

**FACULTY OF ENGINEERING**  
**DEGREE OF BACHELOR OF**  
**TECHNOLOGY**  
**IN**  
**BIOTECHNOLOGY**  
**DEPARTMENT OF BIOTECHNOLOGY**  
**(REGULAR PROGRAMME)**  
**CURRICULUM & SYLLABI**  
**(2015 -2016)**



**KARPAGAM ACADEMY OF HIGHER EDUCATION**  
**(Established Under Section 3 of UGC Act 1956)**  
**COIMBATORE 641 021 INDIA**



## **KARPAGAM ACADEMY OF HIGHER EDUCATION**

*(Deemed to be University Established Under Section 3 of UGC Act 1956)*

**Pollachi Main Road, Eachanari Post, Coimbatore – 641 021. INDIA**

**Phone : 0422-6471113-5, 6453777 Fax No : 0422 -2980022-3**

**Email : [info@karpagam.com](mailto:info@karpagam.com) Web : [www.kahedu.edu.in](http://www.kahedu.edu.in)**

### **FACULTY OF ENGINEERING**

**DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY (B. E. /B. Tech.)**

**REGULAR PROGRAMME**

### **REGULATIONS (2015)**

### **CHIOCE BASED CREDIT SYSTEM**

Phone : 0422-6453777, 6471113-5, 2980011-2980018;

Fax No : 0422 – 2980022, 2980023

Email : [www.kahedu.edu.in](http://www.kahedu.edu.in)

Web : [info@karpagam.com](mailto:info@karpagam.com)

**OBJECTIVES:**

- To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
- To help students acquire their ability to speak effectively in real life situations.
- To inculcate the habit of reading and to develop their effective reading skills.
- To ensure that students use dictionary to improve their active and passive vocabulary.
- To enable students to improve their lexical, grammatical and communicative competence
- To acquire good vocabulary for sentence structure and sentence formation.

**OUTCOMES:**

- Use English language for communication: verbal & non –verbal.
- Enrich comprehension and acquisition of speaking & writing ability.
- Gain confidence in using English language in real life situations.
- Improve word power: lexical, grammatical and communication competence.
- Acquire good vocabulary for easy communication.
- Be familiar with sentence structure and sentence formation.

**Unit I****(9)**

**Listening** – Types of listening - Listening to class reading - Video tapes/ Audio tapes. **Speaking** – Introduction on self - Introduction on one's friend. **Reading** - Reading for comprehension – Reading different kind of passages like descriptive, narrative, objective, conversational and argumentative. **Writing** – Free writing on any topic –My favorite place, hobbies, dreams, goals, etc- Writing short messages - To fill in different application forms. **Grammar** – Articles- WH questions –Yes/No Question - Subject Verb agreement. **Vocabulary** - Word Formation – Word expansion (Root word) - Prefix and Suffix.

**Unit II****(10)**

**Listening** – Understanding the passage in English –Pronunciation practice. **Speaking** – Asking and answering questions - Telephone etiquette. **Reading** – Critical reading – Finding key information in a given text (Skimming - Scanning). **Writing** – Coherence and cohesion in writing – Short paragraph writing – Letters to the Editor. **Grammar** – Parts of speech – Noun – Verb – Adjectives - Adverbs. **Vocabulary** – Compound Nouns/Adjectives – Irregular verbs.

**Unit III****(10)**

**Listening** – Listening for specific task – Fill in the gaps. **Speaking** – Phonemes – Syllables – Role play – Conversation Practice. **Reading** – Reading and Comprehension. **Writing** - Autobiographical writing – Biographical writing - Instruction writing. **Grammar** – Preposition – Infinitive – Gerund – Tenses. **Vocabulary** – Foreign words used in English – British and American usage.

**Unit IV****(8)**

**Listening** – Responding to questions – Reading in class for complete understanding and for better pronunciation. **Speaking** – Debate- Presentations in seminars. **Reading** – Making inference from the reading passage – Predicting the content of reading passages. **Writing** - Interpreting visual materials (tables, graphs, charts, etc) – Formal and Informal letters. **Grammar** – Sentence pattern – Voice (active and passive voice). **Vocabulary** – One word substitution.

**Unit V****(8)**

**Listening** - Listening to different accents, speeches/presentations. **Speaking**- Extempore talk – Just-a-minute talk. **Reading**-Reading strategies–Intensive reading – Text analysis. **Writing** - Creative writing – Writing circulars and notices – Writing proposal. **Grammar** – Direct and Indirect speech – Conditional sentences - Auxiliary verbs. **Vocabulary** – Abbreviations & Acronyms.

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

**Total: 45****TEXT BOOK:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	<a href="#">Sangeeta Sharma</a> , <a href="#">Meenakshi Raman</a>	<a href="#">Technical Communication: Principles And Practice</a> 2 <sup>nd</sup> Edition	OUP, New Delhi.	2015

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Lakshminarayanan, K.R. & Murugavel, T.	Communication Skills for Engineers	SCITECH Publications, Chennai	2009
2	Rizvi Ashraf, M	Effective Technical Communication	Tata McGraw-Hill, New Delhi.	2007
3	Rutherford Andrea, J.	Basic Communication Skills for Technology	Pearson Education, New Delhi.	2006

**WEBSITES:**

[www.learnerstv.com](http://www.learnerstv.com) – Listening/ Speaking/ Presentation  
[www.usingenglish.com](http://www.usingenglish.com) – Writing/ Grammar  
[www.englishclub.com](http://www.englishclub.com) – Vocabulary Enrichment/ Speaking  
[www.ispeakyouspeak.blogspot.com](http://www.ispeakyouspeak.blogspot.com) – Vocabulary Enrichment/ Speaking  
[www.teachertube.com](http://www.teachertube.com) – Writing Technically  
[www.Dictionary.com](http://www.Dictionary.com) – Semantic / Grammar

**OBJECTIVES:**

- To develop analytical skills for solving different engineering problems.
- To understand the concept of Matrices and Theory of equations.
- To know the basics of differential calculus and its applications.
- To impart the knowledge of integral calculus and its applications.
- To learn the basics of ordinary differential equations.
- To Apply the concept of ordinary differential Equations and solving the problems.

**OUTCOMES:**

- Acquire the basic knowledge and understanding of mathematics
- Apply advanced matrix knowledge to engineering problems.
- Improve their ability in evaluating problems by applying theory of equations.
- Evaluating engineering problems involving differential calculus and its applications.
- Understand the concepts involving integral calculus and its applications.
- Applying the concept of ordinary differential Equations and solving the problems.

**UNIT-I         MATRICES**

**(12)**

Fundamentals of Matrix- Inverse of a matrix- Rank of a Matrix – Consistency and Inconsistency of a system of ‘m’ linear equations in ‘n’ unknowns – Eigenvalues and Eigenvectors of a real matrix .

**UNIT- II       THEORY OF EQUATIONS**

**(12)**

Relations between coefficients and roots: Irrational and imaginary roots – symmetric functions of the roots – transformation of equations – reciprocal equations and formation of equations whose roots are given.

**UNIT - III     DIFFERENTIAL CALCULUS AND ITS APPLICATION**

**(12)**

Differentiation and Derivatives of simple functions – Successive Differentiation – Tangent and Normal-Radius of curvature – Velocity and acceleration.

**UNIT - IV     INTEGRAL CALCULUS AND ITS APPLICATIONS**

**(12)**

Various types of integration - Reduction formula for  $e^{ax} x^n$ ,  $\sin^n x$ ,  $\cos^n x$ ,  $\sin^n x \cos^m x$  (Statement only). – Length, Area and Volume of solid revolution.

**UNIT - V       ORDINARY DIFFERENTIAL EQUATIONS**

**(12)**

Differential equations of first order and higher degree – higher order differential equations with constant coefficients.

**Total : 60**

**TEXT BOOKS:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Grewal. B.S	Higher Engineering Mathematics	Khanna Publications, Delhi.	2013
2	B.V.Ramana	Higher Engineering Mathematics	Tata McGraw Hill Education Pvt.Ltd, New Delhi.	2010

**REFERENCES:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Dass H.K.	Engineering Mathematics	S.Chand & Co., New Delhi.	2008
2	Bali N.P., Manish Goyal	A text book of Engineering Mathematics	Laxmi publications Pvt. Ltd, New Delhi.	2014
3	Michael D. Greenberg	Advanced Engineering Mathematics	Pearson Education, India	2006

**WEBSITES:**

1. <a href="http://www.intmath.com">www.intmath.com</a>
2. <a href="http://www.efunda.com">www.efunda.com</a>
3. <a href="http://www.mathcentre.ac.uk">www.mathcentre.ac.uk</a>

**OBJECTIVES:**

- To enhance the fundamental knowledge in Physics and its applications relevant to various branches of Engineering and Technology
- Understand the basics of laser and optical fiber with appropriate applications.
- Introduce the concepts of quantum mechanics for diverse applications.
- Impart the basic knowledge of crystal and its various crystal structures.
- Disseminate the fundamentals of nuclear physics and their applications.
- To Illustrate the basic ideas of nuclear reactors for energy resources

**OUTCOMES:**

- Identify the elastic nature of materials and its thermodynamic properties.
- Infer the characteristics of laser and optical fibers for engineering applications.
- Develop the idea of quantum mechanics through applications.
- Identify the different atomic arrangements of crystals and its defects
- Make use of the concepts of sound waves for medical applications
- Illustrate the basic ideas of nuclear reactors for energy resources

**UNIT I      PROPERTIES OF MATTER AND THERMODYNAMICS      (9)**

Three types of modulus of elasticity – basic definitions, relation connecting the moduli (Derivation), poisson ratio- Torsional pendulum- bending of beams- bending moment – basic assumption of moment – uniform and non uniform bending

Concept of entropy- change of entropy in reversible and irreversible processes – refrigeration.

**UNIT II      LASER AND FIBER OPTICS      (9)**

Introduction – emission and absorption process- Einstein's coefficients derivation. Types of LASER -CO<sub>2</sub>, Semiconductor LASER- Applications of LASER in industry and medicine.

Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle –derivations, types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram).

**UNIT III      QUANTUM PHYSICS      (9)**

Introduction to quantum theory – Compton effect- dual nature of matter and radiation – de Broglie wavelength, uncertainty principle – physical significance of wave function, Schrödinger's wave equation – time dependent and time independent equations – particle in one dimensional box- scanning electron microscope.

**UNIT IV      CRYSTAL PHYSICS      (9)**

Lattice – unit cell – Bravais lattice – lattice planes – Miller indices – calculation of number of atoms per unit cell, atomic radius, coordination number, packing factor for SC, BCC, FCC and HCP structures- crystal defects – point, line and surface defects.

**UNIT V        ULTRASONICS AND NUCLEAR PHYSICS****(9)**

Production of ultrasonics by piezoelectric method –Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications – Sonogram Introduction – basics about nuclear fission and fusion, nuclear composition – Radiation detectors – semi conductor detector. Reactors – essentials of nuclear reactor- power reactor.

**Total: 45****TEXT BOOK:**

S.No	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Ganesan.S and Baskar.T	Engineering Physics I	GEMS Publisher, Coimbatore-641 001	2 <sup>nd</sup> Edition- 2015

**REFERENCES:**

S.No	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Serway and Jewett	Physics for Scientists and Engineers with Modern Physics	Thomson Brooks/Cole, Indian reprint, New Delhi	8 <sup>th</sup> Edition 2010
2	Gaur, R.K. and Gupta, S.C	Engineering Physics	Dhanpat Rai Publications, New Delhi.	9 <sup>th</sup> Edition 2011

**WEBSITES:**

1. [www.nptel.ac.in](http://www.nptel.ac.in)
2. [www.physicsclassroom.com](http://www.physicsclassroom.com)
3. [www.oyc.yale.edu](http://www.oyc.yale.edu)
4. [www.physics.org](http://www.physics.org)

**OBJECTIVES:**

- To gain knowledge on adsorption phenomena.
- # • To make the students conversant with basics of water technology.
- To make the student acquire sound knowledge of electrochemistry and storage devices.
- To acquaint the student with concepts of fuels and rocket propellants.
- To develop an understanding of the basic concepts of corrosion science.
- To acquaint the students with the basics of surface chemistry.

**OUTCOMES:**

- Outline the basic principles of chemistry for water treatment (K)
- Examine the electrochemical properties to design non – conventional energy storage devices (S)
- Apply the concepts combustion of different fuels (S)
- Identify the concepts of corrosion and its protection in the engineering field (S)
- Apply the concepts of surface chemistry in the field of engineering (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I WATER TECHNOLOGY****(9)**

Characteristics – Alkalinity – Types of alkalinity and determination – Hardness – Types and estimation by EDTA method (problems) - Domestic water treatment – Disinfection methods (Chlorination, Ozonation, UV treatment) – Boiler feed water – Requirements – Disadvantages of using hard water in boilers – Internal conditioning (Phosphate, Calgon and Carbonate conditioning methods) – External conditioning – Demineralization process – Desalination and Reverse osmosis.

**UNIT II ELECTROCHEMISTRY AND STORAGE DEVICES****(9)**

Electrochemical cells – Reversible and irreversible cells – EMF – Measurement of emf – Single electrode potential – Nernst equation – Reference electrodes – Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – Glass electrode and measurement of pH – Electrochemical series – Significance – Potentiometric titrations (Redox -  $\text{Fe}^{2+}$  vs dichromate) –Batteries- Primary batteries-Leclanche cell- Secondary batteries- Lead acid battery.

**UNIT III FUELS AND ROCKET PROPELLANTS****(9)**

Coal - Proximate and Ultimate analysis - Metallurgical coke - Manufacture by Otto-Hoffman method - Petroleum processing and fractions - Synthetic petrol - Bergius and Fischer-Tropsch method - Knocking - Octane number and Cetane number - Gaseous fuels - Water gas, Producer gas, An introduction to Fuel Cell,  $\text{H}_2$ - $\text{O}_2$  Fuel Cell -Rocket engines-Types of rocket engines, Basic principles, Mass fraction.

#### UNIT IV CORROSION SCIENCE

(9)

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings - Paints - Constituents and functions — Metallic coatings - Electroplating (Au) and Electro less plating (Ni) - Surface conversion coating and Hot dipping.

#### UNIT V SURFACE CHEMISTRY

(9)

Introduction-Adsorption-Types, adsorption of gases on solids, adsorption of solutes from solutions, Adsorption isotherms-Freundlich adsorption isotherm-Langmuir adsorption isotherm- Industrial adsorbent materials- Role of adsorbents in catalysis and water softening- Emulsion- Types-water/oil, oil/water- Applications of adsorption.

**Total: 45**

#### TEXT BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	Dr. Vairam.S	Engineering Chemistry	Gems Publishers, Coimbatore.	2014
2.	Dr.Ravikrishnan.A	Engineering Chemistry I & II	Sri Krishna Hi tech Publishing Company (P) Ltd., Chennai.	2012

#### REFERENCE BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	Raman Sivakumar	Engineering Chemistry I & II	McGraw-Hill Publishing Co.Ltd., 3 <sup>rd</sup> Reprint NewDelhi.	2013
2.	Kuriakose. J.C. and Rajaram	Chemistry in Engineering and Technology. Vol. I & II 5 <sup>th</sup> edition.	Tata McGraw Hill Publishing Company, New Delhi.	2010
3.	Jain, P.C. and Monika Jain	Engineering Chemistry.	Dhanpat Rai Publishing Company (P) Ltd., New Delhi.	2009
4.	Dara.S.S	Text book of Engineering Chemistry.	S.Chand & Co.Ltd., New Delhi	2008
5.	Sharma.B. K	Engineering Chemistry	Krishna Prakasam Media (P) Ltd., Meerut	2001

#### WEBSITES:

- <http://www.studynotes.ie/leaving-cert/chemistry/>
- <http://www.rejinpaul.com/2011/04/engineering-chemistry-ii-second.html>
- <http://www.learnerstv.com/Free-chemistry-Video-lectures-ltv044-Page1.htm>
- <http://ocw.mit.edu/courses/#chemistry>
- <http://www.chem.qmul.ac.uk/surfaces/sec>

## Semester – I

### 15BTCC105 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING 3 0 0 3 OBJECTIVES

1. To impart the basic knowledge about the Electric circuits.
2. To understand the working of various Electrical Machines.
3. To know about various measuring instruments.
4. To understand the basic concepts in semiconductor devices and digital electronics.
5. To understand and analyze basic electric and magnetic circuits.
6. To gain the basic knowledge about the Electric circuits

### INTENDED OUTCOMES

1. The students shall develop an intuitive understanding of the circuit analysis, basic concepts of electrical machines, basics of electronics and be able to apply them in practical situation.
2. To study the working principles of electrical machines and power converters.
3. To introduce the components of low-voltage electrical installations.
4. Gained the knowledge in working of Electrical Machines and Transformers.
5. Students will gain the applications of transformers.
6. To understand and analyze basic electric and magnetic circuits.

### UNIT I ELECTRIC CIRCUITS

(9)

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase balanced Circuits.

