl BS. (2015). A Textbook of Organic Chemistry. 21st Revised edition. S. Chand & Company Pvt. Ltd. New Delhi.
2. Gopalan R. and Sundaram S. (2013). Allied Chemistry. IIIrd edition. Sultan Chand & Sons. New Delhi.
3. Puri BR, Sharma LR, and Kalia K.C. (2017). Principles of Inorganic Chemistry. 33rd edition. Jalandar: Vishal Publishing Company.
4. Puri BR, Sharma LR, and Pathania MS. (2014). Elements of Physical Chemistry. 46th edition. Jalandhar: Vishal Publishing Company
5. Thangamani A. (2018). Text Book on Allied Chemistry. 1st edition. Coimbatore: Karpagam Publication.

SEMESTER - I

20BTU111 INTRODUCTION TO BIOTECHNOLOGY PRACTICAL 3H - 2C

Instruction Hours / week: L: 0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To enable students to learn the basics of laboratory practices and safety measures.
- To develop the practical skills to the students to operate the fundamental equipment.
- To familiarize the students about the techniques related to various fields of biotechnology.
- To give practice to the students to calculate the molarity and normality.
- To observe the microscopic organism.
- To understand the uses of biotechnological techniques.

Course Outcomes

The learners will be able to,

1. Handle of toxic and nontoxic chemicals
2. Acquire the knowledge about good laboratory practices and safety measures.
3. Gain the skill on handlings of basic equipment in the biotechnology laboratory.
4. Obtain the knowledge on the applications of biotechnology to the society.
5. Prepare of buffer solutions.
6. Gain knowledge about the field visit.

Practical

1. Handling of toxic and nontoxic chemicals / solvents.
2. Preparation of molar, normality and percentage solutions by W/V and V/V.
3. Preparation of buffer solutions (acid / alkaline).
4. Microscopic observation of the given samples.
5. Centrifugation: High speed centrifugation and density gradient centrifugation.
6. Case study/Field visit: various uses of biotechnological techniques to the society.

SUGGESTED READINGS:

1. Harisha S. (2006). An Introduction to Practical Biotechnology, Firewall Media, Lakshmi Publications PVT., Ltd., New Delhi
2. Linnea Fletcher, Evelyn Goss, Patricia Phelps, Angela Wheeler, and Shelley O'Grady. (2011). Introduction to Biotechnology Laboratory Manual, USA
3. Madhan Shankar S. R and Rajesh E. M. (2013). A Practical Manual on Basic Techniques in Biotechnology & Nanotechnology, International E – Publication, India.
4. Verma, Ashish S., Das Surajit & Singh Anchal. (2014) Laboratory Manual for Biotechnology S. Chand Publishing, India.

SEMESTER - I

20BTU112 BIOCHEMISTRY AND METABOLISM PRACTICAL 3H - 2C

Instruction Hours / week: L: 0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To acquire skill on various experimental methods and techniques on order to analyze the given biological samples.
- To know the standard procedures for handling the biochemical assays and instruments.
- To know the threshold levels of primary biochemical markers.
- To analyze common organic reagents and compounds based on their properties.
- To analyze biological compounds from unknown mixture/origin.
- To Understand Good laboratory practices in a laboratory.

Course Outcomes

The learners will be able to,

1. Gain skills on quantitative estimation methods for various biomolecules from natural sources.
2. Acquire handling skills to handle the spectroscopy instrumentations.
3. Obtain skills on primary screening of biochemical markers in samples.
4. Develop skills to prepare useful reagents in the laboratory.
5. Use of handling of glass wares, minor equipment for conducting experiments.
6. Learn safety and precautionary measures for working in a laboratory.

Practicals

1. Qualitative tests for Carbohydrates, lipids and proteins
2. Principles of Colorimetry: (i) Beer's law, estimation of protein. (ii) To study relation between absorbance and % transmission.
3. Estimation of carbohydrates.
4. Estimation of proteins
5. Estimation of lipids
6. Separation of Amino acids by paper chromatography/Thin layer chromatography
7. Determination of enzymes activity using different parameters

.

SUGGESTED READINGS:

1. Berg JM, Tymoczko JL, and Stryer L. (2011). Biochemistry. 7th edition. Newyork: W.H. Freeman & Company.
2. Buchanan B, Gruissem W, and Jones R. (2015). Biochemistry and Molecular Biology of Plants. 2nd edition. American Society of Plant Biologists.
3. Hopkins WG, and Huner P.A. (2008). Introduction to Plant Physiology. 4nd edition. John Wiley & Sons.
4. Murray RK, Bender DA, Botham KM, and Kennelly P.J. (2018). Harper's illustrated Biochemistry. 31th edition. London: McGraw-Hill Medical.
5. Nelson DL, and Cox MM. (2017). Lehninger: Principles of Biochemistry. 7th edition. New York: W.H. Freeman and Company.
6. http://172.16.25.76/course/view.php?id=1605

2020-2021

Semester – I

20BTU113 CHEMISTRY PRACTICAL- I 4H–2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- The molecular orbital theory, preparation and properties of inorganic compounds.
- Theory of covalent bond, polar effects and stereochemistry of organic compounds.
- About important industrial chemicals like silicones, fuel gases and fertilizers and their impact on environment.
- Elements of photochemistry, chemical kinetics.
- The principles of chromatography.
- About the dyes, chemotherapy and vitamins.

Course Outcomes

The learners will be able to understand,

1. The molecular orbital theory, preparation and properties of inorganic compounds.
2. Theory of covalent bond, polar effects and stereochemistry of organic compounds.
3. About important industrial chemicals like silicones, fuel gases and fertilizers and their impact on environment.
4. Elements of photochemistry, chemical kinetics and chromatography.
5. About the dyes, chemotherapy and vitamins.
6. Principles and applications of Column, Paper and Thin Layer Chromatography.

Systematic analysis of an organic compound

- Preliminary tests.
- Detection of elements present.
- Aromatic or aliphatic.
- Saturated or unsaturated.
- Nature of the functional group.
- Confirmatory tests– aldehydes, ketones, amines, amides, diamide, carbohydrates, phenols, acids, esters & nitro compounds.

Note: Each student should analyze minimum 6 compounds.

SUGGESTED READINGS:

1. Ramasamy R. (2011). Allied Chemistry Practical Book. Karur: Priya Publications.
2. Thomas A.O. (2012). Practical Chemistry for B.Sc. Main Students. Cannanore: Kerala, Scientific Book Centre.
3. Venkateswaran V, Veeraswamy R, and Kulandaivelu AR. (2015). Basic Principles of Practical Chemistry. 2nd edition. S. Chand Publications. New Delhi.

20LSU201 **4H–4C**

கற்பகம் உயர்கல்வி கலைக்கழகம்
தமிழ்த்துறை
பகுதி – I தமிழ்ப் பாடத்திட்டம் (2020 – 2021)
(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)
(For I-UG Science Degree Classes)

பாடத்திட்டப் பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், ஆய்வுநோக்கையும் மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப் பயன் விளைவு

- இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
- கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
- தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்; 'இணைய தமிழ் ' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை வளர்ச்சி.
- வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல்.
- சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.

தாள்கள் வரிசையும் தேர்வுச் செயல்திட்டமும்
பகுதி-I தமிழ்
இளநிலைப் பட்ட அறிவியல் வகுப்புகள்

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண் அக/எழுத்து	மொத்தம்	மதிப்பீடு
இரண்டு	II	4	3	40 / 60	100	4

கற்பகம் உயர்கல்வி கலைக்கழகம்

தமிழ்த்துறை

பகுதி – I தமிழ்ப் பாடத்திட்டம் (2020-2021)

பகுதி - I, **தமிழ்**, **தாள்**-2 **இரண்டாம் பருவம்** 20LSU201

4-H, 4-C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

அலகு - I : **தமிழ் இலக்கிய வரலாறு**- II (5 **மணிநேரம்**)

தமிழ் இலக்கிய வரிசையில் திருமுறைகளும் நாலாயிரத் திவ்யப்பிரபந்தமும்-பன்னிரு திருமுறைகள் அறிமுகம்- திருமுறை ஆசிரியர்களின் இலக்கியப் பங்களிப்பு-திருமுறைகளில் பக்திநெறியும் சமுதாய நோக்கும்-சமயக்குரவரின் அருள்நெறி- பன்னிரு ஆழ்வார்கள் வரலாறு-ஆழ்வார்களின் இலக்கியப் பங்களிப்பு-திவ்யப் பிரபந்தத்தில் பக்திநெறியும் இலக்கிய நயமும்-தமிழில் சிற்றிலக்கியக் காலமும் கருத்தும்-தொண்ணூற்றாறு வகைச் சிற்றிலக்கிய வரிசை- தமிழ் மொழியின் நாவல், சிறுகதை-கட்டுரை-கவிதை- திறனாய்வு நூல்களின் தோற்றம்-வளர்ச்சி-உத்திகள்-நாட்டுப்புற இலக்கியங்கள்-கொங்குநாட்டார் வாய்மொழி வழக்காறுகள்.

அலகு - II : **பக்தி இலக்கியமும் சிற்றிலக்கியமும்:**

அ. பக்தி இலக்கியம் (10 **மணிநேரம்**)

சைவ, வைணவ இலக்கியங்கள் – தோற்றம் , வளர்ச்சி, வரலாறு.

1. **சைவம்** – (15 **பாடல்கள்**) பெரியபுராணம் - திருமூலநாயனார் புராணம் -அந்தி இளம்பிறைக் கண்ணி, மற்று அவர்தாம் அணிமா, காவிரி நீர் பெருந்தீர்த்தம், அந்நிலைமைத் தானத்தை, அந்தணர்தம் சாத்தனூர், மற்றுஅதன் தன் உடம்பினை, இவன் உயிர்பெற் றெழில், பாய்த்திய பின் திருமூலராய், வெய்ய சுடர் கதிரவனும், அங்கவளும், பித்து உற்ற மையல் அன்று, இந்த நிலைமையில், ஆவடு தண்துறை, ஊன்உடம்பில், முன்னிய அப்பொருள்.
2. **வைணவம் - ஆண்டாள் நாச்சியார் திருப்பாவை**: (11 **பாடல்கள்**): மார்கழித்திங்கள், வையத்து வாழ்வீர்காள், ஓங்கி உலகளந்த, ஆழி மழைக்கண்ணா, மாயனை மன்னுவட மதுரை, சிற்றம் சிறுகாலே, ஒருத்தி மகனாய், மாலே மணிவண்ணா, கூடாரை வெல்லும், கறவைகள் பின்சென்று, வங்கக்கடல் கடைந்த.

ஆ. சிற்றிலக்கியம்

1. முக்கூடற் பள்ளு- 2 பாடல்கள் – சித்திரக் காலிவாலான் (நெல்வகைகள்)
   குற்றாலத் திரிகூட மால்வரை (மீன் வகைகள்)
2. நந்தி கலம்பகம்- 5 பாடல்கள்- என்னையே புகழ்ந்தேன், பதிதொறு புயல்பொழி, இந்தப்புவியில், அடிவிளக்கும் துகில், வானுறுமதியை
3. மதுரைச் சொக்கநாதர் தமிழ்விடு தூது -தமிழின் சிறப்பு பாடியருள பத்துப்பாட்டும்-விளம்பக்கேள்.

அலகு - III: இக்கால இலக்கியம் (10 **மணிநேரம்**)

கவிதை இலக்கியம்

1. மகாகவி பாரதியார் - பரம்பொருள் வாழ்த்து
2. புரட்சிக்கவிஞன் பாரதிதாசன் - தமிழின் இனிமை.
3. கவிமணி தேசிக விநாயகம் பிள்ளை - கோவில் வழிபாடு.
4. கவிக்கோ. அப்துல்ரகுமான் - பாருக்குள்ளே நல்ல நாடு.
5. சிற்பி பாலசுப்பிரமணியன் - காலம்.
6. கவிஞர் தாமரை - தொலைந்து போனேன்.

அலகு - IV : சிறுகதை இலக்கியம் (8 **மணிநேரம்**)

1. மகாமசானம் - புதுமைப்பித்தன்
2. அப்பாவின் வேஷ்டி - பிரபஞ்சன்
3. அந்நியர்கள் - ஆர். சூடாமணி
4. இந்நாட்டு மன்னர் - நாஞ்சில்நாடன்

அலகு- V : அடிப்படை இலக்கணமும் பயன்பாட்டுத்தமிழும் - II (7**மணிநேரம்**)

இலக்கணப் பயிற்சி: அணி இலக்கணம்

உவமையணி-பிறிது மொழிதல் அணி-சிலேடை அணி-தீவக அணி-ஏகதேச உருவக அணி-வேற்றுமையணி-பின்வருநிலையணி

துறை சார் கலைச்சொல் பயன்பாட்டாக்கம்

படைப்பிலக்கியப் பயிற்சிகள்

மரபுக்கவிதை, புதுக்கவிதை, சிறுகதை, கட்டுரை படைப்பாக்க உத்திகள்- பயிற்சிகள்- நேர்காணல் வினா நிரல் தயாரித்தல் நுட்பங்கள்)

மொழிபெயர்ப்புப்பயிற்சிகள்

தமிழ்-ஆங்கில மொழிபெயர்ப்புப் பயிற்சிகள் -2.

ஆங்கிலம்-தமிழ் மொழிபெயர்ப்புப் பயிற்சிகள்-2.

பாட நூல்: கற்பகச்சோலை - தமிழ் ஏடு.

கற்பகம் உயர்கல்வி கலைக்கழகத் தமிழ்த்துறை வெளியீடு.

20ENU201 **ENGLISH II** **4H – 4C**

Instruction Hours/week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objective:

The main objectives of the course are,

- To refresh the grammar knowledge of the students to improvise their language.
- To make the students understand different kinds of communication involved in the business environment.
- To help the students to develop their listening, speaking, reading and writing skills (LSRW).
- Introducing literary works to the students to enhance their analytical and aesthetic skills.
- To practice the communication skills
- To enjoy the literature reading

Course Outcome:

The learners will be able to understand,

1. Strengthen the foundation of the language to elevate the command of standard grammar.
2. Formulate and communicate persuasive arguments for specific business outcome.
3. Apply fundamentals of language for reading, writing and effective communication.
4. Standardize and demonstrate understanding of LSRW skills.
5. Introduce literature to enhance the moral and aesthetic values.
6. Practice the communication skills

UNIT –I – Grammar

Tenses, Voice, Idioms and Phrases and Clauses

UNIT –II –Business and Technical Reports

Business Correspondence – Memo, Notices, Agenda, Minutes- Resume Writing- Report Writing- Letter Writing- Personal and Social Letters- E-mail Writing

UNIT –III – Communication Practice

Verbal and Non-Verbal Communication- Group Discussion and Seminars- Note-Taking and Note-Making

UNIT –IV – LSRW Skills

Listening Skills- Listening Talks and Presentations

Speaking Skills- Public Speaking- Preparatory steps, Time Management, Handling Questions and Meeting unexpected situations

Reading Skills- Language of Newspapers, Magazines and Internet

Writing Skills- Writing Paragraphs and Essays- Content Writing

UNIT –V – Literature

Prose- Morals in the Indian Context by Francis Nicholas Chelliah

Poetry- Telephone Conversation by Wole Soyinka

Short Stories- The Last Leaf by O' Henry

SUGGESTED READINGS:

Oxford Handbook of Writing: St. Martins Handbook of Writing 2013 CU Press

Sound Business, Julian Treasure 2012OUP

20BTU201 **GENERAL MICROBIOLOGY** **SEMESTER II 6H - 6C**

Instruction Hours / week: L: 4 T: 2 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To inculcate knowledge on fundamentals of microorganisms.
- To learn the structural organization, morphology and reproduction of microbes.
- To know the principles of Microscopy and advancements in Microscopy.
- To deal with the study of genetic, metabolic strategies and ecology of microorganisms.
- To know the basic knowledge of the main microbiological techniques to be applied in the laboratory.
- To develop understanding about microbial metabolism, growth, energy generation and disease caused.

Course Outcomes

The learners will be able to understand,

1. Gain knowledge on historical perspective of Microbiology.
2. Acquire basic knowledge on different structure of microbes.
3. Get Ideas on different type of microscope.
4. Acquire basic knowledge of the different applications of microbes in biotechnology.
5. Acquire basic knowledge of genetic, metabolic strategies and ecology of microorganisms.
6. Acquire basic knowledge about microbial metabolism, growth, energy generation.

UNIT-I Classification of Microorganism:

Introduction to Microbiology, Haeckel's three–kingdom concept, Whittaker's Five-kingdom concept, Three-domain concept of Carl Woese, Classification of Bacteria according to Bergey's manual. Principles and applications of microscopy. Microbial taxonomy, criteria used to include molecular approaches, Microbial phylogeny and current classification of bacteria.

UNIT-II Microbial structure and Diversity:

Distribution and characterization of Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms e.g. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

UNIT-III Cultivation and Maintenance of microorganisms:

Nutritional categories of micro-organisms, Media, Types of media, Sterilization, Methods of isolation (pour, streaking and spread plate), Staining types (Simple, Gram, negative, flagella staining), pure culture techniques and preservation.

UNIT-IV Microbial growth:

Growth curve, Microbial growth kinetics, batch and continuous culture, Measurement of growth, growth factors, factors affecting growth of microbes. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT-V Water and Food Microbiology:

Bacterial pollutants of water, coliforms and non coliforms. Major water borne diseases, Sewage composition and its disposal. Important microorganism in Food Microbiology: Moulds, Yeasts, bacteria. Major food borne infections and intoxications. Production of fermented foods.

SUGGESTED READINGS:

1. Aneja KR, and Mehrotra RS. (2015). An Introduction to Mycology. 4nd edition. New Age International.
2. Jay JM, Loessner MJ, and Golden DA. (2005). Modern Food Microbiology. 7th edition. CBS Publishers and Distributors. Delhi: India.
3. Madigan MT, Martinko JM, and Parker J. (2010). Brock Biology of Microorganisms. 13th edition. Pearson/Benjamin Cummings.McGraw Hill Publishers, Boston
4. Prescott, L.M., Harley, J.P. and Klein, D.A. (2014). Microbiology (9th Edition),
5. Robert Edward Lee, (2008). Phycology. 4th edition. Cambridge University Press.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2018). Microbiology: An Introduction. 13th edition. Pearson Education

Semester–II

20BTU203 CHEMISTRY-II 5H – 5C

Instruction Hours / week: L: 4 T: 1 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To know the principles of volumetric analysis
- To estimate the compounds by acidimetry, alkalimetry and permanganometry.
- Experimental practice of quantitative volumetric analysis.
- The objective of the titration is the determination of the concentration or the mass of the minimum formula from the titrated chemical material composing a pure liquid or a solution.
- The main objective of volumetric analysis is to determine the amount of a substance ϖ in a given sample.
- To deal with volumetric analysis the concept of concentration cannot be avoided. Molarity i.e. moles per litre or decimeter is widely used unit of concentration.

Course Outcomes

The learners will be able to understand,

1. Student will be able to learn the principles of quantitative analysis of inorganic compounds.
2. Student will be able to learn the estimation of sample present in a solution by volumetric analysis.
3. Understand the concepts of quantitative analysis.
4. Recognize the indicators, acid and bases used in volumetric analysis.
5. Estimate the amount of substance present in a given solution.
6. Utilize the mathematical skills doing calculations.

Unit-I Metals and Coordination Chemistry:

Metals: General methods of extraction of metals-methods of ore dressing-types of furnaces-reduction methods-electrical methods-types of refining-Van Arkel process-Zone refining. **Coordination Chemistry:** Nomenclature-theories of Werner, Sidgewick and Pauling-chelation and its industrial importance-EDTA-haemoglobin-chlorophyll-applications in qualitative and quantitative analysis.

Unit-II Aromatic Compounds and Heterocyclic Compounds:

Aromatic Compounds: Aromaticity-Huckel's (4n+2) rule- aromatic electrophilic substitution in benzene-mechanism of nitration, halogenation, alkylation, acylation and sulphonation. Naphthalene: Isolation, preparation, properties and structure. **Heterocyclic Compounds:** Preparation and properties of pyrrole, furan, thiophene and pyridine.

Unit-III Amino acids, Proteins and Carbohydrates:

Amino acids: Classification, preparation and properties. Peptides-preparation of peptides (Bergmann method only). **Proteins:** Classification, properties, biological functions and structure. **Carbohydrates:** Classification, preparation and properties of glucose and fructose- discussion of open chain and ring structures of glucose and fructose-glucose-fructose interconversion.

Unit-IV Energetics:

Type of systems-processes and their types - isothermal, adiabatic, reversible, irreversible and spontaneous processes-statement of first law of thermodynamics-need for the second law of thermodynamics-heat engine-Carnot cycle-efficiency-Carnot theorem-thermodynamics scale of temperature-Joule-Thomson effect- Enthalpy- Entropy and its significance-Free energy change.

Unit-V Electrochemistry:
Kohlrausch law-conductometric titrations-hydrolysis of salts-galvanic cells-E.M.F.-standard electrode potentials-reference electrodes- electrochemical series and its applications-buffer solution-buffer solution in the biological systems-pH and its determination-principles of electroplating.

SUGGESTED READINGS:

1. Bahl A, and Bahl BS. (2015). A Textbook of Organic Chemistry. 21st Revised edition. S. Chand & Company Pvt. Ltd. New Delhi.
2. Gopalan R, and Sundaram S. (2013). Allied Chemistry. IIIrd edition. Sultan Chand & Sons. New Delhi.
3. Puri BR, Sharma LR, and Kalia KC. (2017). Principles of Inorganic Chemistry. 33rd edition. Jalandar: Vishal Publishing Company.
4. Puri BR, Sharma LR, and Pathania MS. (2014). Elements of Physical Chemistry. 46th edition. Jalandhar: Vishal Publishing Company.
5. Veeraiyan V, and Vasudevan ANS. (2012). Text Book of Allied Chemistry. IInd edition. Highmount Publishing House. Chennai.

SEMESTER II

20BTU211 GENERAL MICROBIOLOGY PRACTICAL 4H - 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic principles of microscopy ultra-structure of microbes along with staining and sterilization methods.
- To understand various accessories for microbiology practicals.
- To explain the students with various aspects of basic and applied microbiology.
- To understand the biochemical characterization of isolated microbes.
- To develop practical biological skills such as staining, sterilization etc.
- To develop skills on primary screening of microorganisms.

Course Outcomes

On completion of the course, students are able to

1. Develop basic skill in aseptic techniques.
2. Have outline knowledge on isolation, sub culture and maintenance of microbes.
3. Gain experience in microbiological laboratory practices and skills in the design and execution of microbiology related research.
4. Develop skills to prepare useful media for microbial growth in the laboratory.
5. Use of handling of glass wares, minor equipment for conducting experiments.
6. Learn safety and precautionary measures for working with microbes in a laboratory.

Practicals

1. Preparation of media & sterilization methods.
2. Methods of Isolation of bacteria from different sources.
3. Enumeration of microorganism - total & viable count.
4. Basic staining methods.
5. Biochemical characterization of isolated microbes.
6. Determination of bacterial cell size by micrometry.
7. Antibiotic sensitivity of microbes.

SUGGESTED READINGS:

1. Cappuccino, J.H. and Sherman, N. (2014). Microbiology – A Lab Manual (10th Edition), The Benjamin Publishing Company, Singapore.
2. Goering R, Dockrell H, Zuckerman M, and Wakelin D. (2012). Mims' Medical Microbiology. 5th edition. Elsevier.
3. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.

Semester–II

20BTU212 CHEMISTRY PRACTICAL-II 4H–2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are is to

- Know the principles of volumetric analysis.
- Estimate the compounds by acidimetry, alkalimetry and permanganometry.
- Experimental practice of quantitative volumetric analysis.
- Understand the objective of the titration is the determination of the concentration or the mass of the minimum formula. from the titrated chemical material composing a pure liquid or a solution.
- Determine the amount of a substance in a given sample.
- To analyse the concept of concentration and Molarity

Course Outcomes

Student will be able to

1. Know the principles of quantitative analysis of inorganic compounds.
2. Calculate the estimation of sample present in a solution by volumetric analysis.
3. Understand the concepts of quantitative analysis.
4. Recognize the indicators, acid and bases used in volumetric analysis.
5. Estimate the amount of substance present in a given solution.
6. Utilize the mathematical skills doing calculations.

Volumetric analysis

A. Acidimetry & Alkalimetry

1. Estimation of sodium carbonate using standard sodium hydroxide.
2. Estimation of sodium hydroxide using standard sodium carbonate.
3. Estimation of sulphuric acid using standard oxalic acid.
4. Estimation of potassium permanganate using standard sodium hydroxide.

B. Permanganometry

1. Estimation of ferrous sulphate using standard Mohr's salt.
2. Estimation of oxalic acid using standard ferrous sulphate.
3. Estimation of calcium-direct method.

SUGGESTED READINGS:

1. Thomas AO. (2012). Practical Chemistry for B.Sc. Main Students. Scientific Book Centre. Cannanore: Kerala.
2. Ramasamy R. (2011). Allied Chemistry Practical Book. Priya Publications. Karur.
3. Venkateswaran V, Veeraswamy R, and Kulandaivelu AR. (2015). Basic Principles of Practical Chemistry. 2nd edition. S. Chand Publications. New Delhi.

SEMESTER II

20AEC201 ENVIRONMENTAL STUDIES 3H - 3C

Instruction Hours / week: L: 3 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To create awareness about environmental problems among people.
- To develop an attitude of concern for the environment.
- To motivate public to participate in environment protection and improvement.
- To learn about the environment, resources available, biodiversity and its conservation.
- To understand the current scenarios- to find ways for protection and betterment of or habitat.
- To understand the concepts and methodologies to analyze the interactions between social and environmental processes.

Course Outcomes

The learners will be able to,

1. Understand the concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Study the concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Learn the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyse and understand interactions between social and environmental processes.
6. Creating the awareness about environmental problems among people.

Unit I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit II - NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources -Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources- Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit III - BIODIVERSITY AND ITS CONSERVATION

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Unit IV - ENVIRONMENTAL POLLUTION

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Case studies/Field visit of wastewater treatment plant.

Unit V - SOCIAL ISSUES AND THE ENVIRONMENT

Concept of sustainability and sustainable development. Water conservation -Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols). Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Human population growth: Impacts on environment, human health and welfare.

SUGGESTED READINGS:

1. Anonymous. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.
2. Anubha Kaushik., and Kaushik, C.P. 2008. Perspectives in Environmental Studies. (3rd ed.). New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. 2009. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Botkin., and Keller. 2014. Environmental Science: Earth as a Living Planet. (9th ed.) Wiley
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S.Chand & Company Pvt. Ltd., New Delhi.
6. Odum,E.P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
7. Rajagopalan, R. 2016.Environmental Studies: From Crisis to Cure, Oxford University Press.
8. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
9. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
10. Tripathy. S.N., and Sunakar Panda. (2011). Fundamentals of Environmental Studies (3rd ed.). Vrianda Publications Private Ltd, New Delhi.
11. Uberoi, N.K. 2010. Environmental Studies. (2nd ed.). Excel Books Publications, New Delhi.
12. Verma, P.S., and Agarwal V.K. 2016. Environmental Biology (Principles of Ecology).S. Chand and Company Ltd, New Delhi.
13. http://172.16.25.76/course/view.php?id=685

SEMESTER - III

20BTU301 **CELL BIOLOGY** **4H - 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To provide the fundamental knowledge on structures and role of basic components in prokaryotic and eukaryotic cells.
- To understand the role of macromolecules, membranes, and organelles in cells.
- To understand the mechanism of cellular components underlying mitotic cell division.
- To understand the energy production and utilization of the cells.
- To understand the evolution and changes in the genetic composition of cells.
- To understand the gene expression regulation during organogenesis and mis-regulation in carcinogenesis.

Course Outcomes

The learners will be able to,

1. Understand the composition and function of prokaryotic and eukaryotic cells and its function.
2. Acquire information about intracellular and extracellular organelles and their functions.
3. Gain knowledge to prevent cellular abnormalities and associated disorders.
4. Apply the genetic knowledge in a variety of problem- solving situations.
5. Apply their knowledge of cell biology to selected examples of changes or losses in cell function.
6. Apply their knowledge of causal relationships between molecule and cell level phenomena.

UNIT- I Introduction:

Basic of cell biology: Cell as a basic unit: discovery of the cells, Function of cells, classification of cell types, development of cell theory, early chemical investigation in cell biology. Prokaryotic and Eukaryotic cell organization.

UNIT-II Cell organelles:

Structure and functions of cell organelles: cell membrane, cytosol, Golgi bodies, endoplasmic reticulum, ribosomes, mitochondria, chloroplasts, lysosomes, Vacuoles and micro bodies peroxisomes, glyoximes, nucleus and chromosomes.

Unit - III Cell division and interactions

Cell division - mitosis and meiosis. Cell cycle – stages of interphase and M-phase – cell synchrony and its applications. Cell-cell interactions – cell adhesion, Metabolic cooperation, electrical coupling, contact inhibition, autocrine, paracrine and endocrine signaling.

UNIT- IV Membrane Vacuolar system, cytoskeleton and cell motility:

Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

Unit - V: Cell differentiation, senescence and death

Cell differentiation in plants and animals: Fertilization, initial divisions, seed formation, germination, primordial layer formation, organogenesis (only sources of organs from each layer) Cell death and abnormalities – Biochemical changes during senescence, necrosis and programmed cell death, Cancer biology and Autophagy.

SUGGESTED READINGS:

1 Karp G. (2013). Cell and Molecular Biology: Concepts and Experiments. 7th edition. Hoboken, US: John Wiley & Sons. Inc.

2 Cooper GM, and Hausman RE. (2013). The Cell: A Molecular Approach. 6th edition. Washington, USA: ASM Press & Sunderland, D.C., Sinauer Associates.

3 Becker WM, Kleinsmith LJ, Hardin J. and Bertoni GP. (2015). The World of the Cell. 8th edition. San Francisco: Pearson Benjamin Cummings Publishing.

4 De Robertis EDP, and De Robertis E.M.F. (2017). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

5 Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter (2018). Molecular Biology of the Cell Sixth Edition Garland Science publishers.

6 http://172.16.25.76/login/index.php

7 https://nptel.ac.in/courses/102103012/

SEMESTER III

20BTU302 **GENETICS** **4H - 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To deliver the basic concepts of heredity in different living organisms.
- To gain the information about the level of genome organization in various living organisms.
- To obtain the knowledge about transmission of genetic information across generation at the individual and population level.
- To understand the identification and classification of mutations in DNA.
- To relate the structure and function of the DNA molecule, its functional role in encoding genetic material.
- To describe the basic aspects of the flow of genetic information from DNA to proteins.

Course Outcomes

The learners will be able to,

1. Acquire knowledge about the central theories and methodologies traditional, molecular and population genetics.
2. Acquire information on sex- linked inheritance and associated diseases.
3. Understand the role of genetics in breeding and natural selection.
4. Apply the principles of inheritance as formulated by Mendel.
5. Apply the Hardy-Weinberg Law in analyzing population genetics for gene frequency, sex linkage, equilibrium, and heterozygote frequency.
6. Acquire knowledge about the relationship between genetic and cytogenetic maps.

UNIT- I Introduction:

Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance. Prokaryotic genetics. Cell Cycle: Mitosis and Meiosis, Control points in cell-cycle, Cell Cycle regulators: Cyclins, Cyclin dependent kinases and Maturation promoting factor (MPF), Cell senescence and Cell death (Apoptosis): Programmed cell death, Mechanism of cell death and significance.

UNIT-II Chromosome and genomic organization:

Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, repetitive transposed sequences- SINEs & LINEs. Genetic organization of prokaryotic and viral genome. Structure and features of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. Concept of cistron, exons, introns, genetic code, gene function.

UNIT-III Mendelian genetics:

Pre-Mendelian genetic concepts: Preformation, Epigenesis, Chromosomal Theory of inheritance. Heredity and Environment: Concepts of Phenotype, Genotype, Heredity, variation, Pure lines and Inbred lines. Biography of Mendel and his experiment on pea plants, Law of Segregation and Law of Independent assortment – monohybrid, di-hybrid cross, test cross, back cross and reciprocal cross. Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT-IV Sex Determination, Sex linked disease and disorders:

Chromosomal theory of sex determinations: XX-XY, XX-XO, ZO-ZZ, ZZ-ZW; Mechanisms of Sex determination, Genic balance theory in Drosophila; Gynandromorphs; Chromosomal and Genetic mutations: Variations in chromosome structure - deletion, duplication, inversion and translocation, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants. Sex linkage, Sex linked disease and disorder: haemophilia, muscular dystrophy, down syndrome, turner syndrome, Fragile-X-syndrome; Sex linked inheritance.