### UNIT II ELECTRICAL MACHINES

(9)

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, Single Phase Induction Motor.

### UNIT III MEASURING INSTRUMENTS

(9)

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

### UNIT IV SEMICONDUCTOR DEVICES AND APPLICATIONS

(9)

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation, Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics.

### UNIT V DIGITAL ELECTRONICS

(9)

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counter – A/D and D/A Conversion (single concepts)

**Total: 45**

**TEXT BOOKS:**

<b>S.NO</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of publication</b>
1	Mittle, V.M	Basic Electrical Engineering	Tata McGraw Hill Edition, New Delhi	2004
2	Sedha R.S	Applied Electronics	S. Chand & Co	2006

**REFERENCE BOOKS:**

<b>S.NO</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of publication</b>
1	Muthusubramanian R, Salivahanan S and Muraleedharan K A	Basic Electrical, Electronics and Computer Engineering	Tata McGraw Hill, Second Edition	2006
2	Nagsarkar T K and Sukhija M S	Basics of Electrical Engineering	Oxford press	2005
3	Premkumar N	Basic Electrical Engineering	Anuradha Publishers	2003
4	Mahmood Nahvi and Joseph A. Edminister	Electric Circuits	Schaum' Outline Series, McGraw Hill	2002

**ENGINEERING PHYSICS**

**OBJECTIVES:**

- To develop basic laboratory skills and demonstrating the application of physical principles.
- To prepare for the lab experiment and perform individually a wide spectrum of experiments.
- To present experimental data in various appropriate forms like tabulation, and plots.
- To analyze, Interpret and Summarize experimental results.
- To communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
- To develop the skills for understanding basic electric circuits.

**OUTCOMES:**

- The students will have the knowledge on Physics practical experiments and that knowledge will be used by them in different engineering and technology applications.
- Prepare for the lab experiment and perform individually a wide spectrum of experiments.
- Present experimental data in various appropriate forms like tabulation, and plots.
- Analyze, Interpret and Summarize experimental results.
- Communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
- Prepare to develop the skills for understanding basic electric circuits.

**LIST OF EXPERIMENTS – PHYSICS**

1. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
2. Determination of wavelength of mercury spectrum – spectrometer grating.
3. Determination of Young's modulus of the material – Non uniform bending or Uniform bending.
4. Determination of Viscosity of liquid – Poiseuille's method.
5. Spectrometer Dispersive power of a prism.
6. Torsional pendulum – Determination of Rigidity modulus.
7. Particle size determination using Diode Laser
8. Determination of Laser parameters – Wavelength, and angle of divergence.
9. Determination of acceptance angle in an optical fiber.
10. Determination of thickness of a thin wire – Air wedge method
11. Determination of Band Gap of a semiconductor material.
12. Determination of Specific resistance of a given coil of wire – Carey Foster Bridge

## ENGINEERING CHEMISTRY LABORATORY

### OBJECTIVES:

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.
- To estimate the amount of alkalinity ions, hardness, chloride in water sample
- To make the student acquire practical skills in the determination of conductance of solutions, EMF etc
- To acquaint the students with the determination of molecular weight of a polymer by viscometry
- To carried out different types of titrations for estimation of concerned in materials
- To Determine the corrosion rate of steel by weight loss method.

### OUTCOMES:

- The students will be outfitted with hands-on knowledge in quantitative chemical analysis of water quality parameters and corrosion measurement.
- Estimate the amount of alkalinity ions, hardness, chloride in water sample
- Measure molecular/system properties of conductance of solutions, EMF etc
- Acquaint the students with the determination of molecular weight of a polymer by visocometry
- Determine the corrosion rate of steel by weight loss method.
- Carrying out different types of titrations for estimation of concerned in materials using comparatively more qualities and quantities of materials involved for accurate results.

### LIST OF EXPERIMENTS - CHEMISTRY

1. Estimation of alkalinity of Water sample
2. Estimation of hardness of Water by EDTA
3. Estimation of chloride in Water sample (Argentometric method)
4. Determination of corrosion rate by weight loss method.
5. Conductometric Titration (Simple acid base).
6. Conductometric Titration (Mixture of weak and strong acids).
7. Conduct metric Titration using  $\text{BaCl}_2$  vs  $\text{Na}_2\text{SO}_4$ .
8. pH Titration (acid & base).
9. Potentiometric Titration ( $\text{Fe}^{2+}$  /  $\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$ ).
10. Estimation of Ferric iron by Spectrophotometry.
11. Determination of water of crystallization of a crystalline salt (Copper sulphate).
12. Determination of molecular weight and degree of polymerization using Viscometry.
13. Determination of chemical oxygen demand.

**Course Objectives:**

- To provide hands-on training for the fabrication of components using carpentry and welding equipment/tools.
- To gain the skills for making fitting joints and household pipeline connections using suitable tools.
- To develop the skills for preparing the green sand mould.
- To present the skills for making the simple household electrical connection.
- To develop the skills for making wood/metal models using suitable tools.
- Prepare green sand mould using suitable tools.

**Course Outcomes:**

- Fabricate simple components using carpentry and welding equipment/tools.
- Make fitting joints and household pipeline connections using suitable tools.
- Prepare green sand mould using suitable tools.
- Make simple household electrical connections using suitable tools.
- Make simple models using wood and metal.
- Make simple plumbing work

**PART – A (CIVIL & MECHANICAL)**

**1. WELDING**

- i. Preparation of arc welding of butt joints, lap joints and tee joints.

**2. BASIC MACHINING**

- i. Simple Turning and Taper turning
- ii. Drilling and Tapping

**3. SHEET METAL WORK**

- i. Model making – Trays, funnels, etc.

**4. DEMONSTRATION ON**

- i. Smithy operations
- ii. Foundry operations
- iii. Plumbing Works
- iv. Carpentry Works

## **PART –B (ELECTRICAL & ELECTRONICS)**

### **5. ELECTRICAL ENGINEERING**

- i. Study of electrical symbols and electrical equipments.
- ii. Construct the wiring diagram for Stair case wiring and Fluorescent lamp wiring.
- iii. Construct the wiring diagram for Residential house wiring using switches, fuse, indicator, lamp and energy meter.
- iv. Measurement of electrical quantities – voltage, current, power & power factor in R load.
- v. Measurement of energy using single phase energy meter.

### **6. ELECTRONICS ENGINEERING**

- i. Study of Electronic components– Resistor (color coding), capacitors and inductors.
- ii. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
- iii. Study of logic gates AND, OR, NOT, NOR and NAND.
- iv. Study of HWR and FWR.

## **REFERENCES**

1. Jeyachandran, K., Natarajan, S. and Balasubramanian, S, “A Premier on Engineering Practices Laboratory”, Anuradha Publications, Kumbakonam, 2007.
2. Jeyapoovan, T., Saravanapandian, M, “Engineering Practices Lab Manual”, Vikas PUBLISHING House Pvt. Ltd, Chennai, 2006.
3. Bawa, H.S, “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2007.

### Course Objectives:

- To learn conventions and use of drawing tools in making engineering drawings.
- To impart knowledge on orthographic projection.
- To draw orthographic projections of points, line and plane surfaces.
- To draw orthographic projections of solids.
- To impart the basic concepts of isometric projections through simple examples.
- To impart knowledge of the CAD software

**Course Outcomes:**

Upon successful completion of the course, the students should be able to:

- Recognise the conventions and apply dimensioning concepts while drafting simple objects.
- Draw freehand sketching of multiple views from pictorial views of objects.
- Draw the orthographic projection of points, line and plane surfaces.
- Draw the orthographic projection of solids.
- Draw the isometric projection of the given objects.
- Demonstrate knowledge of the CAD software

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>(3 + 10)</b>
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Introduction to Engineering Drawing, Bureau of Indian Standards (BIS), Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning– linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension.

## UNIT II      SCALES AND PLANE CURVES      (3 + 10)

SCALES: Reducing Scale, Enlarging Scale, Plain Scale, Diagonal Scale and Vernier Scale.  
Conics – Construction of Ellipse, Parabola and Hyperbola by eccentricity method

**UNIT III      FREE HAND SKETCHING      (3 + 12)**

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

## UNIT IV PROJECTION OF POINTS, LINES AND PLANE SURFACES (3 + 12)

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Traces–Projection of polygonal surface and circular lamina inclined to both reference planes.

**UNIT V      PROJECTION OF SOLIDS      (3+12)**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

**Introduction to Drafting Software/Package (Not for Exam)**

**(4)**

Basic operation of drafting packages, use of various commands for drawing, dimensioning, editing, modifying, saving and printing/plotting the drawings. Introduction to 3D primitives.

**TOTAL: 75**

**TEXT BOOKS**

1. Venugopal K and Prabhu Raja V, “Engineering Graphics”, New Age International Publishers, 2007.
2. VTU, “A Primer on Computer Aided Engineering Drawing” Belgaum, 2006.

**REFERENCES**

1. Kumar M S, “Engineering Graphics”, D D Publications, Chennai, Ninth Edition, 2007.
2. Bureau of Indian Standards, “Engineering Drawing Practices for Schools and Colleges SP 46-2003”, BIS, New Delhi, 2003.
3. Luzadder W J, “Fundamentals of Engineering Drawing”, Prentice Hall Book Co., New York, 1998.

**WEB REFERENCES**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 and 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 and SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 and SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

**OBJECTIVE:**

- To know the value of being a human being and the value of being a useful citizen.

**INTENDED OUTCOME:**

- Educate the values and meaning of life in the young minds and to transform them as responsible citizens
- Educate the values and meaning of life
- to transform them as responsible citizens
- Types of values - Components of values
- Educate the values and meaning of Self Development : Self analysis – Goal Setting
- Individual Qualities

**UNIT – I :****(4)**

Human life on Earth - Concept of Human Values - Value Education - Aim of education and value education - Types of values - Components of values – Attitudes – types of attitudes

**UNIT – II :****(4)**

Self Development : Self analysis – Goal Setting - Thought Analysis – Guarding against Anger - Respect to age, experience, maturity, family members, neighbors, co-workers

**UNIT – III :****(5)**

Individual Qualities – Truthfulness – Constructivity – Sacrifice – Sincerity - Self Control – Altruism – Tolerance - Scientific Vision – Regulating Desire

**UNIT – IV:****(4)**

Mind Culture - Modern Challenges of Adolescent - Emotions and behavior - Sex and spirituality - Adolescent Emotions - Meditation

**UNIT - V :****(3)**

Body and Mind Fitness : (a) Physical Exercises (b) Activities: (i) Moralization of Desires (ii) Neutralization of Anger (iii) Eradication of Worries (iv) Benefits of Blessings.

**REFERENCE BOOKS:****Total: 20**

<b>S.No</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
1	Subramanian. R	Professional Ethics	Oxford, New Delhi	2013
2	Govindarajan. M, Natarajan. S, Senthil Kumar. V.S	Engineering Ethics	Prentice Hall of India, New Delhi	2004
3	Tripathi. A.N	Human Values	New Age International	2009
4	Pope. G. U.	Thirukkural with English Translation	Uma Publication, Thanjavur.	2002

**Course Objectives**

- To motivate learners to acquire listening & speaking skills in both formal and informal context.
- To focus on question forms & to make them understand the importance of using question tags and also the functional use of transformation of sentences.
- To improve their reading habit and to train them in critical and analytical reading.
- To equip them to write for academic as well as work place context.
- To enable students to face interviews.
- To study the receptive and productive skills

**Course Outcomes**

Students undergoing this course will be able to

- Acquire second language: speaking convincingly, expressing their opinions clearly, negotiating and arguing using appropriate communicative strategies.
- Enhance their reading texts critically and analytically.
- Develop writing effectively, persuasively and producing different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- Producing different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- Enrich the ability to face interviews with confidence.
- Ensure the good communication with the society.

**UNIT-1****(10)**

**Listening** - Difference between Hearing & Listening –Listening to informal conversation. **Speaking** - Spoken structures on different situations - Introduction, Greeting, Comments on topics like Films, Games etc, Excuse, Request, Agreement, Disagreement, etc., **Reading** – Extensive and Intensive reading. **Writing** – Report writing - Writing a covering letter. **Grammar** – Regular & Irregular verbs - Kinds of sentences - Question tags. **Vocabulary** – Homonyms and Homophones.

**UNIT-II****(8)**

**Listening** – Note Taking- Improving grasping ability. **Speaking** – Welcome address - Vote of thanks - Master of ceremony. **Reading** – Active and Passive reading - Reading for vocabulary- Reading for a purpose. **Writing** - Writing a review (Film review) - Summary of a story. **Grammar** - Modal verbs – Conjunction - Expression of cause and effect. **Vocabulary** - Phrasal verbs - Idioms.

**UNIT – III****(9)**

**Listening** - Barriers to listening (Physical, Psychological, Linguistic & Cultural). **Speaking** – Stress, Pause and Intonation. **Reading** – Rapid reading – Skimming, Scanning and Surveying. (SQ3R) **Writing** - Essay writing -Minutes of meeting - Agenda – **Grammar** - Active and Passive voice - Purpose expression. **Vocabulary** - Same words used as noun and verb - Often misspelt and confused words.

**UNIT-IV****(8)**

**Listening** – Listening to telephone conversation - Viewing model interviews. **Speaking** – Group Discussion - Correlation between verbal & non - verbal communication. **Reading** – Reading comprehension (short & long text) - Reading job advertisements and profile of a company. **Writing** – Job application - Resume writing - Checklist preparation. **Grammar** - Numerical expressions – Collocations - **Vocabulary** - Singular and Plural (Nouns).

**UNIT- V****(10)**

**Listening** – Types of listening- Improving listening comprehension. **Speaking** - Oral presentation - Vocal communication techniques - Voice, quality, volume, pitch etc., **Reading** -Note making - Making notes from books/ any forms of writing materials. **Writing** - Describing process & products - Recommendation writing – Short essays writing- **Grammar**- Transformation of sentences (Simple, Compound & Complex). **Vocabulary** - Collection of Technical Vocabularies with their meanings.

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

**Total: 45****TEXT BOOK:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	<u>Sangeeta Sharma</u> , <u>Meenakshi Raman</u>	<u>Technical Communication: Principles And Practice</u> 2 <sup>nd</sup> Edition	OUP, New Delhi.	2015

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Lakshminarayanan, K.R. & Murugavel, T.	Communication Skills for Engineers	SCITECH Publications, Chennai	2008
2	Rizvi Ashraf, M	Effective Technical Communication	Tata McGraw-Hill, New Delhi.	2007
3	Rutherford Andrea, J.	Basic Communication Skills for Technology	Pearson Education, New Delhi.	2006

**WEBSITES :**

[www.learnerstv.com](http://www.learnerstv.com) – Listening/ Speaking/ Presentation  
[www.usingenglish.com](http://www.usingenglish.com) – Writing/ Grammar  
[www.englishclub.com](http://www.englishclub.com) – Vocabulary Enrichment/ Speaking  
[www.ispeakyouspeak.blogspot.com](http://www.ispeakyouspeak.blogspot.com) – Vocabulary Enrichment/ Speaking  
[www.teachertube.com](http://www.teachertube.com) – Writing Technically  
[www.Dictionary.com](http://www.Dictionary.com) – Semantic / Grammar

**OBJECTIVES:**

- To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.
- To understand the concepts of Multiple integrals, Functions of several variables and Fourier series
- To Fourier series to apply physical science and signal systems.
- To understand the concepts of Boundary value problems and Statistics.
- To acquire knowledge on the Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To enhance the knowledge on the various measures of central tendencies, dispersion, moments, skewness, kurtosis and to interpret them.

**OUTCOMES:**

- The students will be able to understand mathematical tools needed in evaluating multiple integrals and their usage
- To Calculate and establish identities connecting these quantities, to Evaluate line, surface and volume integrals in simple coordinate systems.
- The students will be able to familiarize functions of several variables which is used in many physical engineering problems. Apply differentiation to solve maxima and minima problems.
- To solve differential equations using Fourier series analysis which plays a vital role in engineering applications
- Introduce the Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- Compute various measures of central tendencies, dispersion, moments, skewness, kurtosis and to interpret them.

**UNIT -I      MULTIPLE INTEGRALS****(12)**

Double integration in Cartesian – Change of order of integration – Area as a double integral – Triple integration in Cartesian coordinates.

**UNIT -II      FUNCTIONS OF SEVERAL VARIABLES****(12)**

Function of two variables – Taylor's expansion – maxima and minima – constrained maxima and minima by Lagrangian multiplier method – Jacobians.

**UNIT- III      FOURIER SERIES****(12)**

Dirichlet's conditions – statement of Fourier theorem – Fourier coefficients – change of scale – Half range series – Harmonic Analysis.

**UNIT- IV     BOUNDARY VALUE PROBLEMS****(12)**

Method of separation of variables – one dimensional wave equation – one dimensional heat equation – steady state conditions – zero and non – zero boundary conditions.

**UNIT – V     STATISTICS****(12)**

Measures of central tendency – Mean, Median, Mode, Standard deviation – moments – skewness and kurtosis-correlation – rank correlation.

**Total : 60****REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Hemamalini. P.T	Engineering Mathematics I & II	McGraw-Hill Education Pvt.Ltd, New Delhi.	2014
2	Dr.P.Kandasamy , Dr.K.Thilagavathy, Dr.K.Gunavathy	Engineering Mathematics Volume III	S.Chand &Co., New Delhi.	2013
3	Veerarajan, T	Engineering Mathematics	Tata McGraw Hill Publishing Co., New Delh.	2010
4	Sundaram V., Balasubramanian R., Lakshminarayanan K.A.	Engineering Mathematics	Vikas publishing house Pvt. Ltd, New Delhi.	2005
5	Gupta S.C., Kapoor V.K	Fundamentals of Mathematical Statistics	Sultan chand & Sons, New Delhi.	2006

**WEBSITES:**

1. [www.intmath.com](http://www.intmath.com)
2. [www.efunda.com](http://www.efunda.com)
3. [www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)

**OBJECTIVES:**

- To enrich the understanding of various types of materials and their applications in engineering and technology
- Introduce the concepts of classical and quantum electron theories for diverse applications.
- Understand the basics of magnetic materials and its properties.
- Impart the basic knowledge of superconducting and dielectric materials.
- Inculcate the technology in synthesis of nano materials.
- To Summarize the basics of nano structures and synthesizing techniques

**OUTCOMES:**

- Explain the ideas of classical and quantum electron theories and energy band structures.
- Illustrate the basics of semiconductor physics and its related concepts.
- Compare the different magnetic materials, its properties and infer its role in various fields.
- Identify the properties of superconducting materials and its engineering applications.
- Extend the various polarization techniques and applications of dielectric materials.
- Summarize the basics of nano structures and synthesizing techniques

**UNIT I CONDUCTING MATERIALS****(9)**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

**UNIT II SEMICONDUCTING MATERIALS****(9)**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect – Determination of Hall coefficient – Applications.

**UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS****(9)**

Origin of magnetic moment – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications. Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Temperature superconductors – Applications of superconductors – magnetic levitation.

**UNIT IV      DIELECTRIC MATERIALS****(9)**

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials – ferroelectricity and applications.

**UNIT V      ADVANCED MATERIALS****(9)**

Metallic glasses: preparation, properties and applications.

Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, applications.

Composite materials, Aircraft materials and non-metallic materials.

Nano materials: synthesis – Physical and chemical vapour deposition – ball milling - properties of nanoparticles and applications. Carbon nanotubes: structure – properties and applications.

**Total: 45**

**TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Ganesan.S and Baskar.T	Engineering Physics II	GEMS Publisher, Coimbatore-641 001	2 <sup>nd</sup> Edition-2015

**REFERENCES:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	William D Callister Jr	Material Science and Engineering-An Introduction	John Wiley & Sons Inc., New York.	9 <sup>th</sup> Edition 2013
2	James F Shackelford	Introduction to Materials Science for Engineers	Macmillan Publication Company, New York	8 <sup>th</sup> Edition 2014
3	Charles Kittel	Introduction to Solid State Physics	John Wiley & sons, Singapore.	8 <sup>th</sup> Edition 2005

**WEBSITES:**

1. [www.nptel.ac.in](http://www.nptel.ac.in)
2. [www.physicsclassroom.com](http://www.physicsclassroom.com)
3. [www.oyc.yale.edu](http://www.oyc.yale.edu)
4. [www.physics.org](http://www.physics.org)

**Course Objectives:**

- To give a comprehensive insight into natural resources, ecosystem and biodiversity.
- To educate the ways and means of the environment
- To protect the environment from various types of pollution.
- To impart some fundamental knowledge on human welfare measures.
- To create the awareness about environmental problems among people.
- To motivate public to participate in environment protection and improvement.

**Course Outcomes (COs)****Upon completion of the course the students will be able to**

- Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
- Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.

**UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES****(9)**

Definition, Scope and Importance – Need for public awareness -Forest resources: Use and over-exploitation, deforestation- Water resources-Use and over-utilization of surface and ground water, floods, drought, conflicts over water- Land resources-Land as a resource, land degradation, man induced landslides, soil erosion and desertification –Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources- Food resources-World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture- Energy resources-Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources- role of an individual in conservation of natural resources.

## UNIT II ECOSYSTEM

(9)

Chemistry and Environment- Environmental segments, Composition and Structure of atmosphere- Concept of an ecosystem- Structure, components and function of an ecosystem Energy flow in the ecosystem – Food chain, Food web and Ecological pyramids, Structure and function of Terrestrial ecosystem (Forest, Desert and Grassland ecosystem) and Aquatic ecosystem (Fresh water and Marine ecosystem)

## UNIT III BIODIVERSITY

(9)

Introduction to biodiversity, Definition- Genetic diversity, Species diversity and Ecosystem diversity, Biogeographical classification of India, Importance of biodiversity-Value of biodiversity – Hot Spots of biodiversity-Threats to biodiversity - Endangered and Endemic Species of India – Conservation of biodiversity- In-Situ and Ex-Situ conservation of biodiversity.

## UNIT IV ENVIRONMENTAL POLLUTION

(9)

Definition – causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution and Thermal pollution. Solid waste management-causes, effects and control measures of urban and industrial wastes– Role of an individual in prevention of pollution–Disaster management-earthquake, tsunami, cyclone and landslides.

## UNIT V SOCIAL ISSUES AND ENVIRONMENT

(9)

From Unsustainable to Sustainable development, Urban problems related to energy sources, Water conservation, Rain water harvesting and Watershed management, Resettlement and rehabilitation of people, its problems and concerns, Environmental ethics- Issues and possible solutions- Climate change- Green house effect and Global warming, Acid rain, Ozone layer depletion, Wasteland reclamation- Environment Protection Act- Human Rights- Value education, Role of Information Technology in Environment and Human health- Population growth, Variation of population among nations- Population explosion.

**Total: 45**

### TEXT BOOKS:

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Dr. Ravikrishnan, A	Environmental Science	Sri Krishna Hi tech Publishing Company Private Ltd., Chennai	2012
2.	Anubha kaushik C.P. Kaushik	Environmental Science and Engineering	New Age International (P) Ltd., New Delhi.	2010

### REFERENCES:

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	William P. Cunningham	Principles of Environmental Science	Tata Mc Graw -Hill Publishing Company, New Delhi.	2008
2.	Linda D. Williams	Environmental Science Demystified	Tata Mc Graw -Hill Publishing Company Ltd., New Delhi.	2005

3.	Bharucha Erach	Environmental Science Demystified	Mapin Publishing (P) Ltd., Ahmedabad.	2005
4.	Tyler Miller G. Jr	Environmental Science	Thomson & Thomson Publishers, New Delhi.	2004
5.	Trivedi, R.K. and Goel, P.K	Introduction to Air Pollution	Techno-Science Publications, Jaipur.	2003

#### **WEBSITES:**

- <http://people.eku.edu/ritchisong/envscinotes1.html>
- <http://nptel.ac.in/courses.php?disciplineId=120>
- [www.newagepublishers.com/samplechapter/0012\(8\)1](http://www.newagepublishers.com/samplechapter/0012(8)1).
- [www.unesco.org/ext/field/beijing/scienceb.htm](http://www.unesco.org/ext/field/beijing/scienceb.htm),
- [www.infinitepower.org/education.htm](http://www.infinitepower.org/education.htm)

**COURSE OBJECTIVE:**

- To understand the foundations of biochemistry
- To discuss the properties of water and its interactions
- To explain the structure and properties of carbohydrates
- To explain the structure and properties of amino acids, Peptides, Proteins and lipids
- To understand the chemistry and function of nucleotides and nucleic acids.
- To discuss the various functions and properties of important biomolecule.

**COURSE OUTCOMES:**

1. Outline the cellular foundations of Biochemistry
2. Interpret different types of biomolecules and its interaction with water.
3. Analyze the function and properties of carbohydrates.
4. Explain the importance of amino acids, Peptides, Proteins and lipids.
5. Examine the structure, function and properties of nucleotides, nucleic acid, DNA.
6. Assess various functions and properties of important biomolecule.

**UNIT-I THE FOUNDATIONS OF BIOCHEMISTRY (8)**

Cellular foundations: the universal features of living cells, phylogeny of three domain of life, classification of organisms based on energy. Chemical foundation: essential elements, common functional groups of biomolecules, molecular component of an *E.coli* cell, macromolecules of cells. Physical foundation: Energy interconversion in living organisms, entropy, enthalpy, Gibbs theory, Genetic foundations: DNA to RNA to protein, Evolutionary foundations: genetic mutation, role of genetic mutation, stimulation of chemical evolution, molecular anatomy revealing evolutionary relationship.

**UNIT-II WATER (9)**

Weak interactions in aqueous systems, Hydrogen bonding, structure of water molecules, bond dissociation energy, common hydrogen bonds in biological systems, directionality of hydrogen bond, electrostatic interaction of water with charged solutes, Polar, Nonpolar, and Amphipathic Biomolecules, Entropy changes upon dissolving crystalline substances, clathrates, micelles, Van der Waals interaction, hydrophobic interaction, four types of non covalent interactions in biomolecules in aqueous solvent, colligative properties, osmosis and the measurement of osmotic pressure, ionization of weak acid and weak bases, buffers.

**UNIT-III (a) AMINO ACIDS, PEPTIDES, PROTEINS (10)**

General structure of amino acid, properties, conventions of amino acids, classification of amino acids by R group, uncommon amino acids, Zwitterion. Peptides: Peptide bond, polypeptides, oligomers, protomers. Proteins: hierarchy, four levels of structure in protein, steps in sequencing of a polypeptide, locating disulfide bond. Chemical synthesis of a peptide.

**(b) LIPIDS**

Fatty acids, structural lipids in membrane, galactolipids, sphingolipids, and sterols, lipid extraction.

**UNIT-IV CARBOHYDRATES AND GLYCOBIOLOGY****(9)**

Monosaccharides: aldose, ketose, epimers, pyranoses, furanoses, anomers, Haworth formula, conformation of pyranoses, sugars as reducing agents, Disaccharides: Glycosidic bonds, hydrolysis, Polysaccharides: starch, glycogen, dextrans, homopolysaccharides, chitin. Glyconjugates: Glycoproteins, proteoglycan, and glycolipids. Sugar code, methods of carbohydrate analysis

**UNIT-V NUCLEOTIDES AND NUCLEIC ACIDS****(9)**

Nucleotides and nucleic acid nomenclature, Phosphodiesterase Linkage, structure of purine and pyrimidine, Absorption spectra of the common nucleotide, Nucleic acid structure: DNA stores genetic information, DNA is a Double helix, Watson-Crick structure, RNA-three dimensional structure, nucleic acid chemistry: denaturation and annealing, DNA sequences determination, chemical synthesis of DNA, purine, pyrimidine synthesis.

**Total: 45****TEXT BOOK:**

<b>S.N O</b>	<b>AUTHOR (S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	D. L. Nelson, M. Cox & M. M. Cox	Lehninger Principles of Biochemistry 4 <sup>th</sup> Edition	Freeman, W. H. & Company, New York	2004

**REFERENCES:**

<b>S.N O</b>	<b>AUTHOR (S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Zubay, G.L	Principles of Biochemistry	WCB Publishers, London	1996
2	Herg, J.M., J.L. Tymoczko & L. Stryer	Biochemistry. V Edition	WH-Freeman and Co, New York	2002
3	Voet, G. & A. Voet	Fundamentals of Biochemistry. II Edition	John Wiley and Sons, Inc. New York	2015

**Course Objectives:**

- To identify and understand the working of key components of a computer program.
- To identify and understand the various kinds of keywords and different data types of C programming.
- To understand, analyse and implement software development tools like algorithm, pseudo codes and programming structure.
- To study, analyse and understand the logical structure of a computer program, and different construct to develop a program in C language.
- Understand, analyze and implement software development tools like algorithm, pseudo codes and programming structure.
- Study, analyze and understand logical structure of a computer program, and different construct to develop a program in 'C' language

**Course Outcomes:**

**Upon successful completion of the course, the students should be able to:**

- Formulate simple algorithms for arithmetic and logical problems.
- Translate the algorithms to programs (in C language).
- Test and execute the programs and correct syntax and logical errors.
- Implement conditional branching, iteration and recursion.
- Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
- Apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.

**UNIT I      OVERVIEW OF COMPUTER      (8)**

What is computer- Computer Components-Generation of Computers- Memory Organization-Memory Types-Input and Output Devices- Concepts of Hardware and Software- What is OS-Windows and Unix OS- Programming Languages- Basics of Computer Networks- LAN, WAN-Concept of Internet- ISP- Basics of word processing- Basics of spreadsheet – Basics of presentation Software

**UNIT II      OVERVIEW OF 'C'      (8)**

Algorithms-Representation of Algorithms-Flowchart- Introduction to programming Languages-What is C- C Character set- Constants, Variables and Keywords-General form of C Program-The First C Program-Data types-Arithmetic Instructions- Type conversions- Relational and Logical Operators- Hierarchy and associativity

**UNIT III      SELECTION AND ITERATION      (9)**

Selection Structures- If and nested if - Loops-Definition and types-While loop-for loop- do-while loop- break and continue- Nested loops- Advantages of iteration-Menu driven programs-Switch Case

**UNIT IV      FUNCTIONS****(10)**

Functions- Definition-types-Functions without arguments- Functions with Input arguments- Functions with output parameters-local and global variables- advantages of functions- Call by value and Call by reference- Recursion- Function as an argument

**UNIT V      ARRAYS AND STRINGS****(10)**

Arrays-definition- Declaring and referencing arrays- Array initialization- Using for loops for accessing arrays-Passing array elements as function arguments-2D Array - Matrix Addition and multiplication- Introduction to Strings- declaration and Initialization--String constant -Strings as Array of Characters

**Total : 45**

**REFERENCES:**

1. E. Balagurusamy, “ Computing Fundamentals and C Programming”, TMH Education, 5<sup>th</sup> Edition, 2014
2. Yashavant Kanetkar, “ Let us C”, BPB Publications, 13<sup>th</sup> Edition, 2013
3. H. M. Deitel and D. J. Deitel, ‘C: How to Program’, Prentice Hall, 7<sup>th</sup> Edition, 2012
4. E. Balagurusamy, “ Programming in ANSI C”, TMH Education, 6<sup>th</sup> edition, 2012

**Semester – II**  
**15BTCC211    COMPUTER PRACTICE AND PROGRAMMING LABORATORY    0 0 3 2**

**Course Objectives**

- Identify and understand the working of key components of a computer program.
- Identify and understand the various kinds of keywords and different data types of C programming
- Understand, analyze and implement software development tools using algorithm
- Understand, analyze and implement software development tools using linux
- Acquire and analyse the roots of equations
- Study, analyze and understand logical structure of a computer program, and different construct to develop a program in “C” language

**Course Outcomes:**

The course will enable the students.

- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs(in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.
- To decompose a problem in to functions and synthesize a complete program using divide and conquer approach. and use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

**LIST OF EXPERIMENTS**

1. Working with word Processing, Spreadsheet and presentation software in Linux
2. Programming in Scratch:  
Practicing fundamental concepts of programming like sequence, selection decision statements, working of loops and event driven programming
3. C Programming:  
Practicing programs to get exposure to basic data types, algebraic expressions, Conditional statements, Input and Output Formatting, Decision Statements, Switch Case, Control structures, arrays, Strings and function

**Total: 45**

**COURSE OBJECTIVE:**

- To experiment with sugar quantification method
- To perform analysis to distinguish reducing and non-reducing sugars
- To understand the protein quantification using Lowry's method
- To explain the quantification of lipid and amino acid
- To experiment the separation of solutes through chromatography
- To demonstrate the DNA and RNA estimation through DPA and Orcinol method.

**COURSE OUTCOMES:**

1. Outline the sugar quantification through anthrone method
2. Illustrate the procedure for distinguishing reducing and non-reducing sugars
3. Perform the protein quantification
4. Recall the procedure for distinguishing imino and amino acids using ninhydrin test.
5. Interpret the solutes separated through chromatography
6. Discuss the DNA and RNA estimation.

**LIST OF EXPERIMENTS:**

1. Quantification of sugars (Anthrone method)
2. Distinguish reducing and nonreducing sugars.
3. Quantification of proteins (Lowry *et al* Method)
4. Using ninhydrin for distinguishing Imino and amino acids
5. Quantification of lipids
6. Analysis of oils- Acid number
7. Paper Chromatography
8. Estimation of DNA (DPA method)
9. Estimation of RNA (Orcinol method)

**TEXT BOOKS:**

S. NO.	AUTHOR (S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Boyer, R.	Experimental Biochemistry	Benjamin Cummings, Redwood City, California, USA	2000
2	Palanivelu, P.	Analytical Biochemistry and Separation Techniques	Kalaimani Printers, Madurai	2001

**REFERENCE BOOK:**

<b>S. NO.</b>	<b>AUTHOR (S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Sadasivam, S. & A. Manickam	Biochemical Methods	New Age International Pvt Ltd Publishers, New Delhi	2002

**OBJECTIVE:**

- • To understand the basics of biomolecules, human anatomy and physiology
- To have better understanding of advancements in biology
- To understand the basics of biomolecules
- To understand the basics of human anatomy
- To understand the basics of physiology
- To have better understanding of advancements

**UNIT-I BASICS OF CELL BIOLOGY****(4)**

History, Cell theory, Cell Structure-Prokaryotic and Eukaryotic cells, Animal and Plant Cell. Cell cycle, Mitosis, Meiosis and Reproductive cycle.