UNIT-V Genetic linkage and population genetics:

Linkage and Recombination of genes in a chromosome crossing over. Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

SUGGESTED READINGS:

1. Gardner EJ, Simmons MJ, and Snustad DP. (2006). Principles of Genetics. 8th edition. John Wiley & Sons.
2. Griffiths AJF, Wessler SR, Lewontin RC, and Carroll SB. (2015). Introduction to Genetic Analysis. 11th edition W. H. Freeman & Co.
3. Leland Hartwell, Michael L. Goldberg, Janice Fischer, Leroy Hood (2017). Genetics: From genes to genomes. 6th edition. McGraw-Hill Publishers.
4. Russell PJ. (2016). Genetics- A Molecular Approach. 5th edition. Benjamin Cummings.
5. Snustad DP, and Simmons MJ. (2009). Principles of Genetics. 5th edition. John Wiley and Sons Inc. USA.

SEMESTER -III

20BTU303 MOLECULAR BIOLOGY 4H - 4C

InstructionHours/week:L:4T:0P:0 **Marks:** Internal:**40**External:**60**Total:**100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To emphasize the basic knowledge about the structure and functions of nucleic acids (DNA/RNA) and proteins.
- To obtain the adequate knowledge on the replication of DNA.
- To gain the information about the DNA damage and repair mechanisms.
- To understand the mechanisms behind gene regulations.
- To understand the mechanism behind translation and transcription.
- To understand the mutations and its significance.

Course Outcomes

The learners will be able to,

1. Achieve knowledge about the functions of nucleic acids and proteins.
2. Acquire an in-depth knowledge of chemical and molecular processes that occur within and between the cells.
3. Gain an insight into the most significant molecular and cell-based methods used today to expand our understanding of biology.
4. Acquire knowledge about the mechanisms behind gene regulations.
5. Gain knowledge about mechanism behind translation and transcription.
6. Acquire an in-depth knowledge about mutation and its significance.

UNIT-I

DNA structure and organization: DNA as genetic material, Structure of DNA, Types of DNA: A-DNA, B-DNA and Z-DNA. Organization of DNA in prokaryote and eukaryotic cells, Chromosome biology - histone and non-histone proteins, organization, structure and functions.

UNIT-II

DNA replication: Replication of DNA in prokaryotes and eukaryotes: Semi-conservative nature of DNA replication, Bi-directional replication, DNA polymerases and its types, Replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT-III

Transcription and RNA processing: RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT-IV

Regulation of gene expression and translation: Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation, Posttranslational modifications of proteins.

UNIT-V

Mutations, DNA damage, repair and homologous recombination: DNA damage and repair: causes and types of DNA damage, Spontaneous mutations, Induced mutations – physical mutagen: radiations, temperature as mutagen, chemical mutagens: alkylating agents, nitrous acid, hydroxylamine.

Mechanism of DNA repair: SOS repair, Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, non-homologous end joining. Homologous recombination: models and mechanism.

SUGGESTED READINGS:

1. Becker, W.M., Kleinsmith, L.J., Hardin. J., & Bertoni, G. P. (2009). *The World of the Cell* (7th ed.). San Francisco: Pearson Benjamin Cummings Publishing.
2. De Robertis, E.D.P., & De Robertis, E.M.F. (2011). *Cell and Molecular Biology* (8th ed.). Lippincott Williams and Wilkins, Philadelphia.
3. Karp, G. (2015). *Cell and Molecular Biology: Concepts and Experiments* (8th ed.). Hoboken, US: John Wiley & Sons. Inc.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular Biology of the Gene* (7th ed.). Cold Spring Harbour Lab. Press, Pearson Pub.

SEMESTER - III

20BTU304A **BIO- ANALYTICAL TOOLS** **3H - 3C**

InstructionHours/week:L:3T:0P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To study the bio-analytical tools and their applications.
- To have sufficient knowledge on the separation of compounds from a mixture.
- To know the application of PCR in biotechnology.
- To develop the skills to understand the theory and practice of bio analytical techniques.
- To provide scientific understanding of analytical techniques and detail interpretation of results.
- To learn how to design experiments and understand the instrumentation.

Course Outcomes

The learners will be able to,

1. Know the working principle, maintenance, and calibrations of bioanalytical tools and technique.
2. Estimate the biomolecules using the Bioanalytical tool.
3. Implement the chromatographic techniques and purify the chemical compounds.
4. Use appropriate techniques for cell fractionation.
5. Be familiar with working principals, tools and techniques of analytical techniques.
6. To understand the strengths, limitations and creative use of techniques for problem-solving.

UNIT-I

Spectrophotometry and Microscopy: Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), absorption and emission spectroscopy, florescence and electron microscopy (TEM and SEM).

UNIT-II

Cell fractionation techniques: centrifugation, ultra centrifugation, high speed centrifugation, tissue homogenization, isolation of sub-cellular organelles and particles. Flow cytometery.

UNIT-III

Chromatography: Introduction to the principle of chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, HPLC, GC-MS, and LC-MS.

UNIT-IV

Electrophoresis: Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), Agarose-gel electrophoresis, 2D- gel electrophoresis. Pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing

UNIT-V

Molecular techniques: Principal and applications of polymerase chain reactions, RT-PCR, FISH, ELISA, Western blotting, Biosensors, Biochips on Lab, Microarray.

SUGGESTED READINGS:

1. Karp, G. (2015). *Cell and Molecular Biology: Concepts and Experiments* (8th ed.). Hoboken, US: John Wiley & Sons. Inc.
2. Cooper, G.M., & Hausman, R.E. (2013). *The Cell: A Molecular Approach* (6th ed.). Washington, USA: ASMPress & Sunderland, D.C., Sinauer Associates.
3. De Robertis, E.D.P., & De Robertis, E.M.F. (2011). *Cell and Molecular Biology* (8th ed.). Lippincott Williams and Wilkins, Philadelphia.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J., & Bertoni, G. P. (2009). *The World of the Cell* (7th ed.). San Francisco: Pearson Benjamin Cummings Publishing.
5. http://172.16.25.76/course/view.php?id=1585.

SEMESTER - III

20BTU304B **I.P.R.& ENTREPRENEURSHIP** **3H - 3C**

InstructionHours/week:L:3T:0P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic knowledge of copy rights and related property rights.
- To develop the entrepreneurship skills using biological product formation.
- To provide the information of filling the patents and copy rights.
- To disseminate knowledge on trademarks and registration aspects.
- To disseminate knowledge on design, geographical Indication (GI), plant variety and layout design protection and their registration aspects.
- To learn about current trends in IPR and Govt. steps in fostering IPR.

Course Outcomes

The learners will be able to,

1. Acquire the knowledge on filling and submission of copy rights and related property rights.
2. Gain knowledge in developing new pilot scale / large scale industries and associated formalities.
3. Understand the importance of patenting /copyrights/Trade marks.
4. Acquire the knowledge on fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
5. Disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
6. Disseminate knowledge on copyrights and its related rights and registration aspects.

UNIT-I

Introduction to Indian Patent Law: World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

UNIT-II

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

UNIT-III

Entrepreneurship development: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

UNIT-IV

Establishing Entrepreneurship: Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

UNIT-V

Financing the Enterprise: Importance of finance / loans and repayments, Characteristics of Business finance, fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw materials and its management.

SUGGESTED READINGS:

1. David H. Holt. (2016). *Entrepreneurship: New Venture Creation*. 1st edition ISBN: 9789332568730, 9332568731
2. Gupta, C.B., Khanka, S.S. (2017). *Entrepreneurship and Small Business Management*. 7th edition Sultan Chand & Sons.
3. Jack M. Kaplan. (2015). *Patterns of Entrepreneurship*.
4. Pandey, N., Dharni, K. (2014) Intellectual Property Rights. PHI Learning PVT. LTD. New Delhi.
5. Sateesh, M.K. (2010). *Bioethics and Biosafety*, I. K. International Pvt Ltd.
6. Sree Krishna, V. (2007) *Bioethics and Biosafety in Biotechnology*. New age International publishers.

SEMESTER - III

20BTU311 CELL BIOLOGY PRACTICAL 4H - 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To learn the basics of prokaryotic and eukaryotic cells.
- To develop practical biological skills such as staining, sterilization, dialysis etc.
- To understand the physiology of organisms such as cell division, enzyme activity etc.
- To understand the basics of techniques to study cells.
- To handle the equipment available and identify the suitable and appropriate experiments for their experiments.
- To learn aseptic techniques and microbial culture methods.

Course Outcomes

The learners will be able to,

1. Understand the unique features of plant and animal cells.
2. Gain the practical skills on tissue mounting techniques to visualize the cell morphology.
3. Acquire knowledge about cell's response to various environmental conditions.
4. Able to differentiate the cells of various living organisms and get awareness of physiological processes of cell.
5. Able to observe and correctly identify different cell types, cellular structures using different microscopic techniques.
6. Able to handle the equipment available and identify the suitable and appropriate experiments for their experiments.

Practicals

1. Study of Prokaryotic and Eukaryotic cell structure.
2. Study the effect of temperature and organic solvents on semi permeable membrane.
3. Demonstration of dialysis.
4. Study of plasmolysis and de-plasmolysis.
5. Cell division in onion root tip.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, pancreas, kidney.
7. Cell counting methods.
8. Chromosomal banding techniques.
9. Determination of enzyme activity in organelles using sprouted seed or any other suitable source.

SUGGESTED READINGS:

1. Becker WM, Kleinsmith LJ, Hardin J. and Bertoni GP. (2015). The World of the Cell. 8th edition.San Francisco: Pearson Benjamin Cummings Publishing.
2. Cooper GM, and Hausman, RE. (2013). The Cell: A Molecular Approach. 6th edition. ASM Press & Sunderland, D.C., Sinauer Associates. Washington, USA.
3. De Robertis EDP, and De Robertis E.M.F. (2017). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G. (2013). Cell and Molecular Biology: Concepts and Experiments. 7th edition. Hoboken, US: John Wiley & Sons. Inc.

SEMESTER III

20BTU312 GENETICS PRACTICAL 4H - 2C

InstructionHours/week:L:0T:0P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To learn about the prokaryotic and eukaryotic genetic system using modern techniques.
- To inculcate knowledge on cell division stages.
- To develop skills on cell mounting techniques.
- To develop skills on karyotyping.
- To inculcate knowledge on pedigree analysis.
- To learn about the mendelian laws and the experiment outcomes.

Course Outcomes

The learners will be able to

1. Gain rich knowledge on genetic model system used in research.
2. Acquire basic knowledge on different stages in cell division.
3. Get Ideas on pedigree analysis for detection of genetic disorders.
4. Acquire basic knowledge on karyotyping.
5. Acquire basic knowledge of genetic variations among microorganisms.
6. Apply the principles of inheritance as formulated by Mendel.

Practicals

1. Permanent and temporary mount of mitosis.
2. Genetic study of model organisms and their significance
   - *a)*Bacteria: *E. coli*
   - b) *Saccharomyces* sp.
   - *c) Drosophila melanogaster*
   - *d)Arabidopsis thaliana*
3. Demonstration of - Barr Body-*Rhoeo* translocation.
4. Karyotyping with the help of photographs.
5. Pedigree charts of some common characters like blood group, colour blindness and PTC tasting.
6. Study of polyploidy in onion root tip by colchicine treatment.

SUGGESTED READINGS:

1. Gardner EJ, Simmons MJ, and Snustad DP. (2006). Principles of Genetics. 8th edition. John Wiley & Sons.
2. Griffiths AJF, Wessler SR, Lewontin RC, and Carroll SB. (2015). Introduction to Genetic Analysis. 11th edition W. H. Freeman & Co.
3. Klug WS, Cummings MR, and Spencer CA. (2018). Concepts of Genetics. 12th edition. Benjamin Cummings.
4. Russell PJ. (2016). Genetics- A Molecular Approach. 5th edition. Benjamin Cummings.
5. Snustad DP, and Simmons MJ. (2009). Principles of Genetics. 5th edition. John Wiley and Sons Inc. USA.

SEMESTER -III

20BTU313 MOLECULAR BIOLOGY PRACTICAL 4H - 2C

InstructionHours/week:L:0T:0P:4 **Marks:** Internal: **40**External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To inculcate practical skill in chromosomal and plasmid DNA separation by electrophoresis.
- To develop skills on extraction of proteins from plant and animal sources.
- To detect the reverse mutation for carcinogenicity.
- To learn what genes are and how they are inherited.
- To learn what are the solutions required for molecular biology experiments and how to prepare it.
- To understand the principles and applications of molecular biology

Course Outcomes

The learners will be able to

1. Perform the experiments for isolation, purification and visualize the nucleic acid from various sources.
2. Acquire skills on plasmid DNA extraction.
3. Gain basic knowledge on DNA extraction and separation by electrophoresis.
4. Know the protocol for detection of mutation in microbes.
5. Understand the genes are and their inheritance.
6. Know how DNA and protein control cellular activity and they respond to environment.

Practicals

1. Isolation of chromosomal DNA from plants.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method.
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA.
5. Preparation of restriction enzyme digests of DNA samples.
6. Protein Extraction and separation from bacterial cells-SDS page.
7. Demonstration of AMES test or reverse mutation for carcinogenicity.

SUGGESTED READINGS:

1. Carson, S., H. Miller, M.Srougi, D. Scott Witherow (2019). olecular Biology Techniques 4th Edition - A Classroom Laboratory Manual.Academic Press.
2. Chaitanya KV (2013). Cell and Molecular biology laboratory manual . PHI learning private limited, New Delhi.
3. Karp, G. (2013). *Cell and Molecular Biology*: Concepts and Experiments (7th ed.). John Wiley & Sons. Inc.
4. Sambrook, J., Fritsch, E.F., &Maniatis, T. (2001). *Molecular Cloning-A Laboratory Manual.* (3rd ed.). Cold Spring Harbor Laboratory Press.
5. Watson, J. D., Baker, T.A., Bell, S. P., Gann, A., Levine, M., &Losick, R. (2008). *Molecular Biologyof the Gene* (6th ed.). Cold Spring Harbour Lab. Press, Pearson Pub.

SEMESTER - III

20BTU314A BIO-ANALYTICAL TOOL PRACTICAL 3H - 1C

InstructionHours/week: L: 0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To study the bio-analytical tools and their applications.
- To have sufficient knowledge on the separation of compounds from a mixture.
- To know the application of PCR in biotechnology.
- To develop the skills to understand the theory and practice of bio analytical techniques.
- To provide scientific understanding of analytical techniques and detail interpretation of results.
- To learn how to design experiments and understand the instrumentation.

Course Outcomes

The learners will be able to

1. Know the working principle, maintenance, and calibrations of bioanalytical tools and technique.
2. Estimate the number of biomolecules using the Bioanalytical tool.
3. Implement the bioanalytical techniques to analyze the biomolecules.
4. Use selected analytical techniques.
5. Be familiar with working principle, tools and techniques of analytical techniques.
6. To understand the strengths, limitations and creative use of techniques for problem-solving.

Practicals

1. Native gel electrophoresis of proteins.
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by TLC.
6. To identify lipids in a given sample by TLC.
7. Determine the molar extinction coefficient of NADH and validity of Beer's law.

SUGGESTED READINGS:

1. Becker, W.M., Kleinsmith, L.J., Hardin. J., & Bertoni, G. P. (2009). *The World of the Cell* (7th ed.). San Francisco: Pearson Benjamin Cummings Publishing.
2. Cooper, G.M., & Hausman, R.E. (2013). *The Cell: A Molecular Approach* (6th ed.). Washington, USA: ASM Press & Sunderland, D.C., Sinauer Associates.
3. De Robertis, E.D.P., & De Robertis, E.M.F. (2011). *Cell and Molecular Biology* (8th ed.). Lippincott Williams and Wilkins, Philadelphia.
4. Karp, G. (2015). *Cell and Molecular Biology: Concepts and Experiments* (8th ed.). Hoboken, US: John Wiley & Sons. Inc.
5. http://172.16.25.76/course/view.php?id=1580

SEMESTER - III

20BTU314B I.P.R. AND ENTREPRENEURSHIP PRACTICAL 3H - 1C

InstructionHours/week: L: 0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic knowledge of copy rights and related property rights.
- To develop the entrepreneurship skills using biological product formation.
- To provide the information of filling the patents and copy rights.
- To disseminate knowledge on trademarks and registration aspects.
- To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects.
- To learn about current trends in IPR and Govt. steps in fostering IPR.

Course Outcomes

The learners will be able to

1. Acquire the knowledge on filling and submission of copy rights and related property rights.
2. Gain knowledge in developing new pilot scale / large scale industries and associated formalities
3. Understand the importance of patenting /copyrights/Trade marks.
4. Acquire the knowledge on fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
5. Disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
6. Disseminate knowledge on copyrights and its related rights and registration aspects.

Practical's

1. Proxy filing of Indian Product patent.
2. Proxy filing of Indian Process patent.
3. Planning of establishing a hypothetical biotechnology industry in India.
4. Case study on role of biotechnology-based entrepreneurship.