**UNIT-II BIOMOLECULES****(4)**

Carbohydrates-Classification, Qualitative tests for sugars, Lipids-Definition, Classification; Proteins- classification and functions; Nucleic acids-basic structure; Hormones-definition, importance; Vitamins.

**UNIT-III HUMAN ANATOMY AND PHYSIOLOGY****(5)**

Levels of Structural organization, the eleven systems of human body, central nervous system- cardiovascular system and immune system.

**UNIT-IV GENETICS AND GENETIC DISORDERS****(4)**

History of genetics-Scope and Importance of genetics, Mendel and his work, DNA stores genetic information- gene mutation, disorders due to mutant genes.

**UNIT-V TECHNOLOGICAL ADVANCES IN BIOLOGY****(3)**

Biopharmaceuticals, Gene therapy, genetically modified crops, probiotics.

**Total: 20****TEXT BOOK:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATIONS
1	Verma, P. S., Agarwal, V. K.	Cell Biology, Genetics, Molecular Biology, Evolution and Ecology	S. Chand & Company Ltd., New Delhi	2006

**REFERENCE BOOKS:**

S.NO	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATIONS
1	Nelson, D. L. and Cox, M. M	Lehninger Principles of Biochemistry 4 <sup>th</sup> Edition	Freeman, W. H. & Company, New York	2004
2	Tortora, G. J., Derrickson, B	Principles of Anatomy and Physiology, 11 <sup>th</sup> Edition	John Wiley & Sons, New York	2006

**WEBSITE**

- |  |
|--|
| 1. <a href="http://www.biotechonweb.com/Application-of-biotech-in-Medical.html">http://www.biotechonweb.com/Application-of-biotech-in-Medical.html</a> |
|--|

**OBJECTIVES**

- To understand the basic laws and concepts of chemical calculations.
- To explain the first and second laws of thermodynamics.
- To explain the overall material balances of chemical reactions and its basic calculations.
- To discuss the fluid flow mechanics and its concepts.
- To understand the fluid transportation.
- To understand the basic principles of chemical calculations and measurements.

**COURSE OUTCOMES**

1. Outline the basic chemical calculations and the basic laws governing it.
2. Illustrate basic laws of thermodynamics.
3. Infer the overall material balances of chemical reactions and its basic calculations.
4. Outline the application of fluid flow mechanics in chemical engineering.
5. Discuss the fluid flow and its measurements.
6. Understand the basic principles of chemical calculations and measurements.

**UNIT- I      BASIC CHEMICAL CALCULATIONS      (9)**

SI units, stoichiometry, basic chemical calculations: mole, atomic mass and molar mass, equivalent mass, conversion of mass fraction to mole fraction, molarity, normality, density, specific gravity. Ideal gas law- Ideal mixtures and solutions – Dalton's law of additive volumes, Henry's law, Raoult's law, Concepts of Simpson's rule and their applications to different systems.

**UNIT- II      FIRST AND SECOND LAWS OF THERMODYNAMICS      (8)**

Energy balances, sensible heat, latent heat, vapour pressure, steady and unsteady state calculations.

**UNIT- III      MATERIAL BALANCES      (10)**

Overall and component balances, material balances without and with chemical reactions, degrees of freedom, steady and unsteady state, unit operations, recycle and bypass humidity calculations.

**UNIT- IV      FLUID MECHANICS      (10)**

Fluids; fluid statics and applications in chemical engineering; fluid flow; laminar; Turbulent pressure drops; compressible fluid flow concepts; multiphase flow concepts.

**UNIT-V      FLOW THROUGH PACKED COLUMNS      (8)**

Fluidisation, centrifugal and piston pumps, characteristics, compressors, work.

**TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Bhatt B.I., and Vora S.M.	Stoichiometry	Tata McGraw- Hill,	2010
2	McCabe W.L., Smith J.C, and Harriot P.	Unit Operations In Chemical Engineering	McGraw-Hill Inc	1993

**Course Objectives:**

- To understand the basics of bioenergetics
- To explain the metabolism of carbohydrate
- To explain the nucleic acid synthesis and regulations
- To discuss the synthesis and catabolism of amino acids pathways
- To understand the lipid metabolism and its associated genetic disorders
- To relate the importance of metabolism and how it leads to disorders.

**Course Outcomes:**

1. Outline the relationship of bioenergetics in biological reactions.
2. Examine the knowledge of carbohydrate metabolic pathways.
3. Describe the concept of nucleic acid synthesis and regulations.
4. Illustrate the synthesis and catabolism of amino acids pathways.
5. Explain the lipid metabolism and its associated genetic disorders.
6. Discuss the importance of metabolism and how it leads to disorders.

**UNIT-I      BIOENERGETICS      (8)**

Energy relationship between the catabolic and anabolic pathways, Five major reactions in living cells, Bioenergetics and thermodynamics. Phosphoryl group transfers; ATP hydrolysis in two steps, Ping-Pong mechanism of nucleoside diphosphate kinase.

**UNIT-II      METABOLISM OF CARBOHYDRATES      (9)**

Major pathways of glucose utilization: glycolysis, fermentation, gluconeogenesis: carbohydrate synthesis from simple precursors. Pentose phosphate pathway; TCA cycle: Reactions and regulations.

**UNIT III      METABOLISM OF NUCLEIC ACIDS      (9)**

Biosynthesis of nucleotides, denovo and salvage pathways for purines and pyrimidines, regulatory mechanisms: Metabolic disorders associated with nucleic acid metabolism.

**UNIT-IV      METABOLISM OF AMINO ACIDS      (10)**

Biosynthesis of amino acids from acetyl coA, Biosynthesis of essential amino acids (Met, Thr, Lys, Ile, Val, Leu, Phe, Trp, Tyr). Glucose-alanine cycle, Urea cycle. Pathways of degradation of aromatic, glucogenic and ketogenic aminoacids. Human genetic disorders affecting amino acid metabolism.

**UNIT-V      METABOLISM OF LIPIDS      (9)**

Biosynthesis of fatty acid, Triacylglycerol. Biosynthesis of cholesterol. Digestion, mobilization, and transport of fats, fatty acid entry into mitochondria via the acyl-carnitine/carnitine transporter. The  $\beta$ -oxidation pathway. Oxidation of a monounsaturated and polyunsaturated fatty acid. Genetic defects in fatty Acyl-CoA dehydrogenases causing serious diseases.

### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Nelson, D. L. and Cox, M. M	Lehninger Principles Biochemistry 4 <sup>th</sup> Edition	Freeman, W. H. & Company	2004

### REFERENCES

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Voet and Voet	Biochemistry	John Wiley & Sons Inc	1995
2	Murray, R. K., Granner, B.K., Mayes, P.A., and Rodwell. V.W.	Harper's Biochemistry	Prentice Hall International	2000
3	Creighton. T.E.	Proteins, Structure and Molecular Properties	Freeman and Co	1993
4	Salway, J. G.	Metabolism at a Glance	Blackwell Science Ltd	2000

**Course Objectives**

- To explain the cell structure of Prokaryotes and Eukaryotes
- To understand how cells undergo mitosis
- To outline the views on transport across the cell membranes.
- To explain the signaling process involved in the cell.
- To illustrate the function of mitochondria and chloroplast.
- To recall the importance of cell signaling process to understand diseases.

**Course Outcomes**

1. Summarize the structure and function of cell components
2. Understand the role of the cytoskeletal proteins and link it with cell cycle.
3. Illustrate the transport process across the cell membrane.
4. Outline the basic ideas on signaling process through the receptors.
5. Explain the electron transfer in mitochondria.
6. Relate the importance of cell signaling process to understand diseases.

**UNIT-I CELL STRUCTURE AND CELL ORGANELLES (9)**

History of cell biology, comparison of eukaryotic and prokaryotic cells, principles of membrane organisation, membrane proteins; Structure of prokaryotic cells - cilia, flagella, cell wall; Structure of eukaryotic cell organelles: cytoplasm, endoplasmic reticulum, mitochondria, chloroplast, peroxisomes, nucleus.

**UNIT-II CYTOSKELETAL PROTEINS & CELL DIVISION (9)**

Cytoskeletal proteins, contractile proteins – actin & myosin; extracellular matrix; Types of cell division: mitosis & meiosis, Cell cycle and molecules that control cell cycle

**UNIT-III TRANSPORT ACROSS CELL MEMBRANES (9)**

Passive & active transport, permeases, sodium potassium pump, Ca<sup>2+</sup> ATPase pumps, lysosomal and vacuolar membrane ATP dependent proton pumps, co transport symport, antiport, active group translocation; endocytosis and exocytosis; Entry of viruses and toxins into cells.

**UNIT-IV RECEPTORS AND MODES OF CELL SIGNALLING (9)**

Cytosolic, nuclear and membrane bound receptors, examples of receptors, identify cation and purification of cell surface receptors, autocrine, paracrine and endocrine modes of action

**UNIT- V FUNCTION OF MITOCHONDRIA AND CHLOROPLAST (9)**

Electron Transport in Mitochondria: Electron transport chain, Reduction Potentials of Electron Carriers, Electron transfer from reduced cytochrome *c* to O<sub>2</sub>, Chloroplast: photosynthetic stages and light-absorbing pigments.

### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	H. Lodish, A. Berk, S. L. Zipurursky, P. Matsudaria, D. Baltimore and J. Darnell	Molecular Cell Biology	Freeman press	2000
2	B. Alberts, A. Johnson, J. Lewis, Raff, K. Roberts, an P. Walter	Molecular Biology of the Cell	Garland PUB	2002

### REFERENECE

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	S. C. Rastogi	Cell Biology	New Age International Pub. Ltd	2004
2	Karp, G and Puritt, N. L	Cell and Molecular biology, Concepts and Experiments	John Wiley and Sons Inc.,	2005
3	De Robertis, E. D. P. and De Robertis, E. M. F	Cell and Molecular biology	B. I publications pvt. Ltd.	2005

**Course Objectives**

- To illustrate the basic concepts of microbiology and different microbial identification techniques.
- To explain the structure and multiplication of microorganism.
- To interpret the microbial growth and its metabolism.
- To outline the mechanism for the control of microorganisms.
- To infer the application of microorganism in industries.
- To explain the role of microorganisms in bioremediation.

**Course Outcomes**

1. Outline the history of microbiology and microbial staining techniques.
2. Discuss the microbial structural organization and multiplication.
3. Infer the basic requirements for microbial growth towards the biosynthesis of important molecules.
4. Discuss the controlling mechanism of microorganisms.
5. Illustrate the production of various metabolites and its applications.
6. Explain the role of microorganisms in bioremediation.

**UNIT-I INTRODUCTION****(8)**

History of microbiology, classification and nomenclature of microorganism, Microbes in soil, air and water microscopic examination of microorganisms, light and electron microscopy, principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

**UNIT-II MICROBES-STRUCTURE AND MULTIPLICATION****(10)**

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage.

**UNIT- III MICROBIAL NUTRITION, GROWTH AND METABOLISM****(10)**

The cultivation of bacteria, Nutritional requirements of bacteria and different media used for bacterial culture; growth curve and different methods to quantify the bacterial growth, aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

**UNIT – IV CONTROL OF MICROORGANISMS****(8)**

Physical and chemical control of microorganisms, host-microbe interactions, antibacterial, anti-fungal and anti-viral agents, mode of action and resistance to antibiotics, clinically important microorganisms.

**UNIT – V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY****(9)**

Primary metabolites; secondary metabolites and their applications-preservation of food; Microorganism used for the production of penicillin, alcohol, vit.B-12; biogas; bioremediation; mycorrhiza; Biological Nitrogen fixation, microorganisms and pollution control.

**Total Hours: 45**

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	TalaronK,Casita,Pelczar And Reid.	Foundations In Microbiology	W.C.Brown Publishers	1993
2	Pelczar MJ, Chan ECS and Krein NR	Microbiology,	Tata McGraw- Hil  Edition	2007
3	Prescott LM, Harley JP, Klein DA,	Microbiology, 5 <sup>th</sup> Edition	McGraw Hill	2002
4	Kolwzan, B, Adamiak, W, Grabes, K, Pawelczyk A	Introduction to Environmental Microbiology	ebook	2006

**COURSE OBJECTIVES**

- To explain the basic reactions in organic chemistry
- To discuss the kinetics of enzymes using different methods
- To illustrate the enzyme inhibition process
- To outline the various enzymatic reactions in relation with stereochemistry
- To determine the specific enzyme structure and mechanism
- To classify the protein folding kinetics

**COURSE OUTCOMES**

1. Interpret the basic reactions in stereochemistry
2. Derive and calculate the kinetics of enzymes in different orders
3. Summarize the enzymatic reactions in stereochemistry
4. Illustrate the mechanism behind specific enzymes
5. Explain the protein folding kinetics
6. Discuss the protein folding pathways

**UNIT-I CONCEPTS IN ORGANIC CHEMISTRY (9)**

Stereochemistry: optical activity, chiral center – enantiomers - *R*, *S* notation, stereo selective and stereospecific reactions-*Z* and *E* isomers, *Re*, *Si* faces, conformational analysis, ethane, n-butane mechanisms of  $SN_1$   $SN_2$  reactions,  $E_1E_2$  reactions, ester formation and hydrolysis, reaction rates, hammond's postulate, h/d effects, catalysis: general acid – base and covalent catalysis.

**UNIT-II ENZYME KINETICS AND INHIBITION (9)**

Steady state kinetics, derivation and significance of Michaelis Menten equation, Line weaver-Burke Plot, single and double displacement reactions, cooperativity with respect to oxygen binding by haemoglobin. Inhibition –reversible and irreversible – competitive, non-competitive, uncompetitive inhibition (characteristics and examples).

**UNIT-III STEREOCHEMISTRY OF ENZYMATIC REACTIONS (9)**

Stereospecific enzymatic reactions - fumarase catalysed reactions - NAD dependent oxidation and reduction reactions - stereochemistry of nucleophilic reactions - chiral methyl group, chiral phosphate.

**UNIT-IV ENZYME STRUCTURE AND MECHANISM (9)**

The dehydrogenases (alcohol dehydrogenase) - proteases (serine protease), lysozyme, Ribonucleases, Ribozymes.

**UNIT-V PROTEIN FOLDING KINETICS AND FOLDING PATHWAYS (9)**

Kinetics of protein folding: basic methods, two state kinetics, multistate kinetics, transition states in protein folding,  $^1H/^2H$  exchange methods, folding of peptides, CI2 folding, molecular chaperones.

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Fersht A. R	Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding	W H Freeman	1999
2	Morrison, R. T and Boyd, R. N	Organic Chemistry	Prentice Hall of India Pvt Ltd	1999

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Dugas H	Bioorganic Chemistry	Springer Verlag	1999
2	Zubay G L,	Biochemistry	WCB/McGraw- Hill publishers	1998
3	Nelson, D. L. and Cox, M. M	Lehninger Principles of Biochemistry 4 <sup>th</sup> Edition	Freeman, W. H. & Company	2004
4	Palmer, T	Enzymes	Affiliated East West Press Pvt.Ltd	2004

**Course objective:**

- To understand the nature of the cells present in the biological sample through microscope.
- To explain the different staining techniques.
- To understand the stages of mitosis.
- To understand the chloroplast isolation from leaves.
- To demonstrate the different types of blood cells.
- To understand about the osmosis and tonicity.

**Course outcomes:**

1. Illustrate the handling of microscope and categorize the cells present in the biological sample.
2. Interpret the various staining techniques to identify the cell.
3. Outline the stages of mitosis.
4. Understand the blood cell identification.
5. Understand the knowledge about the cell concentration with osmosis and tonicity.
6. Recall assay to identify the cell condition.

1. Principles of microscopy – Phase contrast and Fluorescent Microscopy.
2. Identification of given plant, animal and bacterial cells and their components by microscopy.
3. Staining Techniques: (i) Leishmann staining (ii) Giemsa staining.
4. Staining for different stages of mitosis in *Allium cepa* (Onion).
5. Separation of plant pigments by Chromatography.
6. Identification of different types of blood cells
7. Isolation of chloroplasts from spinach leaves.
8. Osmosis and Tonicity.
9. Tryphan Blue Assay.