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SUGGESTED READINGS:

1. David H. Holt. (2016). *Entrepreneurship: New Venture Creation*. 1st edition ISBN: 9789332568730, 9332568731
2. Gupta, C.B., Khanka, S.S. (2017). *Entrepreneurship and Small Business Management*. 7th edition Sultan Chand & Sons
3. Jack Kaplan, M., (2009). *Patterns of Entrepreneurship* (3rd ed.).
4. Sateesh, M.K. (2010). *Bioethics and Biosafety*. I. K. International Pvt Ltd.
5. Sree Krishna,V. (2007). *Bioethics and Biosafety in Biotechnology.* New age international publishers.

SEMESTER - IV

20BTU401 **IMMUNOLOGY** **4H - 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** 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 elucidate the genetic basis for immunological diversity and the generation of adaptive immune Responses.
- To understand the basic knowledge of immunological processes at cellular and molecular level.
- To learn central immunological principles and concepts.

Course Outcomes

The learners will be able to,

1. Gain knowledge about the various cells and organs involved in the immune system.
2. Understand the molecular mechanisms of antigen-antibody interactions
3. Learn the theoretical basis for various immunological techniques.
4. Describe which cell types and organs present in the immune response.
5. Apply basic techniques for identifying antigen antibody interactions.
6. Illustrate various mechanisms that regulate immune responses

UNIT-I

Immune system: An overview, components of mammalian immune system, Antigens- Essential features of Ag, haptens, Carrier molecule, Immunological valence, Antigenic determinants. Adjuvants: Freund's complete and incomplete. Antibodies - Molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells).

UNIT-II

Regulation of immunoglobulin gene expression: T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination. Clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

UNIT-III

Hypersensitivity Reactions (HS): Type I: Allergies and anaphylaxis; Type II: Antibody mediated HS reactions; Mechanism and pathogenicity; Type III: Immune complex mediated HS reactions: Mechanism & pathogenicity; Type IV: Delayed type (or) cell-mediated HS reactions; Mechanisms and pathogenicity. Type V: Stimulatory HS reactions. Mechanism and pathogenesis.

UNIT-IV

Major Histocompatibility complexes: Class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases with special reference to Hashimoto's thyroiditis and Systemic Lupus Erythematosus**,** Immunodeficiency-AIDS.

UNIT-V

Vaccines & Vaccination: Adjuvant, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization Introduction to immunodiagnostics – RIA, ELISA, Immunoblotting, Immunofluorescence.

SUGGESTED READINGS:

1. Goldsby, R.A., Kindt, T.J., Osborne, B.A. (2007). *Kuby's Immunology* (6th ed.). New York: W.H. Freeman and Company.
2. Hayat, M. (2017) Immunology, (1st ed) Academic Press, New Jersey, USA.
3. Murphy, K., Travers, P., & Walport , M. (2008). *Janeway's Immunobiology* (7th ed.). New York: Garland Science Publishers.
4. Owen, J., Punt, J. and Stranford, S. (2012) Immunology, Seventh Edition, W.H. Freeman and Company Publishers, New York.
5. Peakman, M., & Vergani, D. (2009). *Basic and Clinical Immunology* (2nd ed.). Edinberg: Churchill Livingstone Publishers.
6. Prescott, L.M., Harley, J.P. and Klein, D.A. (2010) Microbiology, Eight Edition, The McGraw Hill Companies Publishers, New York.
7. Richard, C., & Geiffrey, S. (2009). *Immunology* (6th ed.). Wiley Blackwell Publication.
8. Roitt, I., Brostoff, J. and Male, D. (2012). Essential Immunology, Twelfth Edition, Wiley Blackwell Publishers, New York.
9. William E. Paul (2012) Fundamental Immunology (7th ed), Lippincott Williams and Wilkins.

SEMESTER - IV

20BTU402 BIOPROCESS TECHNOLOGY 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To learn the procedure for isolation and screening of industrial important microbes.
- To derive industrially important products from microbes.
- To acquire knowledge on downstream processing.
- To learn the principle and applications of bioprocess technology.
- To learn the fundamental calculation for bioprocessing.
- To learn the schematic diagram of upstream and downstream processing for product recovery and purification.

Course Outcomes

The learners will be able to

1. Gain overall knowledge on industrial biotechnology.
2. Obtain information about the application of industrially important microbes.
3. Know the screening, extraction and purification of enzymes.
4. Designing of bioreactors for large scale production of desired products.
5. Select and optimize media for maximum production of microbial metabolites.
6. Designing of protocols for strain improvement and separation of molecules after fermentation process.

UNIT- I

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture. Types of fermentation- submerge and solid state; aerobic and anaerobic fermentation.

UNIT-II

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Stirred tank; Cyclone Column; trickled bed; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inoculum development and sterilization.

UNIT-III

Bioreactor control and monitoring, Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT-IV

Downstream processing: Sedimentation, Filtration, Centrifugation, Cell disruption, Chromatography, liquid-liquid extraction, product recovery, purification, drying, and crystallization. Effluent treatment, sludge process, waste disposal.

UNIT-V

Application of bioprocess technology: Microbial production of ethanol, amylase, lactic acid, citric acid and Single Cell Proteins (algal mediated and fungal mediated). Fermentation economics.

SUGGESTED READINGS:

1. Casida, LE. (1991). *Industrial Microbiology*. (1st ed.). Wiley Eastern Limited.
2. Crueger, W., & Crueger, A. (2017). *Biotechnology: A textbook of Industrial Microbiology* (3rd ed.). Medtech.
3. Patel, A.H. (1996). *Industrial Microbiology*. (1st ed.). Macmillan India Limited.
4. Patel, A.H. (2011). *Industrial Microbiology*. (2nd ed.). Laxmi Publications
5. Stanbury, P.F., Whitaker, A. & S.J. Hall. (2008). *Principles of fermentation technology*. (2nd ed.).

SEMESTER - IV

20BTU403 RECOMBINANT DNA TECHNOLOGY 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To learn the procedure for isolation of nucleic acids and proteins.
- 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 utilize versatile tools and techniques employed in recombinant DNA technology.
- To learn the history and recent developments in rDNA technology.

Course Outcomes

On completion of the course, students are able to

1. Outline the fundamental steps in genetic engineering techniques.
2. Describe the mechanism of action and the use of restriction enzymes in biotechnology research
3. Explain the procedures for plasmid preparations.
4. Discuss cloning strategies and techniques used to probe DNA for specific gene of interest.
5. Conceptualize PCR technique in medical and forensic science.
6. Summarize various applications of rDNA technology in human health care and safety regulations.

UNIT-I

Introduction to r-DNA technology: Basic tools and applications – isolation and purification of nucleic acids, Enzymes used in cloning - restriction enzymes, ligases, polymerases, kinases, phosphatases. Expression vectors and cloning vector types (bacteriophage-derived, artificial chromosomes), Gene recombination and gene transfer – transformation, transfection, microinjection, electroporation, ultrasonication.

UNIT-II

Selection and screening of recombinant clones: Probes – radio labeled and non-radio-labeled, guessmer and degenerate probes. Sequence dependent and independent screening, southern, northern hybridization, colony and plaque hybridization, *in situ* chromosomal hybridization, chromosome walking, Genome mapping, DNA fingerprinting, Polymerase chain reaction (PCR), RT- (Reverse transcription) PCR.

UNIT-III

Expression and characterization of cloned DNA: Optimization of protein expression in heterologous systems, Fusion proteins, *In vitro* translation systems. Preparation and comparison of Genomic and cDNA library. Expression vector GFP and RFP.

UNIT-IV

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

UNIT-V

Applications of Genetic Engineering: In plants: use of *Agrobacterium tumefaciens* and *A. rhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

In animals: Production and applications of transgenic mice, role of embryonic stem cells in gene targeting in mice, Therapeutic products - blood proteins, human hormones, immune modulators and vaccines (one example each). Ethical, legal and social issues.

SUGGESTED READINGS:

1. Brown, T.A., (2016). *Gene Cloning and DNA Analysis* (7th ed.). Wiley-Blackwell.
2. Clark, D.P., & Pazdernik, N.J. (2009). *Biotechnology-Applying the Genetic Revolution*. USA: Elsevier Academic Press.
3. Glick, B.R., & Patten C. L. (2017). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. (5th ed.). Washington: ASM Press.
4. Primrose, S.B., & Twyman, R.M. (2013). *Principles of Gene Manipulation and Genomics* (7th ed.). Wiley-Blackwell.

SEMESTER - IV

20BTU404A PLANT PHYSIOLOGY 3H - 3C

InstructionHours/week: L: 3 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the physiological conditions of the plants and metabolism.
- To understand the basic concepts of Photosystems and their importance in plant growth.
- To gain the information about the economic importance of algae and fungi.
- To acquire adequate knowledge on plant development, biochemistry, and their metabolism.
- To be familiar with cutting edge technology employed in contemporary plant biology.
- To integrate the acquired knowledge of plant physiology with cultural, social, and legal aspects of their lives.

Course Outcomes

The learners will be able to

1. Gain adequate knowledge on plant physiology and its importance.
2. Understand the molecular mechanisms of macro and micro nutrients in plant growth.
3. Get the basic and applied knowledge of plant growth, development and metabolism.
4. Impart an insight into plant water relations.
5. Understand the mechanism of various metabolic processes in plants.
6. Equip students with skills and techniques related to plant physiology to design their own experiments.

UNIT-I

Anatomy: The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi- ventral and isobilateral leaf).

UNIT-II

Plant water relations and micro & macro nutrients: Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport.

UNIT-III

Carbon and nitrogen metabolism: Photosynthesis- Photosynthesis pigments, concept of two photo systems, photphosphorylation, calkin cycle, CAM plants, photorespiration, compensation point. Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

UNIT-IV

Growth and development: Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene). Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization.

UNIT-V

Stress Physiology: Stress adaptation mechanism: Definitions, Indicators of stress response - morphological, physiological, biochemical and molecular level. Stress adaptation and tolerance mechanism – biotic and abiotic stress, Effect of stress on crop productivity, Global warming - physiological effects on crop productivity. Metallothioneins.

SUGGESTED READINGS:

1. Bhatnager, S.P. & Moitra, A. (1996). *Gymnosperms.* New Delhi: New Age International (P) Ltd. Publishers.
2. Dickinson, W.C. (2000). *Integrative Plant Anatomy.* USA: Harcourt Academic Press.
3. Esau, K. (2009) *Anatomy of Seed Plants.* 3rd edition. Wiley Publishers.
4. Hopkins,W.G., & Huner, P.A. (2008). *Introduction to Plant Physiology*. John Wiley & Sons.
5. Salisbury, F.B, & Ross, C.W. (1992). *Plant Physiology.* Wadsworth Publishing Co. Ltd.
6. Sambamurty, (2008). *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. IK International Publishers.
7. Taiz, L., & Zeiger, E. (2010). *Plant Physiology* (5th ed.). MA: USA, Sinauer Associates Inc.

SEMESTER - IV

20BTU404B ANIMAL PHYSIOLOGY 3H - 3C

Instruction Hours / week: L: 3 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic mechanism of various systems in animal growth.
- To provide an in-depth knowledge of the diversity on structure and habits of invertebrates.
- To learn the basics of systematic and understand the hierarchy of different categories.
- To obtain an overview economically important invertebrate fauna.
- To learn about muscle physiology.
- To understand endocrine co-ordination.

Course Outcomes:

The learners will be able to

1. Outline the origin and classification of animal kingdom.
2. Know the relationship between animal diversity and evolutionary derived changes in animal system.
3. Get information on the diverse physiological activities in animal system.
4. Know the mechanism of generation & propagation of nerve impulse.
5. Understand the plasma proteins & their role.
6. Able to explain the mechanism of action of hormones.

UNIT I: Digestion and Respiration

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice Respiration: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift.

UNIT II: Circulation

Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

UNIT III: Muscle physiology

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, mechanism of muscle contraction.

UNIT IV: Nervous System

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters.

UNIT V: Endocrine coordination

Mechanism of action of hormones (insulin and steroids), Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

SUGGESTED READINGS:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002). *The Invertebrates: A New Synthesis* (3rd ed.). Blackwell Science.
2. Barrington, E.J.W. (1979). *Invertebrate Structure and Functions* (2nd ed.). E.L.B.S. and Nelson.
3. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
4. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
5. Kent, G.C., & Carr, R.K. (2000). *Comparative Anatomy of the Vertebrates* (9th ed.). The McGraw-Hill Companies.
6. Myers, P., Espinosa, R., Parr, C. S., Jones, T., Hammond, G. S., & Dewey, T. A. (2006). The Animal Diversity Web. 12 , 2.
7. Ruppert, Edward, E., Fox Richard, S. & Barnes Robert, D. (2009). *Invertebrate Zoology: A Functional Evolutionary Approach* (7th ed.). Thomson Brooks/Cole.

SEMESTER - IV

20BTU411 IMMUNOLOGY PRACTICAL 4H - 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basic concepts of immunology.
- To train the students to use these principles of immune system to combat infections.
- To gain the information about the auto immune diseases.
- To familiarize students with the various immunological techniques.
- To identify the cellular and molecular basis of immune responsiveness.
- To describe immunological response and how it is triggered and regulated.

Course Outcomes

The learners will be able to

1. Gain knowledge on the various components of immune system.
2. Understand the molecular mechanisms behind the immune response evoked after infection by various pathogens.
3. Demonstrate Hemagglutination assay.
4. Perform ELISA test
5. Separate serum from blood sample.
6. Do immunoblotting

Practicals

1. Differential leucocytes count.
2. Total leucocytes count.
3. Total RBC count.
4. Haemagglutination assay.
5. Haemagglutination inhibition assay.
6. Separation of serum from blood.
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.
9. Immuno blotting.

SUGGESTED READINGS:

1. Abbas, A.K., Lichtman, A.H., & Pillai, S. (2011). *Cellular and Molecular Immunology* (7th ed.). Philadelphia: Saunders Publication.
2. Delves, P., Martin, S., Burton, D., & Roitt, I.M. (2017). *Roitt's Essential Immunology* (13th ed.). Wiley- lackwell Scientific Publication, Oxford
3. Goldsby, R.A., Kindt, T.J., Osborne, B.A. (2013). *Kuby's Immunology* (7th ed.). New York: W.H. Freeman and Company.
4. Murphy, K., Travers, P., Walport, M. (2017). *Janeway's Immunobiology* (9th ed.).New York : Garland Science Publishers.
5. Peakman, M. & Vergani, D. (2009). *Basic and Clinical Immunology* (2nd ed.). Edinberg: Churchill Livingstone Publishers.
6. Richard, C., & Geiffrey, S. (2009). *Immunology* (6th ed.). Wiley Blackwell Publication.

SEMESTER - IV

20BTU412 BIOPROCESS TECHNOLOGY PRACTICAL 4H - 2C

InstructionHours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To learn the procedure for isolation, screening of industrial important microbes.
- To derive industrially important enzymes from microbes.
- To acquire knowledge on the application of amylase.
- To learn the production method of ethanol.
- To learn the fundamental calculation in bioprocessing.
- To know the protocol for liquid-liquid extraction.

Course Outcomes

The learners will be able to

1. Calculate thermal death point.
2. Design bioreactor
3. Perform amylase activity
4. Demonstrate the working principle of fermenter.
5. Perform liquid-liquid extraction.
6. Do bacterial growth analysis

Practicals

1. Isolation of industrially important microorganism from natural resources.
2. Bacterial growth curve.
3. Calculation of thermal death point (TDP) of microbial samples.
4. Production and analysis of ethanol.
5. Production and analysis of amylase.
6. Production and analysis of lactic acid.
7. Demonstration: Fermentors working principle.
8. Liquid - liquid extraction of microbial metabolites using non polar solvents.

SUGGESTED READINGS:

1. Casida, L.E. (1991). *Industrial Microbiology* (1st ed.). Wiley Eastern Limited.
2. Crueger, W., & Crueger, A. (2017). *Biotechnology: A textbook of Industrial Microbiology* (3rd ed.). Medtech.
3. Patel, A.H. (2011). *Industrial Microbiology*. (2nd ed.). Laxmi Publications
4. Stanbury, P.F., Whitaker, A. & S.J. Hall. (2008). *Principles of fermentation technology*. (2nd ed.). Elsevier Science Ltd.

SEMESTER - IV

20BTU413 RECOMBINANT DNA TECHNOLOGY PRACTICAL 4H - 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To learn the procedure for isolation of chromosomal DNA.
- To learn the strategies of cloning.
- To acquire knowledge on plasmid DNA isolation.
- To familiarize the student with PCR technique.
- To acquaint the students to get knowledge on competent cell preparation
- To learn principles of restriction digestion techniques.