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Bregman, A. A	Laboratory Investigations in Cell and Molecular Biology	Wiley	2001
2	Dr.S.Rajan and Mrs.R.Selvi Christy	Experimental procedures in Life Sciences	Anjanna Book House, Chennai	2011

**Course objective:**

- To understand the nature of the cells present in the biological sample through microscope.
- To explain the different staining techniques.
- To discuss the different culture media preparation.
- To demonstrate the culturing, growth and control of micro organisms.
- To understand about the chemicals that controls the bacterial growth.
- To optimize the parameters on bacterial growth.

**Course outcomes:**

1. Illustrate the handling of microscope and categorize the cells present in the biological sample.
2. Interpret the various staining techniques to identify the cell.
3. Outline the different types of media preparation techniques.
4. Understand the growth of the organism and the parameters that influences their stability to grow.
5. Understand the knowledge about the chemicals that controls the bacterial growth.
6. Recall the growth curve and the control of microorganisms.

1. Laboratory Safety and Aseptic Techniques
2. Microscopy-Light Microscopy
3. Culture media – Types, preparation of nutrient broth and nutrient agar
4. Culturing of microorganisms – in broth and in plates (spread plate, pour plate, streak plate)
5. Staining Techniques & Motility Test
6. Quantitation of Microorganisms
7. Chemical Control of Microorganisms &Antibiotic Sensitivity Assay
8. Bacterial Growth Curve
9. Effect of different parameters on bacterial growth (temperature, UV irradiation)

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Leboffee, M. J.	Micro Biology : Laboratory Theory and applications	BE Pierce  Morten Publishing House	2006

2	Aneja, K.R.,	Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology	New Age International (P) Limited Publishers, New Delhi	2001
3	Cappucino, J.G. and N. Sherman	Microbiology A Laboratory Manual	Benjamin Cummings, New York	2001

4	Dubey, R.C. and D.K. Maheshwari	Practical Microbiology	S. Chand and Company Ltd, New Delhi	2002
5	Gunasekaran, P	Lab Manual in Microbiology	New Age International (P) Ltd, Publishers, New Delhi	1996
6	Arora, B., D.R. Arora	Practical Microbiology	CBS Publishers and Distributors, Bangalore	2007
7	Chakraborty, P. and N.K. Pal	Manual of Practical Microbiology and Parasitology	New Central Book Agency (P) Ltd, India.	2008

**COURSE OBJECTIVES**

- To understand the synthesis of Aspirin and p-nitroacetanilide
- To explain the preparation method for Acetanilide from Aniline
- To experiment on sucrose hydrolysis
- To perform reactions for the preparation of alpha D-glucopyranose penta acetate and 1,2:5,6-dicyclohexylidene- alpha-D glucofuranose.
- To determine the extraction procedure for lycopene
- To discuss the methods for the preparation of oleic acid and casein

**COURSE OUTCOMES**

1. Analyze the protocol for aspirin synthesis and p-nitroacetanilide
2. Infer the preparation of Acetanilide from Aniline
3. Outline the inference on sucrose hydrolysis
4. Determine the protocol for preparation of alpha D-glucopyranose penta acetate and 1,2:5,6-dicyclohexylidene- alpha-D glucofuranose.
5. Perform the extraction of lycopene from different sources
6. Experiment the suitable method for the preparation of casein from milk

1. Synthesis of Aspirin.
2. Synthesis of p-nitroacetanilide.
3. Preparation of Acetanilide from Aniline.
4. Hydrolysis of Sucrose.
5. Extraction of Lycopene
6. Preparation of alpha D-glucopyranose penta acetate.
7. Preparation of 1,2:5,6- dicyclohexylidene- alpha-D glucofuranose.
8. Preparation of Oleic acid.
9. Preparation of casein from milk

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Leonard, J Lygo, B and Procter, G	Advanced Practical Organic Chemistry	CRC Press	1994

**OBJECTIVES:**

- To assist students to understand the role of thinking in all forms of communication.
- To help students with neutral accent.
- To guide students to read and comprehend articles from newspapers and magazines.
- To equip students with oral and appropriate written communication skills.
- To assist students with employability and job search skills
- To make soft skills will be incorporated and have a good listening capability.

**OUTCOMES:**

- Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- Write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- Listen to/ view and comprehend different spoken discourses/ excerpts in different accents.
- Take national and international examination and enhance the performance at Placement Interviews.
- Be motivated to lead a group and able to guide the group with confidence.
- Soft skills will be incorporated and have a good listening capability.

**UNIT - I      ESSENTIALS OF COMMUNICATION**

Communication: Definition-Process-Scope-Types- Barriers- Dyadic Communication exercises.

**UNIT - II      SPEECH PROCESS**

Pronunciation – Voice quality – Vowels – Consonants – Diphthongs – Syllables – Word stress - Sentence Stress – Pause - Intonation – Accent.

**UNIT - III      ORAL COMMUNICATION**

Distinguishing between Formal and Informal speech – Defining and Describing objects and people –Self Introduction – Extempore talk on a given topic - Asking questions politely, disagreeing politely in formal contexts – Speaking to a group - Giving oral presentations – Group discussion – Debates- Types of Interview.

**UNIT - IV      WRITTEN COMMUNICATION**

Formal Reports - Project Proposals - Book reviews - Official Correspondence - Proof Reading & Editing.

**UNIT – V      ENGLISH FOR COMPETITIVE EXAMINATION**

Synonyms, Antonyms –Grammar and usage – Error Identification – Reading comprehension- Verbal analogy- Verbal Test.

**TEXT BOOK:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	<a href="#">Jane Summers</a> & <a href="#">Brett Smith</a>	Communication Skills Handbook: How to Succeed in Written and Oral Communication  3 <sup>rd</sup> Ed.	Hoboken, N.J. : Wiley ; Chichester : John Wiley [distributor], USA.	2009

**REFERENCES:**

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Anderson, Paul V	Technical Communication	Thomson and Wadsworth Publishers, USA.	2007
2	Barun, Mitra K	Effective Technical Communication – A Guide for Scientists and Engineers	Oxford University Press, New Delhi.	2006
3	Seely, John.	The Oxford Guide to Effective Writing and Speaking	Oxford University Press, New Delhi.	2005

**WEBSITES :**

[www.learning-development.hr.toolbox.com](http://www.learning-development.hr.toolbox.com) – Unit-III- Oral Communication  
[www.englishclub.com](http://www.englishclub.com) - Writing/ Grammar – Unit-IV  
[www.ispeakyouspeak.blogspot.com](http://www.ispeakyouspeak.blogspot.com)- Vocabulary Enrichment/ Speaking – Unit-II  
[www.teachertube.com](http://www.teachertube.com) - Writing Technically – Unit- V  
[www.Dictionary.com](http://www.Dictionary.com) - Semantic / Grammar – Unit-IV & V

**OBJECTIVES:**

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.
- To acquaint the student with concepts of sampling distributions and statistical techniques used in engineering and management problems.

**OUTCOMES:**

- To understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- To understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- To apply the concept of testing of hypothesis for small and large samples in real life problems.
- To apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- To have the notion of sampling distributions and statistical techniques used in engineering and management problems.
- To make the student acquire sound knowledge of techniques in quality control that model engineering problems.

**UNIT- I      PROBABILITY      (11)**  
Probability – Definition – Law - conditional probability-Bayes theorem- Probability mass function - Probability density functions.

**UNIT- II      RANDOM VARIABLES      (13)**  
Introduction to one dimensional random variables – Discrete – Continuous - Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression.

**UNIT- III      TESTING OF HYPOTHESIS      (12)**  
Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions – Tests for independence of attributes and Goodness of fit.

**UNIT – IV      DESIGN OF EXPERIMENTS      (12)**  
Analysis of variance – one way classification – CRD – Two-way classification – RBD – Latin square.

**UNIT – V      RELIABILITY AND QUALITY CONTROL      (12)**  
Concepts of reliability – hazard functions – Reliability of series and parallel systems – control charts for measurement ( $\bar{X}$  and  $R$  charts) - Control charts for attributes (p, c and np charts).

**Total : 60**

**REFERENCES:**

<b>S. NO.</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	P.S.S.Sundar Rao and J.Richard	Introduction to Biostatistics and Research Methods	Prentice Hall of India, New Delhi.	2012
2	R.A.Johnson and C.B.Gupta	Miller and Freund's Probability and Statistics for Engineers	Pearson Education Asia, New Delhi.	2007
3	S.C.Gupta and V.K.Kapoor	Fundamentals of Applied Statistics	Sultan Chand & Sons, New Delhi	2007

**WEBSITES:**

1. [www.cut-the-knot.org/probability.shtml](http://www.cut-the-knot.org/probability.shtml)
2. [www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)
3. [www.mathworld](http://www.mathworld.wolfram.com). Wolfram.com

**Course Objectives**

- To outline the classical genetics concepts of eukaryotes and prokaryotes.
- To explain the structure of nucleic acids and DNA replication.
- To understand the molecular process of transcription.
- To understand the basic machinery of translation and its mechanisms.
- To understand the regulation of gene expression and various types of mutation
- To discuss the different types of mutation and DNA repair mechanisms

**Course outcomes**

1. Discuss the concepts related to eukaryotic and prokaryotic genetics.
2. Identify the structure of nucleic acids, DNA replication and chromosome organization.
3. Illustrate the prokaryotic and eukaryotic transcription, and its post transcriptional modifications.
4. Outline the concept of genetic code, translation process and post translational modifications.
5. Interpret the process of regulation of gene expression and its importance.
6. Identify the different types of mutation and DNA repair mechanisms.

**UNIT-I CLASSICAL GENETICS****(7)**

Mendelian genetics, linkage, crossing over, classical experiments – Hershey and Chase, Avery McLeod & McCarty. Bacterial conjugation, transduction and transformation. Conformation of DNA and RNA.

**UNIT- II STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION (10)**

Replication in prokaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organisation of eukaryotic chromosome – cot value, replication of telomeres in eukaryotes

**UNIT-III TRANSCRIPTION****(10)**

In prokaryotes and eukaryotes, features of promoters and enhancers, transcription factors, nuclear RNA splicing, regulation of transcription: prokaryote and eukaryote

**UNIT-IV TRANSLATION****(9)**

Elucidation of genetic code, basic machinery of translation and its mechanism, codon usage, suppressor mutation, regulation of translation: prokaryote and eukaryote.

**UNIT-V REGULATION OF GENE EXPRESSION****(9)**

Lac and trp operon, phage life cycle, mutation and repair of DNA, regulation of gene expression in eukaryotes

**Total Hours: 45**

**TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	David, F	Molecular biology	NarosaPubl	2001
2	Benjamin, L	Gene VIII	Pearson Education	2004
3	Watson, J. D	Molecular Biology of the Gene	Pearson Education	2004

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Weaver, R. F	Molecular biology	Mc Graw Hill	2005

## **15BTBT403 CHEMICAL THERMODYNAMICS AND BIO THERMODYNAMICS 3 0 0 3 100**

### **Course Objectives**

- To explain the thermodynamic properties of fluids and its calculations.
- To discuss the basic concepts of solution properties.
- To illustrate the phase equilibria concepts for various systems.
- To outline the equilibrium criteria for various chemical reactions.
- To infer the knowledge on general thermodynamic processes.
- To explain the working principles and the process involved in the refrigeration and Liquefaction system.

### **Course Outcomes**

1. Discuss the various properties of the fluids and its calculations.
2. Explain the concept of solution thermodynamics and composition models.
3. Analyze the criteria of phase equilibria for different components system.
4. Apply the concept of chemical reaction equilibria and equilibrium conversion.
5. Analyze the thermodynamic flow process.
6. Illustrate the working principles and the process involved in the refrigeration and Liquefaction system.

### **UNIT-I THERMODYNAMIC PROPERTIES OF FLUIDS (9)**

Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

### **UNIT- II SOLUTION THERMODYNAMICS (9)**

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

### **UNIT- III PHASE EQUILIBRIA (9)**

Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.

### **UNIT- IV CHEMICAL REACTION EQUILIBRIA (9)**

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

## **UNIT- V THERMODYNAMIC ANALYSIS OF PROCESSES**

**(9)**

Thermodynamics of flow processes, Concept of lost work; entropy generation; power cycle (rankine, regenerative, reheat); liquefaction.

**Total Hours: 45**

**TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Smith, J. M., Van Ness H.C., and Abbot M. M.	Chemical Engineering Thermodynamics	McGraw-Hill	2001
2	Narayanan K. V.	A Text Book Of Chemical Engineering Thermodynamics	Prentice Hall India	2001

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Sandler S.I.	Chemical And Engineering Thermodynamics	John Wiley	1989
2	Urs von Stockar, Luuk A. M. van der Wielen	Biothermodynamics: The Role of Thermodynamics in Biochemical Engineering	EPFL Press	2013

**Course Objectives**

- To explain the basic concepts of wave properties and radiation sources.
- To discuss the instrumentation and application of various molecular spectroscopy.
- To understand the concept and instrumentation of magnetic resonance spectroscopy and mass spectroscopy.
- To categorize the different separation methods for product purification.
- To outline the thermal analysis techniques and its applications.
- To understand the instrumentation and applications of different thermal analysis techniques.

**Course Outcomes**

1. Infer the various sources and properties of electromagnetic radiation.
2. Discuss the theory of molecular absorption spectroscopy.
3. Relate the theory, instrumentation and applications of various molecular spectroscopies.
4. Interpret the theory and instrumentation of magnetic resonance and mass spectroscopy.
5. Identify the various chromatographic and electrophoresis techniques for purification.
6. Explain the instrumentation and applications of different thermal analysis techniques.

**UNIT I      INTRODUCTION TO SPECTROMETRY      (9)**

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

**UNIT II      MOLECULAR SPECTROSCOPY      (9)**

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

**UNIT III      MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY      (9)**

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMRspectrometers – applicatons of  $^1\text{H}$  and  $^{13}\text{C}$  NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

**UNIT IV      SEPARATION METHODS      (9)**

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography - Adsorption chromatography – Ion exchange chromatography -size exclusion chromatographyAffinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications

## **UNIT V      THERMAL METHODS**

**(9)**

Different thermal analysis techniques. Differential scanning calorimetry - instrumentation & application. Differential thermal analysis - instrumentation & application, DTA curve. Thermogravimetry – instrumentation & application, TG curve.

**Total Hours: 45**

**TEXT BOOK**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Willard, H. H and Merrit, L. L	Instrumental Methods of Analysis	Prentice Hall of India	2005
2	Skoog, D, A. Holler, J. F and Nieman, T. A.	Principles of Instrumental Analysis	Thomsan	2006

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	G. W. Ewing	Instrumental Methods of Chemical Analysis	McGraw-Hill	1985
2	Skoog, D, A. Holler, J. F and Nieman, T. A.	Instrumental Methods of Chemical Analysis	Krishna prakasan	2004

**Course Objectives**

- To understand the process of fermentation and basic fermentor configuration.
- To explain the medium requirements and media optimization methods for fermentation process.
- To explain the different sterilization methods and its kinetics and design.
- To discuss and solve the problems related to metabolic stoichiometry and energetics.
- To understand the modes of operations and various kinetic models for product formation.
- To analyze the different kinetic models for microbial growth and product formation.

**Course outcomes**

1. Discuss the general process of fermentation and fermentor configuration.
2. Analyze the medium requirements and medium formulations for fermentation process.
3. Outline the thermal death kinetics and different sterilization methods.
4. Solve problems related to stoichiometry of cell growth and energetic.
5. Illustrate the various modes of operation in fermentation process.
6. Analyze the different kinetic models for microbial growth and product formation.

**UNIT-I OVERVIEW OF FERMENTATION PROCESSES****(7)**

Overview of fermentation industry, general requirements of fermentation processes, basic

configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

**UNIT-II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS****(9)**

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals,

vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods.

**UNIT- III STERILIZATION KINETICS****(9)**

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media,

filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

## **UNIT- IV METABOLIC STOICHIOMETRY AND ENERGETICS (10)**

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of

substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

## **UNIT- V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION (10)**

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models

for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking-piret models, substrate and product inhibition on cell growth and product formation.

**Total Hours: 45**

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Bailey and Ollis	Biochemical Engineering Fundamentals	McGraw-Hill (2nd Ed.),	1986
2	Shule and Kargi	Bioprocess Engineering	Prentice Hall	1992

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Pauline Doran	Bioprocess Engineering Calculation	Academic Press	2012
2	Peter F. Stanbury, Stephen J. Hall & Whitaker	Principles of Fermentation Technology	Butterworth- Heinemann	1999

3	Harvey W. Blanch, Douglas S. Clark	Biochemical Engineering	CRC Press	2014
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**Course Objectives**

- To explain the basic idea on scope of biotechnology and its commercial production in modern biotechnology.
- To analyse the modern biotechnological processing techniques for the production of commercial bioproducts.
- To discuss the process of primary metabolite production in different industries.
- To discuss the process of secondary metabolite production.
- To explain the basic procedures for production of bioproducts.
- To illustrate the various methods for the production of recombinant products.

**Course Outcomes**

1. Outline the scope of biotechnology and its commercial potential.
2. Interpret the modern biotechnological processing techniques for the production of commercial bioproducts.
3. Illustrate the production methods of primary metabolites.
4. Illustrate the production methods of secondary metabolites.
5. Infer the knowledge on commercial enzyme and bioproduct production.
6. Explain the production of various commercially available products using recombinant technology.

**UNIT-I INTRODUCTION TO INDUSTRIAL BIOPROCESS****(8)**

Biotechnology: Scope and importance, Commercial potential of Biotechnology in India. Traditional and modern biotechnology. products relating to modern biotechnology A brief survey of industrially important organisms, fermentation processes – modes of operation -pictorial representation of fermentation process

**UNIT- II PRODUCTION OF PRIMARY METABOLITES****(10)**

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid ) amino acids (glutamic acid, phenylalanine, aspartic acid ) and alcohols (ethanol, butanol )

**UNIT-III PRODUCTION OF SECONDARY METABOLITES****(10)**

Study of production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin), aminoglycosides (streptomycin ) macrolides (erythromycin), vitamins (B12) and steroids (progesterone).

**UNIT- IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS****(9)**

Production of industrial enzymes such as proteases, amylases, lipases, cellulases etc., Production of biopesticides, biofertilizers, biopreservatives (Nisin), cheese, biopolymers (xanthan gum, PHB), single cell protein.

**UNIT- V      PRODUCTION RECOMBINANT DNA PRODUCTS****(8)**

Production of recombinant proteins having therapeutic and diagnostic applications, production of vaccines (hepatitis B vaccine), hormones (insulin). Production of monoclonal antibodies-commercial scale, products of plant (human growth hormone) and animal cell culture (interferons).

**Total Hours: 45**

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Casida Jr, L.E.	Industrial Microbiology	New Age International (P) Ltd	2000
2	Presscott, S. C. and Dunn, C. G	Industrial Microbiology	Agrobios (India).	2006

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher/journal	Year of Publication
1	Cruger, W and Crueger, A	Biotechnology: A Textbook of Industrial Microbiology	Panima Publishing Corporation	2003
2	Moo, M and Young	Comprehensive Biotechnology	Pergamon	2007
3	Barta, A. <i>et al.</i>	The expression of a nopaline synthase  human growth hormone chimaeric gene in transformed tobacco and sunflower callus tissue	Plant Mol. Biol	1986

### Course Objectives

- To understand the basic principle of analytical techniques
- To discuss the instrumental techniques used in chemical and biochemical research labs.
- To explain the fundamentals of spectroscopy operations.
- To carry out qualitative analysis experiments using Lambert's – Beer law using absorption spectroscopy.
- To carry out different spectroscopic techniques.
- To carry out different chromatographic techniques.

### Course Outcomes

1. Explain the basic principle of analytical techniques
2. Discuss the instrumental techniques used in chemical and biochemical research labs.
3. Explain the fundamentals of spectroscopy operations.
4. Perform the qualitative analysis experiments using Lambert's – Beer law using absorption spectroscopy.
5. Demonstrate the different spectroscopic techniques.
6. Demonstrate the different chromatographic techniques.

1. Precision and validity in an experiment using absorption spectroscopy and validating Lambert-Beer's law using  $\text{KMnO}_4$
2. Determination of analytical wavelength for  $\text{KMnO}_4$
3. Determination of iron concentration using 1,10 phenanthroline.
4. Finding the  $\text{pK}_a$  of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. UV – spectra of proteins.
7. Estimation of Sulphate by nephelometry.
8. Estimation of  $\text{Al}^{+++}$  by fluorimetry.
9. Determination of  $R_f$  value using TLC.

**Course Objectives**

- To outline and evaluate the methods for isolation and purification of DNA from plant and animalsamples.
- To explain the protocol to run the agarose gel electrophoresis sampleanalysis.
- To demonstrate the DNA ligation techniques for transformation and screening ofrDNA.
- To understand the methods involved in optimization protocol for recombinant protein expression.
- To explain the procedure for competent cell preparation.
- To compile the overall structure of rDNA technology and implement its techniques in research anddevelopment.

**Course Outcomes**

1. Carry out agarose gel electrophoresis and isolation of DNA samplesindividually.
2. Develop the knowledge of techniques involved in DNA isolation andpurification.
3. Perform the restriction enzyme digestion and ligation of DNAsamples.
4. Produce recombinant DNA and implement blue white screening techniques to screen them.
5. Develop methods to produce competent cells.
6. Summarize the overall structure of rDNA technology and implement its techniques in research anddevelopment.

1. Agarose gel electrophoresis
2. Isolation of bacterial plasmid DNA
3. Isolation of bacterial chromosomal DNA
4. Isolation of plant cell genomic DNA
5. Isolation of animal cell genomic DNA
6. Restriction enzyme digestion
7. Competent cells preparation
8. Transformation and screening for recombinants
9. Blue and white selection for recombinants

**TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	David, L. G and Michael, K. W	Basic Methods in Molecular Biology	Prentice Hall Inc	1994
2	Sambrook, J. and Russel, D. W	Molecular Cloning Laboratory Manual	Cold Spring Harbor Laboratory Press	2001

**Course Objectives**

- To infer the basic knowledge on agitation and its flow pattern in different systems.
- To explain the concept of filtration and its industrial application.
- To understand the different modes of heat transfer and its transfer through different dimensional surfaces.
- To discuss the types of convective heat transfer and its application.
- To explain the different types and designing parameters of heat exchangers and evaporators.
- To explain the basics of design, equipmentation and calculations of evaporators and heat exchangers.

**Course Outcomes**

1. Interpret the properties of mixing and agitation in different flow systems.
2. Outline the basic principle of filtration and its application in different filtration methods.
3. Discuss the modes of heat transfer.
4. Illustrate the mechanism of heat transfer through different dimensional surfaces.
5. Infer the basics of convective heat transfer in different surfaces.
6. Appraise the basics of design, equipmentation and calculations of evaporators and heat exchangers.

**UNIT- I      MIXING AND AGITATION****(8)**

Purpose of agitation, equipments for agitation, flow pattern in agitator vessels, dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas-solid suspensions; agitator scale up.

**UNIT-II      FILTRATION****(8)** Filtration-

types of filtration, filter media, selection of medium, filter aids-filter theory, constant pressure filtration, constant volume batch filtration; continuous filtration; industrial filters; settling and sedimentation; centrifugation.

**UNIT- III      MECHANISM OF HEAT TRANSFER****(10)** Modes of

heat transfer, principles of conduction, Fourier's Law of heat conduction, thermal conductivity, steady state conduction, combined resistances, heat flow through a cylinder, unsteady state conduction, heat transfer from extended surfaces, individual and overall heat transfer coefficients

**UNIT- IV      CONVECTION HEAT TRANSFER****(10)**

Dimensional analysis, forced and natural convection, convection in flow over surfaces through pipes boiling and condensation.

**UNIT- V      HEAT EXCHANGERS****(9)**

Heat exchanger types, Equipments; overall heat transfer coefficients; design of heat exchangers; NTU concept; Evaporators; single and multiple effects; mass and enthalpy balances.

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Geankoplis C.J.	Transport Process And Unit Operations	Prentice Hall India	2002
2	McCabe W.L., Smith J.C, and Harriot P.	Unit Operations In Chemical Engineering	McGraw-Hill Inc	1993

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Incropera F.P.	Fundamentals Of Heat And Mass Transfer	John Wiley and Sons	2000

**Course Objectives**

- To understand the basic concepts of fermentation processes.
- To apply the knowledge about the design of bioreactors
- To explain the scale up of bioreactors.
- To illustrate the bioprocess simulation and modeling
- To explain the immobilized enzyme kinetics and its significance.
- To discuss the commercial production of bioproducts.

**Course outcomes**

1. Understand the fermentation processes.
2. Interpret the design of bioreactors
3. Describe the scale up of bioreactors.
4. Infer the different types of bioprocess simulation and modeling
5. Examine the immobilized enzyme kinetics and its significance.
6. Outline the commercial production of bioproducts.

**UNIT-I ANALYSIS OF STR****(8)**

Analysis of STR: Stirred tank reactor - non-ideality, RTD and stability analysis, tanks in series and dispersion models – application to design of continuous sterilizer.

**UNIT-II ANALYSIS OF OTHER CONFIGURATIONS****(9)**

Analysis of other configurations: Packed bed reactor, airlift reactor, fluidized bed reactor bubble column reactors – non- ideality, RTD and stability analysis.

**UNIT-III BIOREACTOR SCALE – UP****(8)**

Bioreactor scale-up: Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

**UNIT-IV MODELLING AND SIMULATION OF BIOPROCESSES****(10)**

Modelling and simulation of bioprocesses: Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

**UNIT-V BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS****(10)**

Bioreactor consideration in enzyme systems: Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors.

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Anton Moser	Bioprocess Technology, Kinetics and Reactors	Springer Verlag	1988
2	James E. Bailey & David F. Ollis	Biochemical Engineering Fundamentals	McGraw- Hill	1986
3	Shuler and Kargl	Bioprocess Engineering	Prentice Hall	1992

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	James M. Lee	Biochemical Engineering	PHI	1991
2	EMT.EL- Mansi.CFA.Bryce, A.L.Demain, AR.Allman	Fermentation Microbiology And Biotechnology	CRC Press	2011
3	Harvey W. Blanch, Douglas S. Clark	Biochemical Engineering	CRC Press	2014

**Course Objectives**

- To understand the knowledge on enzyme mechanism of action.
- To explain the production & purification of enzymes.
- To explain about the kinetics of single substrate enzyme action
- To understand the kinetics of multi substrate enzyme action
- To illustrate on immobilization and applications.
- To understand the features of enzyme biosensors and its application.

**Course Outcomes**

1. Discuss the overview of enzyme mechanism of action.
2. Outline the knowledge on extraction, purification and characterization of enzymes.
3. Understand the kinetics of multi substrate enzyme action.
4. Interpret the various enzyme immobilization techniques and its application in bioreactor.
5. Summarize the basics of enzyme engineering.
6. Explain the features of enzyme biosensors and its application.

**UNIT-I INTRODUCTION TO ENZYMES****(9)**

Chemical nature, apoenzyme, coenzyme, cofactor, prosthetic group. Nomenclature – IUB system of classification - Six main classes with examples. Mechanisms of enzyme action; Specificity, type of enzyme specificity, Active site, Models of enzyme action – Lock and key, induced fit, transition state theory. metal ion catalysis, proximity & orientation. metal-activated enzyme and metalloenzyme.

**UNIT- II EXTRACTION, PURIFICATION AND CHARACTERIZATION OF ENZYMES (9)**

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays,

**UNIT- III KINETICS OF MULTISUBSTRATE - ENZYME ACTION****(9)**

Kinetics of Single substrate reaction – estimation of Michaelis-Menten parameters and Multisubstrate reactions mechanisms; Turnover number; types of inhibition Allosteric regulation of enzymes, Monod - Changeux - Wyman model, pH and temperature effect on enzymes & deactivation kinetics.

**UNIT- IV ENZYME IMMOBILIZATION****(9)**

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, applications, advantages and disadvantages. applications. Immobilised enzyme bioreactors.

## **UNIT- V      ENZYME ENGINEERING AND BIOSENSORS**

**(9)**

Chemical and genetic methods, Property alteration, Prediction of enzyme structure, design and construction of novel enzymes; Classification and Design of enzyme biosensors. Application of enzyme biosensor in industry, healthcare, food and environment.

**TEXTBOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Palmer, T	Enzymes	Affiliated East West Press pvt. Ltd	2004
2	Wiseman	Enzyme Biotechnology	Ellis Horwood Publishers	1995
3	Chaplin and Bucke	Enzyme Technology	Cambridge University Press	1990
4	Price and Stevens	Fundamentals of Enzymology	Oxford University Press	2002

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	H. W. Blanch and D. S. Clark	Biochemical Engineering	Marcel Dekker, Inc.	1996
2	J. E. Bailey and D. F. Ollis,	Biochemical Engineering Fundamentals	McGraw Hill	1986
3	E. K. Pye and L. B. Wingard	Enzyme Engineering II,	Plenum Press	1974

**Course Objectives**

- To understand the basics of operating systems and biological databases.
- To explain the various methods for analysis of DNA, RNA and protein sequences.
- To explain the dynamic programming approach and methods of pair wise alignment.
- To explain the multiple sequence alignment techniques for analysis.
- To understand the machine learning techniques and protein structure analysis.
- To understand the basics on available tools and databases for performing research in bioinformatics.

**Course Outcomes**

1. Illustrate the basics of operating systems and biological databases.
2. Analyze the DNA, RNA AND protein sequences using common databases.
3. Discuss the different algorithms for the pairwise sequence analysis
4. Outline the various biological databases used for multiple sequence alignment.
5. Summarize the machine learning techniques and various techniques for protein structure analysis.
6. Understand the use of bioinformatics tools for research.

**UNIT-I INTRODUCTION TO BIOLOGICAL DATABASES (9)**

Introduction- types, Biological databases, Information Retrieval from Biological Databases: for example Nucleic acid databases: Genbank, Protein Databases- Swissprot, Sequence Formats, Sequence storage, Sequence submission to sequence Database.

**UNIT-II ANALYZING DNA, RNA AND PROTEIN SEQUENCES IN DATABASES (9)**

Introduction to biological databases and database technology, Genbank: organisms in Genbank, genomic DNA databases, cDNA databases corresponding to expressed genes, Expressed sequence tags, Sequence tagged sites, Genome survey sequences, High throughput genomic sequence

**UNIT-III PAIRWISE SEQUENCE ALIGNMENT****(9)**

Alignment Types: Local alignment, Global alignment, Scoring matrices- PAM, BLOSUM, Gaps, Dot Plots. Dynamic programming Approach: Needleman and Wunsch Algorithm, Smith and waterman Algorithm, Heuristic Approach: BLAST, FASTA

**UNIT-IV MULTIPLE SEQUENCE ALIGNMENT****(9)**

Exhaustive Algorithm- Divide and Conquer alignment, Heuristic Algorithm: Progressive Alignment- ClustalW Tcoffee, Iterative Alignment- PRRN, Block based method- Match-Box, DIALIGN2

**UNIT-V INTRODUCTION TO PROTEIN STRUCTURE PREDICTION****(9)**

Secondary structure prediction for Globular and Trans-membrane proteins, 3D Protein structure file format: PDB, mmCIF, MMDB, Methods of Tertiary structure prediction: Threading and fold recognition methods, Homology modeling, Fold recognition databases.

**TEXT BOOKS**

<b>S. No.</b>	<b>Author (s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Dan E. Krane, Michael L. Rayme	Fundamental Concepts of Bioinformatics	Pearson education	2004
2	Andreas D. Baxevanis, B. F. Francis Ouellette	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins	Wiley- Interscience	2004
3	David W. Mount	Sequence and Genome Analysis	Cold Spring Harbor Laboratory	2004
4	Jonathan Pevsner	Bioinformatics and Functional Genomics	Wiley-Liss	2003

**Course Objectives**

- To understand chemical engineering principles and its operations.
- To understand the concept of pressure drops in pipes
- To understand the concept of pressure drops in different reactors.
- To understand the concept of filtration and heat transfer.
- To explain the different separation techniques.
- To understand the process involved in leaching

**Course outcomes**

Students undergoing this course will be able to

1. Outline the chemical engineering principles and operations.
  2. Calculate the flow measurements and pressure drop in pipes and different reactors.
  3. Analyze the process of filtration and heat transfer.
  4. Perform the distillation and extraction.
  5. Demonstrate the process involved in adsorption equilibrium.
  6. Demonstrate the process involved in leaching
- 
1. Flow measurement and Pressure drop in pipes.
  2. Pressure drop across Fluidized bed.
  3. Pressure drop across packed column
  4. Continuous rotary filtration
  5. Heat exchanger
  6. Simple and steam distillation
  7. Liquid-liquid equilibria in extraction
  8. Adsorption equilibrium
  9. Leaching

**Course Objectives**

- To perform the NCBI database search.
- To understand the usage of BLAST for similar DNA sequence search.
- To predict the nucleotide and protein sequence using various database.
- To perform the gene prediction.
- To understand the protein sequence analysis tools.
- To build the phylogenetic tree

**Course Outcomes**

1. Discuss the database search through NCBI.
2. Perform the similar DNA sequence search using BLAST.
3. Identify the nucleotide and protein sequence.
4. Demonstrate the experiment to predict the genes.
5. Tell the method to build the phylogenetic tree.
6. Interpret the protein sequence using analysis tools.

1. NCBI database.
2. BLAST – Similar DNA sequences search
3. EMBL – Nucleotide sequence database
4. SWISSPROT/TREMBL – Protein sequence database
5. Analysis of Protein sequence using PIR database
6. Analysis of structural features of proteins using protein data bank and SWISS PDB viewer
7. Eukaryotic gene prediction
8. Phylogenetic tree.
9. Protein sequence analysis tools
10. Multiple sequence alignment

**Course Objectives**

- To understand the concept of thermal death kinetics.
- To understand the concept of batch sterilization.
- To predict the design for media components using Plackett Burman and RSM.
- To perform the batch cultivation and practice  $k_{La}$  estimation methods.
- To understand the procedure to calculate the residence time distribution.
- To demonstrate enzyme kinetics and enzyme immobilization techniques.