Course Outcomes

On completion of the course, students are able to

1. Isolate chromosomal DNA. .
2. Demonstrate PCR.
3. Perform restriction digestion of plasmid
4. Do the transformation of competent cells.
5. Analyze the DNA both qualitatively and quantitatively.
6. To perform plasmid DNA isolation

Practicals

1. Isolation of chromosomal DNA from plant cells.
2. Isolation of chromosomal DNA from Liver.
3. Qualitative and quantitative analysis of DNA using spectrophotometer and agarose gel Electrophoresis.
4. Plasmid DNA isolation.
5. Restriction digestion of DNA/ Plasmid DNA.
6. Ligation of DNA insert into plasmid vector.
7. Preparation of Competent cells.
7. Transformation of competent cells.
8. Demonstration of PCR.

SUGGESTED READINGS:

1. Brown, T.A., (2016). *Gene Cloning and DNA Analysis* (7th ed.). Wiley-Blackwell.
2. Primrose, S.B., & Twyman, R.M. (2013). *Principles of Gene Manipulation and Genomics* (7th ed.). Wiley-Blackwell.
3. S. Janarthanan & S. Vincent (2007), Practical Biotechnology, Methods & Protocol, Universities press, India.
4. Sambrook, J., Fritsch, E.F., & Maniatis, T. (2001). *Molecular Cloning-A Laboratory Manual.* (3rd ed.). Cold Spring Harbor Laboratory Press.

SEMESTER - IV

20BTU414A PLANT PHYSIOLOGY PRACTICAL 3H - 1C

InstructionHours/week: L: 0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To know the preparation of stained mounts.
- To understand the guttation on leaf tips.
- To understand the process stomatal opening and closing.
- To understand the respiration in higher plants with particular emphasis on aerobic and anaerobic respiration.
- To learn about the movement of sap and absorption of water in plant body.
- To understand the preparation of root nodules.

Course Outcomes

The learners will be able to

1. Demonstrate plasmolysis.
2. Perform opening and closing of stomata.
3. Separate photosynthesis pigments by paper chromatography.
4. Demonstrate guttation on leaf tips.
5. Demonstrate aerobic respiration.
6. Prepare the root nodules from leguminous plants.

Practicals

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of plasmolysis by *Tradescantia* leaf peel.
3. Demonstration of opening & closing of stomata
4. Demonstration of guttation on leaf tips of grass and garden nasturtium.
5. Separation of photosynthetic pigments by paper chromatography.
6. Demonstration of aerobic respiration.
7. Preparation of root nodules from a leguminous plant.

SUGGESTED READINGS:

1. Dickinson, W.C. (2000). *Integrative Plant Anatomy.* USA: Harcourt Academic Press.
2. Salisbury, F.B., & Ross, C.W. (1991). *Plant Physiology*. Wadsworth Publishing Co. Ltd.
3. Taiz, L., & Zeiger, E. (2006). *Plant Physiology* (4th ed.). MA: USA, Sinauer Associates Inc.
4. Vander-Poorteri 2009 Introduction to Bryophytes. COP
5. Webster, J. and Weber, R. 2007 Introduction to Fungi. 3rd edition, Cambridge University Press, Cambridge.

SEMESTER - IV

20BTU414B **ANIMAL PHYSIOLOGY PRACTICAL** **3H -1C**

Instruction Hours/week: L:0 T: 0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To gain practical exposure on identification of various blood cells.
- To understand the haemoglobin and its determination methods.
- To provide with an in-depth knowledge of the blood cells in animal physiology.
- To know Counting of mammalian RBCs.
- To handle the equipments with safety measures.
- To provide with Good laboratory practices.

Course Outcomes:

The learners will be able to

1. Recognize the blood cells and their components.
2. Acquire skills on examining and handling enzymes.
3. Handle the techniques on counting the red and white blood cells.
4. Demonstrate the enzyme's action.
5. Understand Coagulation and its principle.
6. Perform TLC and DLC.

Practicals

1. Finding the coagulation time of blood.
2. Determination of blood groups.
3. Counting of mammalian RBCs.
4. Determination of Haemoglobin.
5. Determination of TLC and DLC.
6. Demonstration of action of an enzyme.

SUGGESTED READINGS:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002). *The Invertebrates: A New Synthesis* (3rd ed.). Blackwell Science.
2. Barrington, E.J.W. (1979). *Invertebrate Structure and Functions* (2nd ed.). E.L.B.S. and Nelson.
3. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
4. Kent, G.C., & Carr, R.K. (2000). *Comparative Anatomy of the Vertebrates* (9th ed.). The McGraw-Hill Companies.
5. Ruppert, Edward, E., Fox Richard, S. & Barnes Robert, D. (2009). *Invertebrate Zoology: A Functional Evolutionary Approach* (7th ed.). Thomson Brooks/Cole.

SEMESTER - V

20BTU501 PLANT & ANIMAL BIOTECHNOLOGY 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To introduce biotechnological methods for production of transgenic plants and animals.
- To give knowledge about various methods of gene transfer in plants and animals.
- To cognize and get the knowledge on micro propagation to protect endangered plants.
- To explain the basics of the physiological and molecular processes that occur during plant and animal growth and development and during environmental adaptations.
- To use basic biotechnological techniques to explore molecular biology of plants and animals.
- To understand the processes involved in the planning, conduct and execution of plant and animal biotechnology experiments.

Course Outcomes

On completion of the course, students are able to

1. Understand the growth conditions required to culture the plants and animals' cells in *in-vitro* conditions.
2. Inculcate the deep understanding of gene expression system of plants and animals.
3. Acquire knowledge on producing transgenic plants and animals.
4. Inculcate the deep knowledge involved in the planning, conduct and execution of plant and animal biotechnology experiments.
5. Learn the structure and organization of plant and animal genome.
6. Learn the basic techniques for hybridization in producing transgenic plants and animals.

UNIT - I

Micropropagation: Tissue culture media – composition and preparation, Callus and suspension culture, somaclonal variation, micropropagation, organogenesis, somatic embryogenesis, Embryo culture and embryo rescue. Haploidy; protoplast fusion and somatic hybridization; cybrids; anther, pollen and ovary culture for production of haploid plants and homozygous lines. Plant hardening transfer to soil, green house technology.

UNIT - II

Plant genetic engineering: Methodology; Plant transformation with Ti plasmid of *Agrobacterium tumifacians*; Ti plasmid derived vector systems, Ri plasmids; Physical methods of transferring genes to plants - Microprojectile bombardment, Electroporation; Manipulation of gene expression in plants; Production of marker free transgenic plants.

UNIT -III

Animal Cell culture: Types, disaggregation of tissue, primary culture, established culture; suspension culture, organ culture, embryo culture, three-dimensional culture and tissue engineering, feeder layers; cell synchronization; cryopreservation. Biology and characterization of cultured cells, tissue typing; cell – cell interaction; measuring parameters of growth; measurement of cell death – apoptosis and its determination.

UNIT-IV

Animal genetic engineering: **Molecular cell techniques:** cell transformation- physical, chemical and biological methods; manipulation of genes; cell and organism cloning; green fluorescent protein and its application. Gene therapy. *In vitro* fertilization and stem cell research.

UNIT - V

Applications of plant and animal genetic transformation:

In Plants: Productivity and performance: herbicide resistance, insect resistance, virus resistance, fungal resistance, nematode resistance, Induction of abiotic stress and cold stress. Delay in fruit ripening, LEA protein, plantibodies, edible vaccines - primary and secondary metabolite modification, biopolymers, plant-based enzyme engineering.

In Animal: Transgenic animals; transgenic animals as models for human diseases; transgenic animals in live- stock improvement; Ethical issues in animal biotechnology.

SUGGESTED READINGS:

1. Bhojwani, S.S., &Razdan, (2004). *Plant Tissue Culture and Practice*.
2. Brown, T.A., (2006). *Gene Cloning and DNA Analysis* (5th ed.). Oxford: UK, Blackwell Publishing.
3. Chawla, H.S. (2018). *Introduction to Plant Biotechnology* (3rd ed.). CRC Press, Florida, United States.
4. Freshney, R.I. (2000). *Animal Cell Culture: A Practical Approach* (3rd ed.). Oxford University Press, Oxford, United Kingdom.
5. Gardner, E.J., Simmonns, M.J., & Snustad, D.P. (2008). (8th ed.). *Principles of Genetics*. India: Wiley.
6. Gleba, Y. Y., & Giritch, A. (2012). Vaccines, antibodies, and pharmaceutical proteins. In *Plant Biotechnology and Agriculture* (pp. 465-479). Academic Press.
7. Glick, B.R. & Patten, C.L. (2017). *Molecular Biotechnology* (5th ed.). Taylor & Francis Publishers, Abingdon, United Kingdom.
8. Gordon, I. (2003). *Laboratory Production of Cattle Embryos* (2nd ed.). New Delhi: CABI Publishers, Wallingford, United Kingdom.
9. Halford, N. (2006). *Plant Biotechnology: Current and Future Applications of Genetically Modified Crops*. Wiley-Blackwell, New Jersey, United States.
10. Raven, P.H., Johnson, G.B., Losos, J.B., & Singer, S.R. (2005). *Biology.* Tata MC Graw Hill.
11. Reinert, J., & Bajaj, Y.P.S. (1997). *Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture*. Narosa Publishing House.
12. Russell, P.J. (2009). *Genetics – A Molecular Approach* (3rd ed.). Benjamin Co.
13. Sambrook, & Russel. (2012). *Molecular Cloning: A laboratory manual* (4th ed.). Cold Spring Harbor Laboratory Press.
14. Slater, A., Scott, N.W., & Fowler, M.R. (2008). *Plant Biotechnology: The Genetic Manipulation of Plants.* Oxford University Press.

SEMESTER - V

20BTU502A **BIOINFORMATICS** **4H - 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To give knowledge on bioinformatics and its application
- To offer knowledge on biological databases.
- To understand and analyze the protein/nucleotide sequences and to predict its 3D structure.
- To understand the various online databases for submitting and retrieving data's.
- To understand how the phylogeny plays a vital role in finding ambiguities.
- To get practiced with the tools and techniques for analyzing the data.

Course Outcomes

On completion of the course, students are able to

1. Understand the relationship between sequence - structure - function of genes.
2. Familiarize with the algorithms required to compare sequences and require to know the phylogenetic relationship between the gene sequences.
3. Inculcate knowledge on building 3D structures of genes.
4. Locate and use the main databases at the NCBI and EBI resources.
5. Know the difference between databases, tools, repositories and be able to use each one to extract specific information.
6. Use selected tools at NCBI and EBI to run simple analyses on genomic sequences.

UNIT-I

History and milestone of Bioinformatics: Introduction to Bioinformatics – History and Milestones. Data sequence sources- NCBI, EMBL, GenBank, Entrez, UNIGENE. Human genome project.

UNIT-II

Basic concepts of biomolecules: Protein and amino acid, DNA and RNA - Sequence, Structure and function. Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

UNIT-III

Sequence and Phylogeny analysis: Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis. Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT-IV

Biological databases: Types of databases, Sequence databases, Nucleic acid sequence databases - Primary (GenBank, EMBL, DDBJ), Secondary (UniGene, SGD, EMI Genomes, Genome Biology), Protein sequence database – Primary (PIR, SWISS-PROT), Secondary (PROSITE, Pfam), Structural databases (PDB, SCOP, CATH), Bibliographic databases and Organism specific databases.

UNIT-V

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools. Gene prediction: Gene prediction in prokaryote and eukaryotes. Extrinsic approaches and Ab initio approaches. Predicting the protein secondary structure (Domain, blocks, motifs), Predicting protein tertiary structure (Homology, Ab-initio, threading and fold recognition) and visualization of predicted structure.

SUGGESTED READINGS:

1. Shaik, N.A., Hakeem, K.R., Banaganapalli, B. and Elango, R. eds., 2019. *Essentials of Bioinformatics, Volume II: In Silico Life Sciences: Medicine*. Springer Nature.
2. Shanker, A. ed., 2018. *Bioinformatics: Sequences, Structures, Phylogeny*. Springer Ghosh, Z. & Bibekanand M. (2008). *Bioinformatics: Principles and Applications*. Oxford UniversityPress.
3. Pevsner, J. (2009). *Bioinformatics and Functional Genomics* (2nd ed.). Wiley-Blackwell.
4. Campbell, A.M., & Heyer, L.J. (2006). *Discovering Genomics, Proteomics and Bioinformatics* (2nd ed.). Benjamin Cummings.
5. Syed Ibrahim.K., GuruSubramanian, G., Zothansarga, yadav, R.P., Senthil Kumar N., Pandian, S.K., Borah., P., Mohan S., 2017. Bioinformatics- A student's companion.

SEMESTER - V

20BTU502B GENOMICS AND PROTEOMICS 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To import the basic and recent developments in the field of genome sequencing, genome mapping, proteomic data analysis.
- To develop the knowledge on gene sequencing methods.
- To know the structure and interactions of proteins.
- To describe advanced genomics and proteomics technologies and the ways in which their data are stored.
- To use bioinformatics techniques to query examples of genomic and proteomic databases to analyse cell biology.
- To describe the different types of genome variation and their relationship to human diseases.

Course Outcomes

On completion of the course, students are able to

1. Have a clear understanding on the application of genetic markers in genome mapping.
2. Application of 2D technique to analyze the structure of protein.
3. Analyze the genomic and proteomic data.
4. Acquire knowledge and understanding of fundamentals of genomics and proteomics,
5. Discuss how biological systems information relating to genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells.
6. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.

UNIT-I

Introduction to Genomics: Genes, Pseudogenes and Gene structure – Human genome project - DNA sequencing methods –manual and automated strategies - Maxam and Gilbert method; Sangers method; Pyrosequencing. Genome Sequencing: Shotgun and Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT-II

Managing and Distributing Genome Data: Web based servers and software for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Organism-specific databases – FlyBase and OMIM; Three-dimensional structure database – PDB; Protein classification databases – CATH and SCOP.

UNIT-III

Genomic mapping: Genetic markers – RFLP, VNTR, mini and micro satellites, STS, SNPs, ESTs. Genome maps; Mapping techniques; Physical and genetic mapping; FISH and Restriction mappings; Map resources; Practical uses genome maps.

UNIT-IV

Introduction to protein structures: Proteins – protein diversity – Protein folds – Primary structures – Edman degradation – Secondary structures and their unique features – Tertiary structures - Physical interactions stabilizing proteins - Short-range interactions, electrostatic forces, van der Waal interactions, hydrogen bonds, Hydrophobic interactions. Structural characterization of proteins - Sedimentation analysis, Gel filtration, Native PAGE and SDS-PAGE.

UNIT-V

Introduction to Proteomics: Analysis of proteomes - 2D-PAGE - Sample preparation, solubilization, reduction, resolution - Reproducibility of 2D-PAGE. Mass spectrometry-based methods for protein identification - ESI-MS and its applications; *De novo* sequencing using mass spectrometric data.

SUGGESTED READINGS:

1. Bhat S., (2008). Genomics, Bioscience Publishing, New Delhi,
2. Devarajan Thangadurai, Jeyabalan Sangeetha, (2015). Genomics and Proteomics: Principles, Technologies, and Applications. CRC Press, Tylor& Francis Group
3. Glick, B.R., & Patten C. L. (2017). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. (5th ed.). Washington: ASM Press.
4. Lesk A.M., (2014). Introduction to Bioinformatics, (4th ed.). Oxford University Press, UK.
5. Primrose, S.B., &Twyman, R.M. (2013). *Principles of Gene Manipulation and Genomics* (7th ed.). Wiley-Blackwell.
6. Tamarin, R. H. (2017). *Principles of Genetics* (7th ed.). McGraw Hill Education.
7. Timothy P., (2007). Proteomics, SPRINGER.

SEMESTER - V

20BTU503A PLANT DIVERSITY - I 4H - 4C

Instruction Hours/week: L:4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To understand the physiological conditions of the plants and metabolism.
- To understand the basic concepts of photosystems and their importance in plant growth.
- To gain the information about the economic importance of algae and fungi.
- Learn about the structure, pigmentation, food reserves and methods of reproduction of Algae.
- Learn about the structure, pigmentation, food reserves and methods of reproduction of Fungi.
- Studied some plant diseases with special reference to the causative agents, symptoms, etiology and control measures.

Course Outcomes

The learners will be able to,

1. Gain adequate knowledge on plant biodiversity and importance.
2. Understand the molecular mechanisms of macro and micro nutrients in plant growth.
3. Get the basic and applied knowledge of plant physiology, growth, development and metabolism.
4. Discuss about importance of morphological structure, classification, reproduction and economic importance of Algae.
5. Know the control measures of plant diseases.
6. Explain about structure, classification, reproduction, life cycle and economic importance of Bryophytes.