**Course Outcomes**

1. Evaluate the thermal death kinetics.
2. Perform the batch sterilization batch cultivation.
3. Identify and perform media optimization using Plackett Burman and RSM.
4. Demonstrate the different  $k_{La}$  estimation methods.
5. Perform the experiment on residence time distribution.
6. Interpret enzyme kinetics and enzyme immobilization techniques.

1. Thermal death kinetics
2. Batch sterilization design
3. Media designing using Plackett Burman and RSM
4. Batch cultivation, estimation of  $k_{La}$  – dynamic gassing method
5. Batch and Fed batch cultivation
6. Estimation of  $k_{La}$  – sulphite oxidation method
7. Estimation of  $k_{La}$  – power correlation method
8. Residence time distribution
9. Enzyme kinetics – Michaelis Menten parameters.
10. Enzyme immobilization

**OBJECTIVES**

- To equip the students for effective technical presentation
- To improve body language and posture for effective public speaking.

During the seminar session each student is expected to prepare and present a topic on biotechnology, for duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present seminars. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.

Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in facing the placement interviews.

**Course Objectives**

- To understand the basics of molecular diffusion and mass transfer concepts.
- To explain the gas absorption and its related concepts.
- To explain the various vapour liquid operations and its concepts.
- To understand the HETP, HTU and NTU concepts.
- To outline the extraction and leaching principles.
- To outline the Solid Fluid operations.

**Course Outcomes**

1. Discuss the molecular diffusions and mass transfer operation in different system.
2. Outline the absorption principles and its concepts for gas liquid operations.
3. Infer the basic concept of equilibria and distillation concepts in vapour liquid operations.
4. Understand the HETP, HTU and NTU concepts.
5. Interpret the equilibria of different systems in extraction and leaching operations.
6. Outline the concepts of adsorption and drying in solid – fluid operations.

**UNIT- I      DIFFUSION AND MASS TRANSFER      (9)**

Molecular diffusion in fluids and solids; Inter phase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon.

**UNIT- II      GAS LIQUID OPERATIONS      (9)**

Principles of gas absorption; Single and Multi component absorption; Absorption with chemical reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

**UNIT- III      VAPOUR LIQUID OPERATIONS      (9)**

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCabe- Thiele & Ponchon-Savarit Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

**UNIT- IV      EXTRACTION OPERATIONS      (9)**

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching principles.

**UNIT- V      SOLID FLUID OPERATIONS      (9)**

Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves -Time of Drying; Batch and continuous dryers.

**TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Treybal R.E.	Mass Transfer Operations	McGraw-Hill,	1981
2	Geankoplis C.J.	Transport Processes and Unit Operations	Prentice Hall	2002
3	Coulson and Richardson	Chemical Engineering Vol. I & II	Asian Books Pvt Ltd	1998

**Course Objectives**

- To understand the foundation and advanced information on biopharmaceutical aspects in relation to drug development.
- To understand the basics of pharmacokinetics.
- To discuss the drug manufacturing, process and its application.
- To explain the manufacture of solid dosage forms of drugs.
- To understand the manufacture process of liquid orals and topical.
- To discuss the legal steps involved in progressing a new drug to market.

**Course Outcomes**

1. Illustrate the different pharmaceutical parameters for the current and future biotechnology related products on the market.
2. Outline the concepts of Pharmacokinetics.
3. Infer the basic knowledge on drug process, manufacturing methods and its application.
4. Discuss about the solid dosage forms of drug manufacturing.
5. Explain the manufacturing process of liquid orals and topical.
6. Interpret the legal steps involved in progressing a new drug to market.

**UNIT- I INTRODUCTION****(7)**

History of pharmacy, pharmacopeia, monograph, types of various dosage forms, economics and regulatory aspects.

**UNIT- II BASICS OF PHARMACOKINETICS****(10)**

Mechanism of drug action; physico-chemical properties and principles of drug metabolism; pharmacokinetics.

**UNIT- III MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS****(9)**

Types of reaction process and special requirements for bulk drug manufacture.

**UNIT- IV MANUFACTURE OF SOLID DOSAGE FORMS****(9)**

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation.

**UNIT- V MANUFACTURE OF LIQUID ORALS AND TOPICALS****(10)**

Oral liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

**Total Hours: 45**

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	David B. Troy, Paul Beringer	Remington: The science and practice of pharmacy	Lippincott Williams & Wilkins	2006
2	Gareth Thomas	Medicinal Chemistry. An introduction	John Wiley	2000
3	Katzung B.G.	Basic and Clinical Pharmacology	Prentice Hall of Intl	1995

**Course Objectives**

- To understand the basic concepts in rDNA technology.
- To explain the importance of recombinant molecules in rDNA technology.
- To understand the gene libraries construction and to perform blottings.
- To outline the concepts involved in gene library construction and differentiate between different gene libraries.
- To explain about the different types of PCR, the main concept in genetic engineering.
- To understand the vast applications of rDNA technology in diverse fields.

**Course Outcomes**

1. Discuss the knowledge on the basics of rDNA technology.
2. Outline the usage of recombinant molecules in research and development.
3. Understand gene libraries construction and to perform blottings.
4. Interpret the in-depth knowledge acquired to perform PCR reactions and their types.
5. Infer the importance of DNA sequencing methods.
6. Summarize the concept of rDNA technology and its importance in cloning, gene therapy and relate its applications.

**UNIT-I      BASICS OF RECOMBINANT DNA TECHNOLOGY      (6)**

Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.

**UNIT-II      CREATION OF RECOMBINANT MOLECULES      (9)**

Creation of recombinant molecules: Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

**UNIT-III      CONSTRUCTION OF LIBRARIES      (10)**

Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera. Cloning : Characterization of recombinant clones by southern, Northern, western and PCR analysis.

**UNIT-IV      POLYMERASE CHAIN REACTION      (10)**

Polymerase chain reaction: Inverse PCR, Nested PCR, Taqman assay, RT - PCR, RACE PCR, RAPD, site directed mutagenesis, methods of nucleic acid sequencing- Sangers method, (Kunkel's Method).

**UNIT-V      APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY      (10)**

Applications of recombinant DNA Technology: Cloning in plants, Ti plasmid, transgenic and knockout animals, gene therapy.

**Total Hours: 45**

**TEXT BOOKS**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
<b>1</b>	Old RW, Primrose SB	Principles of Gene Manipulation, An Introduction To Genetic Engineering	Blackwell Science Publications	1993

<b>2</b>	Ansabel FM, Brent R, Kingston RE, Moore DD.	Current Protocols In Molecular Biology	Greene Publishing Associates	1988
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## REFERENCE BOOKS

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
1	Berger Sl, Kimmer AR	Methods In Enzymology	Academic Press	1987

**INTENDED OUTCOMES:**

- To know the fundamentals of cost analysis and economics.
- To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.
- To make the students to understand capital market, break even point analysis and depreciation

**UNIT- I      FUNDAMENTALS OF ENGINEERING ECONOMICS**

Introduction to Engineering Economics – Definition and Scope – Significance of Engineering Economics- Demand and supply analysis-Definition – Law of Demand – Elasticity of Demand – Demand Forecasting. Supply – Law of supply – Elasticity of Supply.

**UNIT- II      FINANCIAL MANAGEMENT**

Objectives and functions of financial management – financial statements, working capital management – factors influencing working capital requirements – estimation of working capital. Capital budgeting - Need for Capital Budgeting – Project Appraisal Methods - Payback Period – ARR – Time Value of Money.

**UNIT- III      CAPITAL MARKET**

Stock Exchanges – Functions – Listing of Companies – Role of SEBI – Capital Market Reforms. Money and banking - Money – Functions – Inflation and deflation – Commercial Bank and its functions – Central bank and its functions.

**UNIT- IV      NEW ECONOMIC ENVIRONMENT**

National Income – concepts – methods of calculating national income - Economic systems, Economic Liberalization – Privatization – Globalization. An overview of International Trade – World Trade Organization – Intellectual Property Rights.

**UNIT- V      COST ANALYSIS AND BREAK EVEN ANALYSIS**

Cost analysis - Basic cost concepts – FC, VC, TC, MC – Cost output in the short and long run. Depreciation - meaning – Causes – Methods of computing Depreciation (simple problems in Straight Line Method, Written Down Value Method). Meaning – Break Even Analysis - Managerial uses of BEA.

**TEXT BOOKS:**

S.NO	Author(s) Name	Title of the book	Publisher	Year of publication
1	Ramachandra Aryasri .A, and V. V.Ramana Murthy	Engineering Economics & Financial Accounting	Tata McGraw Hill,–,New Delhi	2007
2	Varshney R. L., and K.L Maheshwari	Managerial Economics	Sultan Chand & Sons, New Delhi	2001

**REFERENCE BOOKS:**

S.NO	Author(s) Name	Title of the book	Publisher	Year of publication
1	M.L.Jhingan	Principles of Economics	Konark Publications	2010
2	Prasanna Chandra	Fundamentals of Financial Management	Tata McGraw Hill, New Delhi.	2007
3	D.M.Mithani	Money, Banking, International Trade & Public Finance	Himalaya Publishing House	2004

**WEBSITES:**

1. <http://economictimes.indiatimes.com>
2. <http://www.economist.com/>
3. <http://www.managementstudyguide.com/financial-management.htm>

**Course Objectives**

- To understand the wet granulation method for granules preparation.
- To explain the dry and wet granulation protocol for tablet preparation.
- To predict the steps for the analysis of tablets for its quality control.
- To perform the preparation of liquid orals-syrup.
- To understand the procedure for the preparation of topical formulations.
- To illustrate the assay techniques for tablets and injection..

**Course Outcomes**

1. Perform the granules preparation using wet granulation method.
2. Experiment the tablet preparation using wet and dry granulation techniques.
3. Identify the quality of tablets using different analysis.
4. Demonstrate the protocol for liquid-orals syrup preparation.
5. Perform the assay for riboflavin tablets.
6. Interpret dextrose injection using basic assays.

1. Preparation of granules by wet granulation
2. Preparation of Tablets by wet and dry granulation
3. Quality control test for tablets
4. Preparation of liquid orals-syrup
5. Preparation of topical preparation-lotion, ointment, cream
6. Assay of Riboflavin tablets
7. Assay of Dextrose Injection

**Course Objectives**

- To outline and evaluate the methods for preparation of plasmid DNA from plant and animal samples.
- To explain the protocol to run the agarose gel electrophoresis for DNA sample elution.
- To demonstrate the DNA ligation and digestion techniques.
- To understand the methods involved in optimization protocol for recombinant protein expression.
- To explain the importance of high throughput screening, SDS PAGE and PCR.
- To understand the basic techniques for DNA analysis.

**Course Outcomes**

1. Carry out agarose gel electrophoresis and isolation of DNA samples individually.
2. Develop the knowledge of techniques involved in DNA isolation and purification.
3. Perform the restriction enzyme digestion and ligation of DNA samples.
4. Produce recombinant DNA and implement blue white screening techniques to screen them.
5. Develop methods to produce recombinant proteins and understand their applications and perform SDS PAGE and PCR reactions.
6. Summarize the DNA properties from various sources.

1. Preparation of plasmid DNA.
2. Elution of DNA from agarose gels.
3. Restriction enzyme digestion
4. Ligation of DNA into expression vectors.
5. Transformation.
6. Optimization of inducer concentration for recombinant protein expression.
7. Optimization of time of inducer for recombinant protein expression.
8. SDS-PAGE
9. PCR.

## 15BTBT651 COMPUTATIONAL RESOURCES FOR DRUG DISCOVERY 1101 100

### Course Objectives

- To explain the selection of lead and target molecule in drug discovery
- To explain the protocol to optimize the target and lead molecule in drug discovery.
- To infer the knowledge on basic properties of drug in the human system.
- To understand the ADME concept of drug molecules.
- To perform the receptor – ligand interactions in biological samples.
- To experiment the enzyme – inhibitor reactions for biological samples.

### Course Outcomes

1. Carry out target and lead molecule selection.
2. Determine the perfect procedure for optimizing lead and target molecules.
3. Summarize the basic properties of drug in the human system.
4. Explain the ADME role of drug molecules inside the body.
5. Develop methods to study receptor-ligand interactions.
6. Perform the enzyme – inhibitor interactions in developing drugs.

### UNIT-I DRUG DISCOVERY

Choosing a therapeutic area, choosing a drug target, bioassay, lead molecule, lead optimization

### UNIT-II DRUG-LIKE MOLECULES

Lipinski's rule of five, Lipophilicity, Log P vs Log D, ADME

### UNIT-III LABORATORY EXERCISES

Receptor-Ligand interactions, Enzyme-inhibitor interactions

### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Lemki, T. L., Williams, D. A., Roche, V. G., Zito S. W.	Foye's Principles of Medicinal Chemistry	Lippincot Williams and Wilkins	2013

**15BTBT681**

**MINI PROJECT**

**0 0 2 1 100**

**OBJECTIVES**

- |   |
|---|
| <ul style="list-style-type: none"><li>• To provide exposure in practical aspects</li><li>• To equip the students to meet the industry standards</li></ul> |
|---|

The students will be directed to do a project work during VI semester and their projects will be evaluated for, forty percentages for Continuous Internal Assessment and sixty percentage for End Semester Examination.

End Semester Examination evaluation will be based on the report submitted by the student after the completion of the project work.

**Course Objectives:**

- To create an awareness on Engineering Ethics
- To incorporate Moral and Social Values and Loyalty
- To appreciate the rights of other
- To motivate the leadership skills
- To train to become an entrepreneur
- To learn the management skills

**Course Outcomes:**

1. Explain the engineering ethics
2. Outline the Moral and Social Values and Loyalty
3. Justify the rights of other
4. Illustrate the values of leadership skills
5. Assess the skills of entrepreneur
6. Discuss the management skills

**UNIT I MANAGEMENT, PLANNING, AND ORGANISING**

Definition of Management – Management and Administration – Contribution of Taylor and Fayol – Functions of Management – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing By Objectives – Forecasting – Decision-making – Formal and informal organization – Organization Chart.

**UNIT II DIRECTING AND CONTROLLING**

Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership, Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Process of Communication – System and process of Controlling – Requirements for effective control – Control of Overall Performance – Direct and Preventive Control .

**UNIT III ENGINEERING ETHICS**

Senses of Engineering Ethics – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action – Self-interest – customs and religion – uses of ethical theories.

**UNIT IV FACTORS OF CHANGES**

Forces that shape culture, social control – Meaning, Agencies, Institution, Customs, Values, Folkways, Norms and Laws. Social changes – Meaning and nature – Theories.

## **UNIT V        ENTREPRENEURSHIP AND MOTIVATION**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur

– Entrepreneurship in Economic Growth – Major Motives Influencing an Entrepreneur –

Achievement Motivation Training, self rating, Business Game, Thematic Apperception Test

– Stress management, Entrepreneurship Development Programs – Need, Objectives.

### TEXT BOOKS

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Harold Koortz and Heinz	Essentials of Management	Tata McGraw–Hill, New Delhi.	1998
2	S. S. Khanka	Entrepreneurial Development	S.Chand and Co. Ltd., NewDelhi	1999

### REFERENCES

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Tripathy P.C and P.N.Reddy	Principles of Management	Tata McGraw–Hill, New Delhi.	1999
2	JAF Stomer, R. E Freeman and Daniel R Gilbert	Management	Pearson Education, New Delhi.	2004
3	Fraidoon Mazda	Engineering Management	Addison Wesley, New Delhi	2001
4	John R Boatright	Ethics and the Conduct of Business	Pearson Education, New Delhi	2003
5	Charles E Harris, Michael S. Protchard a Michael J Rabins	Engineering Ethic Concepts and Cases	Wadsworth Thompson Learning, New Delhi	2000

### WEBSITES

1. [ethics.tamu.edu/](http://ethics.tamu.edu/) – United States
2. [management.about.com/cs/generalmanagement/a/PlanOrg010603.htm](http://management.about.com/cs/generalmanagement/a/PlanOrg010603.htm)

**Course Objectives:**

- To understand the importance of downstream processing and various cell disruption techniques.
- To discuss the various cell disruption techniques for product release.
- To explain the physical methods of separation.
- To understand the methods for the isolation of products.
- To understand the methods for the purification of the bioproducts.
- To explain the various methods for final product formulation and finishing operations.

**Course Outcomes:**

1. Outline the principles involved in downstream processing and characteristics of biomolecules.
2. Discuss the various cell disruption techniques for product release.
3. Illustrate the different physical methods of separation of bioproducts.
4. Relate and apply the methods available for the isolation of products.
5. Discuss the techniques used for the product purification.
6. Outline the principles for the final product formulation and finishing operations.

**UNIT-I DOWNSTREAM PROCESSING (9)**

Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilization of bio-products.