UNIT-I

Algae: General character, classification and economic importance. Life histories of algae belonging to various classes: Chlorophyceae – *Volvox, Oedogonium,* Xanthophyceae –*Vaucheria,* Phaeophyceae – *Ectocarpus,* Rhodophyceae-*Polysiphonia*

UNIT-II

Fungi: General characters, classification & economic importance. Life histories of Fungi: Mastigomycontina-*Phytophthora,* Zygomycotina - *Mucor,* Ascomycotina- *Saccharomyces,* Basidomycotina - *Agaricus,* Deutromycotina-*Colletotrichum*

UNIT-III

Lichens: Classification, general structure, reproduction and economic importance.

UNIT-IV

Bryophytes: General characters, classification & economic importance. Life histories of following: *Marchantia, Funaria.*

UNIT-V

Plant Diseases: Casual organism, symptoms and control of following plant diseases. Rust and Smut of Wheat. White rust of Crucifers. Late blight of Potato. Red rot of Sugarcane. Citrus Canker.

SUGGESTED READINGS:

1. Lee, R.E. (2008). *Phycology* (4th ed.). USA: Cambridge University Press.
2. Pandey B P (1979), *College Botany Volume I, 20/e,* S. Chand Publishing, New Delhi.
3. Pandey B P (2014), *College Botany Volume 20,* S. Chand Publishing, New Delhi.
4. Sambamurty, (2008). *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. IK : International Publishers.
5. Shaw, A.J., & Goffinet, B. (2000). *Bryophyte Biology*. Cambridge University Press.
6. Van den Hoek, C., Mann, D.J. & Jahns, H.M. (1995). *Algae: An introduction to Phycology.* Cambridge Univ. Press.
7. Vander-Poorteri, (2009). *Introduction to Bryophytes*. COP.
8. Webster, J. & Weber, R. (2007). *Introduction to Fungi* (3rd ed.). Cambridge: Cambridge University Press.

SEMESTER - V

19BTU503B **ANIMAL DIVERSITY - I** **4H - 4C**

Instruction Hours/week: L:4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3

Course Objectives

The main objectives of the course are,

- To provide the students with an in-depth knowledge of the diversity in form, structure and habits of invertebrates.
- To learn the basics of systematic and understand the hierarchy of different categories.
- To learn the diagnostic characters of different phyla through brief studies of examples.
- To obtain an overview of economically important invertebrate fauna.
- To explain the organizational hierarchies and complexities of invertebrates.
- To describe the evolutionary trends in external morphology and internal structure.

Course Outcomes

The learners will be able to

1. Outline the origin and classification of animal kingdom
2. Describe the origin of animals and how they differ from other living organisms.
3. Explain the relationship between animal diversity and evolutionary derived changes in animal body Plans.
4. Analyze the various modes of adaptations in animals.
5. Identify and classify with examples the invertebrates.
6. Analyze the various modes of adaptations in animals.

UNIT- I

a) Outline of classification of Non- Chordates up to subclasses. Coelomata, Acoelomata, Symmetries, Deutrostomes, Protostomes.

b) Protozoa: Locomotion, Reproduction, evolution of Sex, General features of *Paramecium* and *Plasmodium*. Pathogenic protozoans.

UNIT-II

a) Porifera: General characters, outline of Classification; skeleton, Canal System

b) Coelenterata: General Characters, Outline of classifications Polymorphism, Various types of stinging cells; Metagenesis, coral reefs and their formation.

UNIT-III

a) Platyhelminthes- General Characters; Outline of classification; Pathogenic flatworms: Parasitic adaptations.

b) Aschelminthes: General features, Outline of classification, Pathogenic roundworms and their vectors in relation to man: Parasite adaptation.

UNIT-IV

a) Annelida: - General features, Outline of classification, Coelom: Metameric segmentation, General features of Earthworm, Vermicomposting.

b) Arthropoda: General Features, Outline of Classification; Larval forms of crustacean, Respiration in Arthropoda; Metamorphosis in insects; Social insects; Insect vectors of diseases; Apiculture, Sericulture.

UNIT-V

a) Mollusca: general features, Outline of classification, Shell Diversity; Torsion in gastropoda,

b) Echinodermata: General features, Outline of Classification Larval forms

c) Hemichordata: Phylogeny: Affinities of *Balanoglossus.*

SUGGESTED READINGS:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002). *The Invertebrates: A New Synthesis* (3rd ed.). Blackwell Science.
2. Barrington, E.J.W. (1979). *Invertebrate Structure and Functions* (2nd ed.). E.L.B.S. and Nelson.
3. Kent, G.C., & Carr, R.K. (2000). *Comparative Anatomy of the Vertebrates* (9th ed.). The McGraw-Hill Companies.
4. Myers, P., Espinosa, R., Parr, C. S., Jones, T., Hammond, G. S., & Dewey, T. A. (2006). The Animal Diversity Web. 12, 2.
5. Ruppert, Edward, E., Fox Richard, S. & Barnes Robert, D. (2009). *Invertebrate Zoology: A Functional Evolutionary Approach* (7th ed.). Thomson Brooks/Cole.

SEMESTER - V

20BTU504A EVOLUTIONARY BIOLOGY 3H - 3C

InstructionHours/week:L:3T:0P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain basic concepts of life and gradual evolution of human and other animals.
- To ascertain the evolutionary concepts through fossil study of Eukaryotes from Prokaryotes.
- To explain Origin of Life especially Prokaryotes as well as Eukaryotes in detail.
- To give detailed explanation of key concepts of Population Genetics in terms of Hardy-Weinberg Law, Genetic Drift and Types of Natural Selection.
- To provide adequate knowledge about Micro-evolutionary changes, Speciation and Adaptive Radiation.
- To impart descriptive knowledge regarding Origin and Evolution of Man.

Course Outcomes

On completion of the course, students are able to

1. Get hold of the knowledge on fundamentals of Evolutionary Biology.
2. Expertise on the concepts of evolution, chromosomal aberrations; recombination and random assortment.
2. Acknowledge on the Qualitative Studies Based on Field Observations.
3. To develop comprehensive knowledge regarding various Sources of Variations and their role in evolution.
4. To explore salient features of various theories of evolution comprising of Lamarckism, Darwinism and Neo-Darwinism.
5. To impart detailed understanding of Analogy, Homology, Paleontological Evidences, Embryological Evidences and Molecular Phylogeny.

UNIT- I

Historical Review of Evolutionary Concept: Pre-Darwinian ideas -Lamarckism – Merits and demerits. Darwinism – Merits and demerits, Post-Darwinian era –Modern synthetic theory; and the theory of population genetics leading to Neo-Darwinism

UNIT- II

Life's Beginnings: Chemogeny – An overview of pre-biotic conditions and events; experimental proofs to abiotic origin of micro- and macro-molecules. Current concept of chemogeny – RNA first hypothesis. Biogeny – Cellular evolution based on proto-cell models (coacervates and proteinoid micro-spheres). Endosymbiotic theory – Evolution of Eukaryotes from Prokaryotes

UNIT-III

Evidences of Evolution: Paleobiological – Concept of Stratigraphy and geological timescale; fossil study (Types, formation and dating methods). Anatomical – Vestigial organs; Homologous and Analogous organs (concept of parallelism and convergence in evolution). Taxonomic – Transitional forms/evolutionary intermediates; living fossils. Phylogenetic – a) Fossil based – Phylogeny of horse as a model. b) Molecule based – Protein model (Cytochrome C); gene model (Globin gene family)

UNIT-IV

Sources of Evolution – Variations as Raw Materials of Change: Types of variations – Continuous and discontinuous; heritable and non-heritable. Causes, classification and contribution to evolution-; chromosomal aberrations; recombination and random assortment (basis of sexual reproduction); Concept of micro- and macro-evolution – A brief comparison.

UNIT-V

Forces of Evolution – Qualitative Studies Based on Field Observations: Natural selection as a guiding force – Its attributes and action Basic characteristics of natural selection. Coloration, camouflage and mimicry, Co-adaptation and co-evolution, Man-made causes of change – Industrial melanism; brief mention of drug, pesticide, antibiotic in various organisms. Modes of selection, Polymorphism, Heterosis and Balanced lethal systems. Genetic Drift (Sewall Wright effect) as a stochastic/random force – Its attributes and action. Basic characteristics of drift; selection vs. drift, Bottleneck effect. Founder principle.

SUGGESTED READINGS:

1. Ridley, M. (2014). *Evolution* (3rd ed.). Blackwell.
2. Hall, B. K., & Hallgrimson, B. (2018). *Strickberger's Evolution* (4th ed.). Jones and Barlett
3. Zimmer, C., & Emlen, D. J. (2013). *Evolution: Making Sense of Life.* Roberts & Co.
4. Evolution: A Very Short Introduction 2017 Brian Charlesworth, Deborah Charlesworth – Oxford University Press London
5. http://172.16.25.76/login/index.php
6. https://nptel.ac.in/content/storage2/courses/122103039/pdf/mod2.pdf

SEMESTER - V

20BTU504B BASICS OF FORENSIC SCIENCE 3H - 3C

Instruction Hours / week: L: 3 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To give knowledge on molecular analysis in forensic science.
- To offer knowledge to assess DNA finger printing.
- To understand the evidence for suspecting victims in crime.
- To handle the evidences left out at the crime scene.
- To understand the basic methods for examine the different types of questioned documents.
- To understand the Classification of fire arms.

Course Outcomes

On completion of the course, students are able to

1. Demonstrate competency in the collection, processing, analyses, and evaluation of evidence.
2. Demonstrate competency in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence.
3. Demonstrate an understanding of the scientific method and the use of problem-solving within the field of forensic science.
4. Identify the role of the forensic scientist and physical evidence within the criminal justice system.
5. Demonstrate the ability to document and orally describe crime scenes, physical evidence, and scientific processes.
6. Identify and examine current and emerging concepts and practices within the forensic science field.

UNIT- I

Introduction and principles of forensic science: Forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operand in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

UNIT-II

Classification of fire arms and explosives: Introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

UNIT-III

Toxicology and Finger printing: Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints.

UNIT-IV

DNA finger printing: Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers.

UNIT-V

Application of Forensic Science: Cyber Crime, Introduction to Cyber security and recent techniques. development of finger print as science for personal identification.

SUGGESTED READINGS:

1. Bernard J. Glick, Jack J. Pasternak, & Cheryl L. Patten. (2010). *Molecular Biotechnology- Principles and Applications of recombinant DNA* (4th ed.). Washington: ASM Press.
2. Bhasin, M.K., & Nath S. (2002). *Role of Forensic Science in the New Millennium*. Delhi: University of Delhi.
3. Eckert, W.G., & Wright, R.K. (1997). *An Introduction to Forensic Sciences* (2nd ed.). CRC Press, Boca Raton (1997).
4. James, S.H., & Nordby J.J. (2005). *Forensic Science: An Introduction to Scientific and Investigative Techniques* (2nd ed.). CRC Press, BocaRaton.
5. Nabar BS,(2013) *Forensic Science in Crime Investigation,* Asia Law House (3rd ed.), Telangana, India
6. Nanda, B.B., & Tiwari, R.K. (2001). *Forensic Science in India: A Vision for the Twenty First Century*. New Delhi: Select Publishers.
7. Saferstein R., (2015). *Criminalistics: An Introduction to Forensic Science* (11th ed.). New Jersey: Prentice Hall.

SEMESTER - V

20BTU511 PLANT & ANIMAL BIOTECHNOLOGY PRACTICAL 4H - 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 hours

Course Objectives

The main objectives of the course are,

- To provide the practical knowledge about the culture the plant and animal cell under *in vitro* condition and for application purpose.
- To get proficiency in handling the contamination free plant and animal tissue culture techniques.
- To acquire hands on training of plant and animal tissue culture Techniques.
- To explain the basics of the viable and non-viable cells of plant and animal tissue.
- To understand the processes involved in the planning, conduct and execution of plant and animal biotechnology experiments.
- To use basic biotechnological techniques to explore molecular biology of plant and animal cells.

Course Outcomes

On completion of the course, students are able to

1. Acknowledge themselves in the preparation of various nutrient growth medium for both plant and animal cells.
2. Well astute in the different culture techniques.
3. Produce *in vitro* plant and animal cell culture for various pharmaceutical and industrial applications.
4. Inculcate the deep knowledge the processes involved in the planning, conduct and execution of plant and animal biotechnology experiments.
5. Inculcate the deep knowledge the processes involved in the planning, conduct and execution of plant and animal biotechnology experiments.
6. Learn the structure and organization of plant and animal genome.

Practicals

Plant Tissue Culture Techniques

1. *In vitro* Germination of Seeds.
2. Callus induction and Micropropagation.
3. Synthetic seed production.
4. Protoplast Isolation.

Animal Biotechnology

5. Preparation and Filter-sterilization of Animal Tissue Culture Medium.
6. Quantification of viable and non-viable cells by trypan blue dye exclusion method.
7. Soft agar assay.
8. Cryopreservation and revival of cell lines.

SUGGESTED READINGS:

1. Bhojwani, S.S., & Razdan, (2004). *Plant Tissue Culture and Practice*.
2. Brown, T.A., (2006). *Gene Cloning and DNA Analysis* (5th ed.). Oxford: UK, Blackwell Publishing.
3. Butler, M. (2003). *Animal cell culture and technology: The basics* (2nd ed.). Taylor & Francis Publishers, Abingdon, United Kingdom.
4. Gardner, E.J. , Simmonns, M.J., & Snustad, D.P. (2008). (8th ed.). *Principles of Genetics*. India: Wiley.
5. Raven, P.H., Johnson, G.B., Losos, J.B., & Singer, S.R. (2005). *Biology*. Tata MC Graw Hill.
6. Reinert, J., & Bajaj, Y.P.S. (1997). *Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture*. Narosa Publishing House.

SEMESTER - V

20BTU512A BIOINFORMATICS PRACTICAL 4H -2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To get practical knowledge on Bioinformatics and its application.
- To retrieve the knowledge by assessing biological databases.
- To understand and to analyze protein/nucleotide sequences and to predict its 3D structure.
- To understand the various online databases for submitting and retrieving data.
- To perform phylogenetic analysis in finding ambiguities.
- To get practiced with the tools and techniques for analyzing the data.

Course Outcomes

The learners will be able to,

1. Workout and Understand the relationship between sequence - structure - function of genes.
2. Familiarize with the algorithms required to compare sequences and perform the phylogenetic relationship between the gene sequences.
3. Inculcate knowledge on building 3D structures of genes.
4. Locate the sequences and use the main databases at the NCBI and EBI resources.
5. Know the difference between databases, tools, repositories and be able to use each one to extract specific information.
6. Perform homology modelling and to run simple analyses on genomic sequences.

Practicals

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.
8. Homology Modelling

SUGGESTED READINGS:

1. Campbell, A. M., & Heyer, L.J. (2006). *Discovering Genomics, Proteomics and Bioinformatics* (2nd ed.). Benjamin Cummings.
2. Ghosh, Z., & Bibekanand M. (2008). *Bioinformatics: Principles and Applications*. Oxford University Press.
3. Mohammed, I., & Mohammed R.G. (2015). *Bioinformatics Practical Manual.* ACM, Digital Library, Create Space Independent Publishing Platform. USA.
4. Pevsner, J. (2009). *Bioinformatics and Functional Genomics* (2nd ed.). Wiley-Blackwell.

SEMESTER - IV

20BTU512B GENOMICS AND PROTEOMICS PRACTICAL 4H - 2C

InstructionHours/week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To practically import the basic and recent developments in the field of genome sequencing, genome mapping, proteomic data analysis.
- To develop the steps to retrieve knowledge on gene sequencing methods.
- To view the structure in 3D form and understand the functional group interactions of proteins.
- To practically describe advanced genomics and proteomics technologies and the ways in which their data are stored.
- To use bioinformatics techniques for identifying query sequence in genomic and proteomic databases and analyse cell biology.
- To get information from specific databases about the different types of genome variation and their relationship to human diseases.

Course Outcomes

The learners will be able to,

1. Retrieve the sequence for genetic markers in genome mapping.
2. Apply the 2D technique to analyze the structure of protein.
3. Analyze the genomic and proteomic data.
4. Acquire practical knowledge and understanding of fundamentals of genomics and proteomics, transcriptomics and metabolomics and their applications in various applied areas of biology.
5. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
6. Perform the given procedures and Utilize the various databases at NCBI and other sites for protein localization.

Practicals

1. Use of NCBI and UniProt databases.
2. Use of OMIM database.
3. Detection of Open Reading Frames using ORF Finder.
4. Proteomics 2D PAGE database.
5. Software for Protein localization.
6. Predicting Secondary structures of proteins.
7. Hydropathy plots of proteins.
8. Three-dimensional protein structure prediction and visualization tools.

SUGGESTED READINGS:

1. Charles Markoff, (2016). Functional Genomics and Proteomics.
2. Devarajan Thangadurai, Jeyabalan Sangeetha, (2015). Genomics and Proteomics: Principles, Technologies, and Applications. CRC Press, Tylor& Francis Group
3. Glick, B.R., & Patten C. L. (2017). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. (5th ed.). Washington: ASM Press.
4. Pevsner, J. (2009). *Bioinformatics and Functional Genomics* (2nd ed.) John Wiley & Sons.

SEMESTER - V

20BTU513A PLANT DIVERSITY - I PRACTICAL 4H - 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3

Course Objectives

The main objectives of the course are,

- To understand the physiological conditions of the plants and metabolism.
- To understand the basic concepts of photosystems and their importance in plant growth.
- To gain the information about the economic importance of algae and fungi.
- Learn about the structure, pigmentation, food reserves and methods of reproduction of Algae.
- Learn about the structure, pigmentation, food reserves and methods of reproduction of Fungi.
- Studied some plant diseases with special reference to the causative agents, symptoms, etiology and control measures.

Course Outcomes

The learners will be able to,

1. Gain adequate knowledge on plant biodiversity and importance.
2. Understand the molecular mechanisms of macro and micro nutrients in plant growth.
3. Get the basic and applied knowledge of plant physiology, growth, development and metabolism.
4. Discuss about importance of morphological structure, classification, reproduction and economic importance of Algae.
5. Know the control measures of plant diseases.
6. Explain about structure, classification, reproduction, life cycle and economic importance of Bryophytes.

Practicals

1. Comparative study of thallus and reproductive organs of various algae mentioned in theory.
2. Comparative study of vegetative and reproductive parts of various fungi mentioned in theory.
3. Study and section cutting and lactophenol mount of plant disease materials studied in theory.
4. Study of various types of lichens.
5. Study of external features & anatomy of vegetative and reproductive parts of *Marchantia* and *Funaria.*
6. Collection of plant disease materials and bryophytes available locally.

SUGGESTED READINGS:

1. Agrios, G.N. (2004). *Plant Pathology* (5th ed.). UK: Academic Press.
2. Aneja, K.R., & Mehrotra, R.S. (2015). *An Introduction to Mycology* (2nd ed.). New Age International pubishers.
3. Kumar, H.D. (1999) *Introductory Phycology*. Aff. East-West Press Pvt Ltd., Delhi.
4. Lee, R.E. (2008). *Phycolog*y (4th ed.). USA: Cambridge University Press.
5. Sambamurty, (2008). *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. IK International Publishers.

SEMESTER - V

20BTU513B ANIMAL DIVERSITY – I PRACTICAL 4H - 2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3

Course Objectives

The main objectives of the course are,

- To provide the students with an in-depth practical knowledge of the diversity in form, structure of invertebrates.
- To learn the practical skills on the basics of systematic and understand the hierarchy of different categories.
- To learn the diagnostic characters of different phyla through brief studies of examples.
- To obtain an overview of invertebrate fauna digestive system.
- To identify the organizational hierarchies and complexities of invertebrates.
- To identify the evolutionary trends in external morphology and internal structure.

Course Outcomes

The learners will be able to

1. Identify the origin and classification of animal kingdom by practical skills.
2. Describe the origin of animals and how they differ from other living organisms.
3. Explain the relationship between animal diversity and evolutionary derived changes in animal body plans.
4. Analyze the various evolutionary change in invertebrate.
5. Visualize the digestive and nervous system of Earthworm.
6. Visualize the digestive and nervous system of Cockroach.

Practicals

1. Identification and Classification of *Ascaris*.
2. Identification and Classification of *Musca*.
3. Identification and Classification of *Dragonfly*.
4. Earthworm: Digestive, Nervous System.
5. Cockroach: Digestive Reproductive, Nervous System.

SUGGESTED READINGS:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002). *The Invertebrates: A New Synthesis* (3rd ed.). Blackwell Science.
2. Barrington, E.J.W. (1979). *Invertebrate Structure and Functions* (2nd ed.). E.L.B.S. and Nelson.
3. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
4. Kent, G.C., & Carr, R.K. (2000). *Comparative Anatomy of the Vertebrates* (9th ed.). The McGraw-Hill Companies.
5. Ruppert, Edward, E., Fox Richard, S. & Barnes Robert, D. (2009). *Invertebrate Zoology: A Functional Evolutionary Approach* (7th ed.). Thomson Brooks/Cole.

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SEMESTER - V

20BTU514A EVOLUTIONARY BIOLOGY PRACTICAL 3H -1C

Instruction Hours / week: L: 0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain practical concepts of types of fossils
- To practically learn the evolutionary concepts through fossil study of Eukaryotes from Prokaryotes
- To explain Origin of Life especially Prokaryotes as well as Eukaryotes in detail.
- To give detailed explanation of practical analyzing the living fossil
- To provide adequate skills to identify the Micro-evolutionary changes, Speciation and Adaptive Radiation.
- To impart practical knowledge regarding the Origin and Evolution of Man

Course Outcomes

The learners will be able to

1. Get hold of the practical knowledge on fundamentals of Evolutionary Biology.
2. Expertise on the Sampling techniques.
3. Acknowledge the skills on the Qualitative Studies Based on Field Observations
4. To develop skills regarding various Sources of Variations and their role in evolution.
5. To explore salient features of various theories of evolution comprising of Lamarckism, Darwinism and Neo-Darwinism.
6. To impart detailed understanding of Analogy, Homology, Paleontological Evidences, Embryological Evidences and Molecular Phylogeny.

Practicals

(A) Variations

1. Sampling of human height, weight and BMI for continuous variation.
2. Sampling for discrete characteristics (dominant *vs* recessive) for discontinuous variations e.g hitch-hiker's thumb, dexterity, tongue rolling, ear lobe (data categorization into 16 groups based on the combination of 4 traits; assigning each subject to the respective group).

(B) Selection Exemplifying Adaptive strategies (Colouration, Mimetic form, Co-adaptation and co-evolution; Adaptations to aquatic, fossorial and arboreal modes of life) using Specimens.

(C) Neo-Darwinian Studies

1. Calculations of genotypic, phenotypic and allelic frequencies from the data provided
2. Simulation experiments using coloured beads/playing cards to understand the effects of Selection and Genetic drift on gene frequencies

(D) Phylogeny.

SUGGESTED READINGS:

1. Barton, Briggs, Eisen, Goldstein, & Patel, (2007). *Evolution.* Cold Spring Harbor Laboratory Press.
2. Hall, B. K., & Hallgrimson, B. (2013). *Strickberger's Evolution* (4th ed.). Jones and Barlett
3. Ridley, M. (2014). *Evolution* (3rd ed.). Blackwell.
4. Zimmer, C., & Emlen, D. J. (2013). *Evolution: Making Sense of Life.* Roberts & Co.
5. http://172.16.25.76/login/index.php

SEMESTER - V

20BTU514B BASICS OF FORENSIC SCIENCE PRACTICAL 3H - 1C

Instruction Hours / week: L: 0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To give practical knowledge on molecular analysis in forensic science.
- To perform DNA finger printing.
- To understand the evidence for suspecting victims in crime.
- To handle the evidences left out at the crime scene.
- To examine the different types of questioned documents.
- To Identify the different petroleum products by TLC examination.

Course Outcomes

The learners will be able to

1. Apply the Laboratory skills to participate in the career needs of Forensic community.
2. Become trained in the laboratory skills of different division of Forensic Science.
3. Be able to work with different R&D organizations.
4. Identify the role of the forensic scientist and physical evidence within the criminal justice system.
5. Demonstrate the ability to document and orally describe crime scenes, physical evidence, and scientific processes.
6. Identify and examine current and emerging concepts and practices within the forensic science field.

Practicals

1. Documentation of crime scene by photography, sketching and field notes.
2. a. Simulation of a crime scene for training.
   b. To lift footprints from crime scene.
3. Case studies to depict different types of injuries and death.
4. Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.
5. Investigate method for developing fingerprints by Iodine crystals.
6. PCR amplification on target DNA and DNA profiling,
7. To identify drug samples using UV-Visible spectroscopy
8. To determine the concentration of a colored compound by colorimetry analysis.

SUGGESTED READINGS:

1. Tilstone, W.J., Hastrup, M.L., & Hald, C. (2013). *Fisher's Techniques of Crime Scene Investigation*. CRC Press.
1. Bernard J. Glick, Jack J. Pasternak , & Cheryl L. Patten. (2010). *Molecular Biotechnology- Principles and Applications of recombinant DNA* (4th ed.). Washington: ASM Press.
2. Bhasin, M.K., & Nath S. (2002). *Role of Forensic Science in the New Millennium.* Delhi: University of Delhi.
3. Eckert, W.G., & Wright, R.K. (1997). *An Introduction to Forensic Sciences* (2nd ed.). CRC Press, Boca Raton (1997).
4. James, S.H., & Nordby J.J. (2005). *Forensic Science: An Introduction to Scientific and Investigative Techniques* (2nd ed.). CRC Press, Boca Raton.
5. Nanda, B.B., & Tiwari, R.K. (2001*). Forensic Science in India: A Vision for the Twenty First Century*. New Delhi: Select Publishers.
6. Saferstein R. (2004). *Criminalistics: An Introduction to Forensic Science* (8th ed.). New Jersey: Prentice Hall.
7. http://172.16.25.76/course/view.php?id=1577

SEMESTER - VI

20BTU601 ENVIRONMENTAL BIOTECHNOLOGY AND MANAGEMENT 4H -4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain the basic concepts of Geological consideration of Atmosphere
- To ascertain the knowledge about Energy transfer in an Ecosystem.
- To obtain knowledge on pollution and environmental Health.
- To gain knowledge about the biotechnological measures for restoring environment.
- To involve in the present scenarios and find valuable solutions for remedy.
- To update about the management strategies by Bio-transformation.

Course Outcomes

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

1. Principles & Concepts of Ecosystem.
2. Ecological efficiencies.
3. Environmental significance of Detection of Environmental pollutants.
4. Bio-geochemical cycles.
5. Hazardous wastes Environmental cleanup.
6. Genetic engineering of bacteria and their potential for bioremediation.

UNIT-I

Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere Scope of Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Bio- geochemical cycles (Nitrogen, Carbon and Phosphate cycles). Biological control of chemical environment.

UNIT- II

Pollution and Bioremediation: Pollution and environmental Health related to Soil, Water, Air, Food, Pesticides, Metals, Solvents, Radiations Carcinogen, Poisons. Detection of Environmental pollutants. Indicators & detection systems. Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products and xenobiotics.

UNIT- III

Waste management: Treatment of municipal waste and Industrial effluents. Basic aspects of Solid waste management (an introduction), Aerobic and anaerobic treatments of SWM, Composting, Vermicomposting, Biogas production, Treatment of Hazardous waste, treatment strategies of PCBP, Biomedical wastes, Types of biomedical waste, Hazards caused by Biomedical waste, Treatment strategies of Biomedical waste.

UNIT-IV

Bio-fertilizers and Bioleaching: Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM). Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium), Heavy metal pollution.

UNIT- V

Fuels: Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol. GMO's: Environmental significance of genetically modified microbes, plants and animals and its impact on environment.

SUGGESTED READINGS:

1. Ajith Sankar R.N (2015). Environmental Management, 1st edition. Oxford University Press;
2. Alicia, L., Ragout De Spencer, & John Spencer, F.T. (Eds.). (2004). *Environmental Microbiology: Methods and Protocols*. Humana Press.
3. Hans-Joachim Jordening, & Jesef Winter, (Eds.). (2005). *Environmental Biotechnology*: Concepts and Applications. Wiley-VCH.
4. Metcalf, & Eddy, (2003). *Waste Water Engineering: Treatment and Reuse* (4th ed.). Tata McGraw hill.
5. Mohapatra, P.K., (2007). *Textbook of environmental biotechnology*. IK publication.
6. Pradipta Kumar Mohapatra, (2007). *Environmental Biotechnology*. I.K. International Publishing House.
7. Purohit, S.S. (2003). *Agricultural Biotechnology* (2nd ed.). Updesh Purohit.
8. Rana, S.V.S., (2013). *Environmental pollution – health and toxicology* (2nd ed.). Narosa Publication.
9. Santra, S.C. (2011). *Environmental Science* (3rd ed.). New Central Book Agency.
10. Sinha, S. (2010*). Handbook on Wildlife Law Enforsement in India*. India: TRAFFIC.
11. Thakur, I. S. (2011). *Environmental Biotechnology*. I K Publication.

SEMESTER - VI

20BTU602A PLANT DIVERSITY-II 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To develop the skills on morphological identification of plants.
- Understand the diversity among various plants.
- Know the systematic morphology and structure of Pteridophytes.
- Learn about the general characters and classification in Pteridophytes, heterospory and origin of seed habit.
- Know about the structure, life history and Economic importance of Gymnosperms.
- Studied the methods of fossilization and fossil plants.

Course Outcomes:

The learners will be able to

1. Study and impart knowledge about the occurrence, distribution, structure and life history of plants
2. Learn in detail about vegetative and reproductive parts of plants.
3. Learn the phylogeny and evolutionary concepts in plants.
4. Learn how to handle a fossilized specimen.
5. Acquire knowledge about the structure, life history and Economic importance of Gymnosperms.
6. Learn the skills on morphological identification of plants.

UNIT-I

Pteridophytes: General characters of pteridophytes, affinities with bryophytes and gymnosperms, classification, economic importance, study of life histories of fossil pteridophytes – *Rhynia.*

UNIT-II

Pteridophytes: Type studies: Life histories of *Selaginella*- (Heterospory and seed habit), Equisetum*, Pteris, Lycopodium.*

UNIT-III

Gymnosperms: General characters, classification, geological time scale, theories of fossil formation, types of fossils, fossil gymnosperms- *Williamsonia* & *Glossopteris,* telome and stele concept.

UNIT-IV

Gymnosperms: Type studies: Life histories of *Cycas* and *Pinus* and economic importance of gymnosperms.

UNIT-V

Angiosperms: General characters, classification, monocot, dicot, floral characters, economic importance.

SUGGESTED READINGS:

1. Bhatnager, S.P. & Moitra, A. (1996). *Gymnosperms.* New Delhi: New Age International (P) Ltd. Publishers.
2. Pandey B P (2014), *College Botany Volume 20,* S. Chand Publishing, New Delhi.
3. Pandey B.P. (1979) *College Botany Volume I, 20/e,* S Chand Publisher, New Delhi.
4. Parihar, N.S. (1996). *The Biology and Morphology of Pteridophytes*. Allahabad: Central Book Depot.
5. Sambamurty, (2008). *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. IK International Publishers.
6. Wickens, G.E. (2004). *Economic Botany: Principles and Practices.* Dordrecht: Netherlands, Springer. Kuwer Publishers.

SEMESTER - V

20BTU602B **ANIMAL DIVERSITY-II** **4H - 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To acquaint knowledge on different classes of vertebrates and invertebrates.
- To understand the vertebrate and invertebrate structure and morphology forms.
- To Provide with an in-depth knowledge of the animal diversity.
- To get knowledge about Pisces and Amphibia.
- To know about replites, avea and mammalia.
- To understand and compare the anatomy of vertebrates.

Course Outcomes:

The learners will be able to

1. Recognize the vertebrates and invertebrates.
2. Demonstrate the basic laboratory techniques associated with examining and handling zoological specimens (Vertebrates).
3. Demonstrate the skills in handling and dissection of earthworm and cockroach (internal organs).
4. Understand the different species of replites, avea and mammalia.
5. Know about the Autonomic Nervous system in Mammals.

UNIT I: Proto-chordates,

Proto-chordates: Outline of classification, General features and important characters of Herdmania, Branchiostoma

UNIT II: Pisces and Amphibia

Pisces: Migration in Pisces, Outline of classification Amphibia: Classification, Origin, Parental care, Paedogenesis

UNIT III: Reptilia, Aves and Mammalia

Reptilia: Classification, Origin
Aves: Classification, Origin, flight- adaptations, migration
Mammalia: Classification, Origin, dentition

UNIT IV: Comparative anatomy of vertebrates I

Comparative anatomy of various systems of vertebrates: Integumentary, digestive respiratory systems.

UNIT V: Comparative anatomy of vertebrates II

Comparative Anatomy of vertebrates – Heart, Aortic arches, Kidney & urinogenital system, Brain, Eye, Ear. Autonomic Nervous system in Mammals

SUGGESTED READINGS:

1. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
2. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
3. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-HillCompanies.
4. Weichert, C.K. (1970). Anatomy of Chordate. McGraw Hill.
5. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.

B.Sc. Biotechnology		2020-2021
		SEMESTER - VI
20BTU603A	MOLECULAR DIAGNOSTICS	3H -3C
Instruction Hours / week: L:3 T: 0 P: 0		Marks: Internal: 40 External: 60 Total: 100
		End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain basic concepts of molecules and its effect on human and other animals.
- To ascertain the diagnostics tools for infectious diseases.
- To achieve a complete knowledge about molecular diagnostics techniques on human welfare.
- To understand the utility and limitations of various molecular diagnostic tests used for managing patient care.
- To attain the concepts of molecular methods used in clinical microbiology.
- To recognize the importance of proper specimen collection and preparation for molecular detection.

Course Outcomes

On completion of the course, students are able to

1. Get hold of the knowledge on fundamentals of molecular diagnostic techniques.
2. Expertise on the concepts of infection, diagnosis and control assortment.
3. Acknowledge on the qualitative studies based on biomarker observations.
4. Apply methodologies of laboratory diagnostics to relevant states of health.
5. Be aware of characteristics signs of clinical manifestations.
6. Comprehend and analyse the concept of disease management.

UNIT-I

Introduction and History of diagnostics: Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Concept of infectious diseases: historical perspective, terminology, nature of infections and sequence of steps necessary for Infection. Detection and differentiation of pathogens: bacterial, viral, fungal, zoonotic, protozoan and other parasites. Clinical specimens and sample collection: general approach clinical specimens, method of collection, transport and processing of samples.

UNIT-II

Molecular methods in clinical microbiology: PCR, Real Time PCR, RFLP, SNP, Nuclear hybridization methods, plasmid fingerprinting in clinical microbiology and its applications. Chemotherapy: Introduction, concept and applications. Antibiotics and Antimicrobial Susceptibility Test (AST): diffusion method, dilution method, Considerations in AST, Automated AST Method, Minimum Inhibitory Concentration, Minimum Bactericidal Concentration, Mechanism of bacterial resistance and multiple drug resistance.

UNIT-III

Enzyme Immunoassays (EIA): Introduction, concept of EIA, enzymes used in EIA. Solid phases used in EIA. Homogeneous and heterogeneous EIA. ELISA, FISH and Immunoblotting. Polyclonal or Monoclonal antibodies in EIA. Enzyme immunohistochemistry and cytochemistry and its applications. IA in microbial diagnosis and merits and demerits.

UNIT-IV

Biomarkers in disease diagnostics: FDA definition of disease biomarkers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour and cancer markers, markers in inflammation and cytoskeletal disorders diagnosis. Flow cytometry.

UNIT-V

Diagnosis and Standardization: Automation in microbial diagnosis, Rapid diagnostic approach, Purification and standardization of antigen and specific antibodies. Diagnostic immunology: agglutination reactions, precipitation reactions, complement fixation test (CFT), direct and indirect hemagglutination (HA and IHA), hemagglutination inhibition (HAI), Radioimmunoassay (RIA) and direct and indirect fluoroimmunoassays (FIA). Concepts and methods: idiotypes, anti-idiotypes, molecular mimicry and receptors.

SUGGESTED READINGS:

1. Chang-Hui Shen (2019), Diagnostic Molecular Biology, Academic Press.
2. Claudio Carini, Mark Fidock, Alain van Gool (2019), Handbook of Biomarkers and Precision Medicine, CRC Press.
3. http://172.16.25.76/course/view.php?id=2088
4. Laura Anfossi (2018), Rapid Test: Advances in Design, Format and Diagnostic Applications, BoD – Books on Demand.
5. Michael Ford (2019), Medical Microbiology: Fundamentals of Biomedical Science, Oxford University Press, 3rd edition.
6. Vishal S. Vaidya, Joseph V. Bonventre (2010), Biomarkers: In Medicine, Drug Discovery, and Environmental Health, John Wiley & Sons.

SEMESTER - VI

20BTU603B BIOSTATISTICS 3H -3C

Instruction Hours/ week: L:3 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To gain mathematical approach for analyzing the data.
- To learn the knowledge about graphical and diagrammatic representation of Statistical data.
- To learn the knowledge about Scope and applications of biostatistics.
- To learn the knowledge about collection, processing and presentation of data and Testing of hypothesis.
- To learn the knowledge about Measures of central tendency, Measures of dispersion.
- To learn the knowledge about Correlation analysis and regression analysis.

Course Outcomes

On completion of the course, students are able to

1. Apply the statistical tool knowledge for research data analysis.
2. Understand the concept of various hypothesis regarding data analysis.
3. To perform analysis for the data based on graphical representation (Bar, multiple bars, histogram, pie chart etc.).
4. To perform analysis to determine the mean, median, mode and standard deviation of given sample/data.
5. To perform analysis, determine the probability of given sample/data.
6. To perform the t-test/F-Test and Chi-square test of given data.

UNIT-I

Statistics: Meaning, Definitions, Introduction to Bio-Statistics -Types of Data, Collection of data; Primary & Secondary data, Classification and tabulation of data, construction of frequency distribution. Graphical and diagrammatic representation of statistical data.

UNIT-II

Measures of central tendency: Mean, Median and Mode. Measures Dispersion – Absolute and relative measures dispersion – Range, Standard deviation and coefficient of variation. Measures of Skewness and Kurtosis.

UNIT-III

Probability: Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT-IV

Population and Sample: parameter and statistic, sampling, methods of sampling, confidence level, critical region, testing of hypothesis, Hypothesis and Null hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, *chi*-square test for goodness of fit and analysis of variance (ANOVA)

UNIT-V

Correlation and regression: Types of correlation, degrees of correlation, methods of calculating correlation coefficient – scatter diagram, Karl Pearson and Spearman rank correlation coefficients. Regression – regression lines, regression equation, regression coefficients, methods of forming regression equations. Emphasis on examples from Biological Sciences. Statistical software R or SAS and its implementation.

SUGGESTED READINGS:

1. Danial, W. (2004). *Biostatistics: A foundation for Analysis in Health Sciences*. John Wiley and Sons Inc.
2. Edmondson, A., & Druce, D. (1996). *Advanced Biology Statistics.* Oxford University Press.
3. Glaser, A.N. (2001). *High Yield TM Biostatistics.* USA: Lippincott Williams and Wilkins.
4. Le, C.T. (2003). *Introductory biostatistics*. USA: John Wiley.

SEMESTER - VI

20BTU612 ENVIRONMENTAL BIOTECHNOLOGY AND MANAGEMENT PRACTICAL 4H -2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain practical knowledge to solve the environmental problems.
- To ascertain the knowledge about wastewater treatment.
- To achieve a water treatment strategy.
- To gain knowledge about for restoring environment.
- To involve in the present scenarios and find valuable solutions for remedy.
- To update about the microbial load in water sample.

Course Outcomes

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

1. Environmental problems.
2. Wastewater treatment.
3. Biological Oxygen Demand (BOD) and its calculation.
4. Chemical Oxygen Demand (COD) and its calculation.
5. Endangered species.
6. Global Positioning System (GPS)

Practicals

Environmental Biotechnology

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. Bacterial Examination of Water by MPN Method.
5. Production of bio fertilizers using waste.

Environmental management

1. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem.
2. Determination of population density in a terrestrial community or hypothetical community by quad rate method and calculation of the Simpson's and Shannon- Weiner diversity index for the same community.
3. Principle of GPS (Global Positioning System).
4. Study of the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data.
5. Study of the types of soil, their texture by sieve method and rapid tests for –pH, chlorides, nitrates, carbonates and organic carbon
6. Study any five endangered/ threatened species- one from each class.

SUGGESTED READINGS:

1 Ghosh, S.K., & Singh, R. (2003). *Social forestry and forest management.* Global Vision Publishing House
2 Joseph, B. (2005). *Environmental studies.* Tata Mc Graw Hill.
3 Michael Allabay, (2000). *Basics of environmental science* (2nd ed.). Routledge Press.
4 Mohapatra, P.K., (2007). *Textbook of environmental biotechnology.* IK publication.
5 Rana, S.V.S., (2013). *Environmental pollution – health and toxicology* (2nd ed.). Narosa Publication.

SEMESTER - VI

20BTU612A PLANT DIVERSITY - II PRACTICAL 4H -2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To develop the skills on morphological identification of plants.
- Understand the diversity among various plants.
- Know the systematic morphology and structure of lichens.
- Know about the Pteridophytes.
- Understand the morphology of gymnosperms.

Course Outcomes

The learners will be able to

1. Study and impart knowledge about the occurrence, distribution, structure and life history of lower plants such as algae, fungi and lichens.
2. Learn in detail about vegetative and reproductive parts of various fungi.
3. Learn the phylogeny and evolutionary concepts in plants.
4. Excel in the internal and external structures of Pteridophytes.
5. Excel in the internal and external structures of gymnosperms.

Practicals

1. Examination of morphology and anatomy of vegetative and reproductive parts of *Selaginella.*
2. Examination of morphology and anatomy of vegetative and reproductive parts of *Equisetum.*
3. Examination of morphology and anatomy of vegetative and reproductive parts of *Pteris*.
4. Examination of morphology and anatomy of vegetative and reproductive parts of – *Cycas & Pinus*.
5. Examination of morphology and anatomy of vegetative and reproductive parts of –*Pinus*.
6. Plant collection -pteridophytes.
7. Plant collection - gymnosperms.

SUGGESTED READINGS:

1. Bhatnager, S.P., & Moitra, A. (1996). *Gymnosperms*. New Delhi:New Age International (P) Ltd. Publishers.
2. Juan, A., Alonso-Vargas, M., Pérez Botella, J., Moreno, J., Agulló Brotons, J. C., Villar García, J. L., & Vicente Caviedes, A. (2013). Laboratory manual for practical Plant Biodiversity. Plant Biodiversity.
3. Parihar, N.S. (1996). *The Biology and Morphology of Pteridophytes*. Allahabad: Central Book Depot.
4. Sambamurty, (2008). *A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. IK International Publishers.
5. Wickens, G.E. (2004). *Economic Botany: Principles and Practices*. Dordrecht: Netherlands, Springer, Kluwer Publishers.

SEMESTER - VI

20BTU612B ANIMAL DIVERSITY - II PRACTICAL 4H -2C

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are,

- To gain practical exposure of different classes of vertebrates and invertebrates.
- To understand the vertebrate and invertebrate structure and morphology forms.
- To Provide an in-depth knowledge of the diversity.
- To Identify the permanent slides.
- To Identify endoskeletons of frog and rabbit
- To know the Ecological Note of the specimen

Course Outcomes:

The learners will be able to

- Recognize the of vertebrates and invertebrates.
- Demonstrate basic laboratory techniques associated with examining and handling zoological specimens (Vertebrates).
- Demonstrate skills in handling and dissection of earthworm and cockroach (internal organs).
- Know Mammalian Histology.
- Know Proto-chordata.
- Know Ecological of the species

Practicals

1. Identification & Classification upto order of the following:
   Proto-chordata: (Any one example)
   Cyclostomata, Chondrichthyes, Ostiechthyes, Amphibia, Reptiles, Aves, Mammalia,

2. An Ecological Note on any one of the specimens in Experiment 1

3. Identification of the following slides
   Mammalian Histology: Liver, Lung, Intestine, Kidney, Ovary, Testes

4. Identification of endoskeletons of frog and rabbit.

SUGGESTED READINGS:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
2. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
3. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
4. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.
5. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.

SEMESTER - VI

20BTU613A MOLECULAR DIAGNOSTICS PRACTICAL 3H -1C

Instruction Hours / week: L: 0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain the basic concepts of Identification of pathogenic bacteria
- To ascertain the diagnostics tools for infectious diseases - RFLP, RAPD.
- To achieve a complete knowledge about molecular diagnostics techniques on microbial infection.
- To understand the utility and limitations of various molecular diagnostic tests used for managing patient care.
- To attain the concepts of molecular methods used in clinical microbiology.
- To recognize the importance of proper specimen collection and preparation for molecular detection.

Course Outcomes

On completion of the course, students are able to

1. Get hold of the knowledge on fundamentals of molecular diagnostic techniques.
2. Expertise on the concepts of infection, diagnosis and control assortment.
3. Acknowledge on the qualitative studies based on biomarker observations.
4. Apply methodologies of laboratory diagnostics to relevant states of health.
5. Be aware of characteristics signs of clinical manifestations.
6. Comprehend and analyses the concept of disease management.

Practicals

1. Perform/demonstrate RFLP analysis.
2. Perform/demonstrate RAPD analysis.
3. Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture.
4. A kit-based detection of a microbial infection (Widal test).
5. Study of Electron micrographs (any four).
6. Perform any one immuno diagnostic test (Typhoid, Malaria, Dengue).
7. Molecular detection of bacteria from spoiled food sample by multiplex PCR.

SUGGESTED READINGS:

1. Bruce Alberts (2014), Molecular Biology of cell, W. W. Norton & Company, 6th edition.
2. Chang-Hui Shen (2019), Diagnostic Molecular Biology, Academic Press.
3. Claudio Carini, Mark Fidock, Alain van Gool (2019), Handbook of Biomarkers and Precision Medicine, CRC Press.
4. Goering, R., Dockrell, H., Zuckerman, M., & Wakelin, D. (2007). *Mims' Medical Microbiology* (4th ed.). Elsevier.
5. Laura Anfossi (2018), Rapid Test: Advances in Design, Format and Diagnostic Applications, BOD – Books on Demand.
6. Michael Ford (2019), Medical Microbiology: Fundamentals of Biomedical Science, Oxford University Press, 3rd edition.
7. Vishal S. Vaidya, Joseph V. Bonventre (2010), Biomarkers: In Medicine, Drug Discovery, and Environmental Health, John Wiley & Sons.
8. Willey, J.M., Sherwood, L.M., & Woolverton, C.J. (2008). *Prescott, Harley and Klein's Microbiology* (7th ed.). McGraw Hill Higher Education.

SEMESTER - VI

20BTU613B BIOSTATISTICS PRACTICAL 3H -1C

Instruction Hours / week: L:0 T: 0 P: 3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To gain mathematical approach for analyzing the data.
- To learn the knowledge about graphical and diagrammatic representation of Statistical data.
- To learn the knowledge about Scope and applications of biostatistics
- To learn the knowledge about collection, processing and presentation of data and Testing of hypothesis
- To learn the knowledge about Measures of central tendency, Measures of dispersion
- To learn the knowledge about Correlation analysis and regression analysis

Course Outcomes

On completion of the course, students are able to

1. Apply the statistical tool knowledge for research data analysis.
2. Understand the concept of various hypothesis regarding data analysis.
3. To perform analysis for the data based on graphical representation (Bar, multiple bars, histogram, pie chart etc.)
4. To perform analysis to determine the mean, median, mode and standard deviation of given sample/data
5. To perform analysis, determine the probability of given sample/data
6. To perform the t-test/F-Test and Chi-square test of given data

Practicals

Based on graphical Representation

1. Drawing of bar and multiple bar diagram
2. Drawing of Histogram
3. Drawing of Pie diagram

Based on measures of Central Tendency

4. Calculation of Mean for individual, discrete series using SPSS Package
5. Mean for continuous series using SPSS Package
6. Median for individual and discrete series using SPSS Package
7. Median for continuous series using SPSS Package
8. Mode for individual and discrete series using SPSS

Package Based on measures of Dispersion

9. Standard deviation for individual and discrete series using SPSS Package
10. Coefficient of variation for individual and discrete series using SPSS

Package Based on Distributions Binomial, Poisson and Normal

11. Calculation of Mean and variance for binomial distribution using SPSS Package
12. Calculation of Mean and variance for Poisson distribution using SPSS

Package Based on t, f, z and Chi-square

13. Karl Pearson's Correlation using SPSS Package
14. Rank Correlation Coefficient for Untied Rank using SPSS Package
15. Rank Correlation Coefficient for Tied Rank using SPSS Package.

SUGGESTED READINGS:

1. Danial, W. (2004). *Biostatistics: A foundation for Analysis in Health Sciences*. John Wiley and Sons Inc.
2. Edmondson, A., & Druce, D. (1996). *Advanced Biology Statistics*. Oxford University Press.
3. Everitt, B. (2003). Modern medical statistics: a practical guide. London, United Kingdom: Arnold.
4. Glaser, A.N. (2001). *High Yield TM Biostatistics.* USA: Lippincott Williams and Wilkins.
5. Le, C.T. (2003). *Introductory biostatistics*. USA: John Wiley.

SEMESTER - VI

20BTU691	**PROJECT – *VIVA VOCE***	**8H -6C**

Instruction Hours / week: L: 0 T: 0 P: 8 **Marks:** Internal: **40** External: **60** Total: **100**