**UNIT-II PHYSICAL METHODS OF SEPARATION (9)**

Unit operations for solid-liquid separation - filtration and centrifugation, flocculation and sedimentation

**UNIT-III ISOLATION OF PRODUCTS (9)**

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation, ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

**UNIT-IV PRODUCT PURIFICATION (9)**

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

**UNIT-V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS (9)**

Crystallization: principles, batch crystallizers, process crystallization of proteins; Drying: Principles, heat and mass transfers, dryers description, batch and continuous dryers, freeze and spray dryers in final product formulation.

**Total Hours: 45 +15 = 60**

**TEXTBOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	P.A. Belter, E.L. Cussler And Wei-Houhu	Bioseparations – Downstream Processing For Biotechnology	Wiley Interscience Pub	1988
2	R.O. Jenkins, (Ed.)	Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series	Butterworth-Heinemann	1992

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	J.C. Janson And L. Ryden, (Ed.)	Protein Purification – Principles, High Resolution Methods And Applications	VCH Pub Press	1989
2	R.K. Scopes	Protein Purification – Principles And Practice	Narosa Pub	1994
3	Roger.G . Harrison , Paul Todd , Scott R.Rudge and Demetr P.Petrides	Bioseparation Science and Engineering	Oxford University Press	2003

**Course objectives:**

- To understand the basic knowledge of cells and organs of Immune system.
- To explain the different cellular responses and its functions.
- To understand the basic views on monoclonal antibodies and antigen- antibody interactions.
- To outline the Immune responses to various disease and different immunologic reactions in Human body.
- To explain the organ transplantation and tumor immunology.
- To outline the basics of autoimmunity.

**Course outcomes:**

1. Discuss the cells and components of immune system.
2. Explain the basics of B, T cells, genes and generation of antibody and its functions.
3. Infer the basic views on monoclonal antibodies and antigen- antibody interactions.
4. Discuss the concept of immunity and various immunological responses to infections.
5. Discuss the basics of Transplantation and tumor therapies.
6. To illustrate the current trends in treatment of autoimmune disease.

**UNIT-I INTRODUCTION****(7)**

Cells of immune system, innate and acquired immunity, primary and secondary lymphoid organs, antigens, haptens, adjuvants, types of immune responses, theory of clonal selection.

**UNIT-II CELLULAR RESPONSES****(10)**

Development, maturation, activation and differentiation of T-cells and B-cells: TCR, antibodies, structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions; monoclonal antibodies: principles and applications; antigen presenting cells; major histocompatibility complex; antigen processing and presentation; regulation of T-cell and B-cell responses.

**UNIT-III INFECTION AND IMMUNITY****(11)**

Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites, cytokines, complement, immunosuppression, tolerance, allergy and hypersensitivity, resistance and immunization: Vaccines.

**UNIT-IV TRANSPLANTATION IMMUNOLOGY****(10)**

Transplantation: genetics of transplantation, laws of transplantation, problems in transplantation: Basis of Graft rejection, specificity and memory of graft rejection; Role of cell mediated response in graft rejection, Transplantation antigens, Mechanisms involved in Graft rejections.

**UNIT-V AUTOIMMUNITY****(7)**

Autoimmunity, Auto immune diseases and diagnosis, proposed mechanisms for induction of Autoimmunity, Treatment of Autoimmune diseases; current therapies, monoclonal antibody and diagnosis, treatment.

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Roitt I, Male, Brostoff	Immunology	Mosby Publ	2002
2	Kuby J,	Immunology	WH Freeman &	2000
3	David W Mount	Bioinformatics: Sequence And Genome Analysis	cold Spring Harbor Press	1996

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Ashim K. Chakravarthy	Immunology	Tata McGraw- Hil	1998

**Course Objectives**

- To illustrate the rate equation with different parameters.
- To explain the basic ideas on first order reaction in reactor design.
- To list the various functions of Non Ideal flow of fluidized bed.
- To label the basic theory of rate equation systems in heterogenous reactions.
- To develop a picture about rate controlling mechanism in solid catalyzed reaction.
- To understand the various biochemical reactions.

**Course Outcomes**

1. Summarize about the rate equation.
2. Determine the first order reaction in reactor design.
3. Express the functions of non ideal flow of fluidized bed.
4. Be aware of the conceptualization behind various rate equations in heterogenous systems.
5. Describe the various rate controlling mechanism in solid catalyzed reaction.
6. Summarize and predict the various reactions.

**UNIT-I KINETICS OF HOMOGENOUS REACTIONS****(9)**

Concentration and temperature dependent term of rate equation – searching for mechanism–predictability of reaction rate from theory; Interpretation of batch reactor data – constant volume and variable volume batch reactors – temperature and reaction rate - development of rate equations for different homogeneous reactions (up to second order reactions both reversible and irreversible reactions).

**UNIT-II REACTOR DESIGN****(9)**

Ideal batch reactors–steady state MFR & PFR – holding time for flow systems; Design for single reactions–performance equations for single reactors ; multiple reactor systems – PFR in series/ parallel – equal size and different size Mixed reactors in series; reactors of different types in series. Design for Multiple reactions (first order reactions only)

**UNIT-III NON IDEAL FLOW****(9)**

RTD of fluid in vessel – relationship between F, C & E curve – conversion from tracer information; non-ideal flow models–Dispersion model and Tanks in series Model; Multi parameter models–models for fluidized beds.

**UNIT-IV DESIGN FOR HETEROGENOUS SYSTEMS****(9)**

Rate equations – contacting patterns for two phase systems; fluid particle reactions – un reacted core model for spherical particles of unchanging size – rate of reaction for shrinking spherical particles – determination of rate controlling step – application to design; reactions steps; resistances and rate equations; Fluid–Fluid reactions – rate equations.

## **UNIT-V SOLID CATALYSED REACTIONS**

**(9)**

Rate equation – rate controlling mechanisms – experimental methods for finding rates – product distribution in multiple reactions–application of design; Deactivating catalysts–mechanism–rate equation.

**Total Hours: 45+15 = 60**

**TEXT BOOKS**

S.No	Author(s) Name	Title of the book	Publisher	Year of Publication s
1	Levenspiel O	ChemicalReactionEngineering.	JohnWiley	1999
2	FoglerH.S..	Elements of Chemical Reaction Engineering	Prentice Hall India	2002

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Missen R.W.,Mims C.A.,Saville B.A	Introduction to Chemical Reaction Engineering and Kinetics	John Wiley	1999

**Course Objectives**

- To illustrate the rate equation with different parameters.
- To explain the basic ideas on first order reaction in reactor design.
- To list the various functions of Non Ideal flow of fluidized bed.
- To label the basic theory of rate equation systems in heterogenous reactions.
- To develop a picture about rate controlling mechanism in solid catalyzed reaction.
- To understand the various biochemical reactions.

**Course Outcomes**

1. Summarize about the rate equation.
2. Determine the first order reaction in reactor design.
3. Express the functions of non ideal flow of fluidized bed.
4. Be aware of the conceptualization behind various rate equations in heterogenous systems.
5. Describe the various rate controlling mechanism in solid catalyzed reaction.
6. Summarize and predict the various reactions.

1. Protein Purification by isoelectric point precipitation.

2. Ammonium Sulphate precipitation.

3. Liquid – Liquid extraction.

4. Solid – Liquid extraction.

5. Crystallization.

6. Cell fractionation using centrifuge.

7. Drying of solid by heat source.

8. Dialysis

9. Purification of  $\alpha$  – Amylase from *Bacillus*.

**Course Objectives**

- To discuss the handling techniques of animals and immunization.
- To understand the isolation and identification of cells and blood group.
- To explain the methods for the detection of antigen-antibody.
- To outline the techniques for antigen identification.
- To understand the techniques of T-cell rosetting.
- To understand the techniques of Western blotting.

**Course Outcomes:**

1. Infer the basic handling techniques for animal studies.
2. Outline the basics of isolation and identification of cells and blood group.
3. Illustrate the Immuno electrophoresis and Immuno diffusion for determination of antibody.
4. Understand the knowledge about ELISA and western blotting for identification of various diseases.
5. Explain the identification of typhoid antigens by Widal test.
6. Discuss principles of T-cell rosetting.

1. Handling of animals, immunization and raising antisera

2. Identification of cells in a blood smear

3. Identification of blood group

4. Immuno diffusion

5. Immuno electrophoresis

6. Testing for typhoid antigens by Widal test

7. Enzyme Linked Immuno Sorbent Assay (ELISA)

8. Isolation of peripheral blood mononuclear cells

9. Identification of T cells by T-cell rosetting using sheep RBC.

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Hay, F.C. and M.R. Westwood	Practical Immunology	Blackwell Science, Publishers	2004
2	Janeway, C.A., and P. Travers.	Immunobiology	Garland Publishing Inc.	1994
3	Kuby, J.	. Immunology	W.H. Freeman and Company	1994
4	Talwar, G. P. and S. K. Gupta,	A Handbook of Practical and Clinical Immunology. Vol 1 and	CBS Publications	1992
5	. Weir, D.M	Immunological Techniques	Blackwell Scientific Publications	1992

**Course Objective**

- To explain the basic concepts of natural product isolations.
- To explain the principles of chromatography.
- To discuss the applications of modern NMR.
- To understand the extraction process.
- To demonstrate the extraction and isolation of caffeine from tea leaves.
- To understand the concept of separation of bioactive compounds.

**Course Outcome**

- Outline the general concepts of bioproduct isolation from various natural sources.
- Elaborate the principles of chromatography.
- Summarize the applications of modern NMR.
- Outline the extraction process.
- Carry out the experiments related to extraction and isolation of caffeine from Tea Leaves.
- Discuss the concept of separation of bioactive compounds.

**UNIT-I GENERAL CONCEPT OF NATURAL PRODUCT ISOLATION**

Natural Product Isolation, Extraction of Plant Secondary Metabolites, Selecting General Separation Conditions, Principles of Chromatography, An Introduction to Planar Chromatography, Applications of Liquid Chromatography, Isolation of Natural Products by Low-Pressure Column Chromatography, Crystallization in Final Stages of Purification, Determination of the Nature of the Compound, Applications of Modern NMR Techniques in the Structural Elucidation, Identification and Characterization

**UNIT-II LABORATORY- EXTRACTION AND ISOLATION OF CAFFEINE FROM TEA LEAVES**

General background and overview of the experiment, Caffeine extraction: Solid-liquid Extraction, Overview of the extraction process, Purification, Isolation of caffeine from tea leaves

**REFERENCES**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Satyajit D. Sarker, ZahidLatif, Alexander I. Gray	Methods in biotechnology: Natural products isolation	Springer	2005

## **DEPARTMENT ELECTIVES**

**Course Objectives**

- To illustrate the genetic material and its biological significance in organization.
- To explain the basic ideas on structure and function on genetic material.
- To list the various functions of Nitrogen fixation.
- To label the basic theory of genes involved in the pathogenesis.
- To develop a picture about applications of plant biotechnology.
- To discuss the different stages of developments in gene analysis and its recombination.

**Course Outcomes**

1. Summarize about the importance of genetic material and its uses.
2. Determine the structure and function of the genetic material.
3. Express the functions of fixing nitrogen to soil through microbes.
4. Be aware of the conceptualization behind various genes involved in pathogenesis.
5. Describe the various functions and application of plant biotechnology through tissue culture.
6. Summarize and predict the different stages of developments in gene analysis and its recombination.

**UNIT- I      ORGANIZATION OF GENETIC MATERIAL      (9)**

Genetic material of plant cells – nucleosome structure and its biological significance; junk and repeat sequences; outline of transcription and translation.

**UNIT II      CHLOROPLAST & MITOCHONDRIA      (9)**

Structure, function and genetic material; rubisco synthesis and assembly, coordination, regulation and transport of proteins. Mitochondria: Genome, cytoplasmic male sterility and import of proteins.

**UNIT- III      NITROGEN FIXATION      (9)**

Nitrogenase activity, nod genes, nif genes, bacteroids.

**UNIT- IV      AGROBACTERIUM & VIRAL VECTORS      (9)**

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – t- DNA, importance in genetic engineering. Viral Vectors: Gemini virus, cauliflower mosaic virus, viral vectors and its benefits.

**UNIT- V      APPLICATION OF PLANT BIOTECHNOLOGY      (9)**

Outline of plant tissue culture, transgenic plants, herbicide and pest resistant plants, molecular pharming, therapeutic products.

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Gamburg OL, Philips GC,	Plant Tissue & Organ Culture fundamental Methods	Narosa Publications	1995
2	Singh BD.	Text Book of Biotechnology	Kalyani Publishers	1998

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Heldt HW	Plant Biochemistry & Molecular Biology	Oxford University Press	1997
2	Ignacimuthu .S	Applied Plant Biotechnology	Tata McGraw-Hill	1996

**Course Objectives**

- To explain basic knowledge on biotech industries in various field.
- To demonstrate the various lab construction through new ventures.
- To construct various parameters of research and development in production of bio based products.
- To explain the case studies of different industries and their strategic planning.
- To outline the basic concepts of IPR and ethics in biotechnology.
- To discuss the different techniques for entrepreneurship in biotechnology.

**Course Outcomes**

1. Summarize the characteristics of different biotech industries.
2. Evaluate the different lab construction through new ventures.
3. List the various parameters of research and developmental techniques.
4. Explain the opportunities to know different industrial strategic plans.
5. Recognize basic concepts of IPR and ethics in biobased product production.
6. Identify and list different techniques for entrepreneurship in biotechnology.

**UNIT I      OVERVIEW OF BIOTECHNOLOGY INDUSTRIES      (9)**

Scope - Biotechnology Industries in India and Abroad - Fundamentals of Biotechnology for biobusiness - Trends and key issues in Biotechnology and devices industries - Technology basis in industry segment, emerging technologies and technical convergences issues.

**UNIT II      NEW VENTURE CREATION – ENTREPRENEURSHIP      (9)**

Plant tissue culture lab construction – Equipment, glassware and chemical requirements - techniques in culturing of plants. Export of tissue cultured plants to abroad – Vermiculture technology – Mushroom cultivation - single cell protein - Biofertilizer technology - production - Commercialization of R&D- Fermentation technology: Bakery, Dairy products.

**UNIT III      PRODUCT DEVELOPMENT      (9)**

Beer, wine and ethanol production using different sources– Enzyme: production, purification and characterization - Organic acids (Citric, lactic) production - Antibiotic production - Biogas technology - Azolla cultivation - Product development and project management, transition from R&D to business units. Institute– industry interaction and partnership/ alliances.

**UNIT IV      INTELLECTUAL PROPERTY, BIOETHICS AND LEGAL ISSUES      (9)**

Intellectual property rights in Biotech, Patent laws - Bioethics and current legal issues - Marketing and public perceptions in product development – Genetically modified products and organisms ( Transgenic products) - Technology licensing and branding concerns.

## **UNIT V      BIOBUSINESS PLANS**

**(9)**

Healthcare, the Biomedical Sciences, agriculture and Agrobiotechnology. Transfer and business planning - Bank loan and finance strategy – Budget plan – licensing and Branding Concerns and Opportunities, Policy and regulatory Concerns and Opportunities Financial assistance for R&D projects and entrepreneurship. Corporate partners marketing – Model project: Case studies of different industries and their strategic planning.

**Total Hours: 45**

**TEXTBOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Richard Oliver	The coming Biotech age: The business of Biomaterials	McGraw Hill Publications, New York	1999
2	Karthikeyan, S. and Arthur Ruf	Biobusiness	MJP Publications. Chennai, Indi	2009

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	GurinderShahi	BioBusiness in Asia: How countries Can Capitalize on the Life Science Revolution	Pearson Prentice Hall	2004
2	Ruth Ellen Bulger	The ethical dimensions of the Biological sciences	Cambridge University Press	1993

**Course Objectives**

- To explain the fundamentals of cancer biology
- To understand the principles of carcinogenesis
- To explain the principles of molecular cell biology
- To explain the principles of cancer metastasis
- To outline the different types of cancer therapy.
- To understand the molecular tools for cancer diagnosis.

**Course Outcomes**

At the end of the course students will be able to

1. Understand the fundamentals of cancer biology
2. Interpret the mechanism of carcinogenesis
3. Outline the principles of molecular cell biology
4. Understand the significance of cancer metastasis
5. Summarize the different types of cancer therapy
6. Recall the molecular tools of cancer diagnosis

**UNIT I      FUNDAMENTALS OF CANCER BIOLOGY      (8)**

Epidemiology of cancer: environmental factors: tobacco, alcohol, diet, occupational exposure, hormones. Regulation of cell cycle, modulation of cell cycle in cancer. Different forms of cancers. Specific type of cancer hepato cellular, melanoma, breast, lung cancer. Genetic basis of cancer- DNA repair. mutations that cause changes in signal molecules, signal switches.

**UNIT II      PRINCIPLES OF CARCINOGENESIS      (9)**

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x- ray radiation-mechanisms of radiation carcinogenesis.

**UNIT III      PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER      (10)**

Signal targets and cancer, activation of kinases; tumor suppressor genes, Oncogenes, identification of oncogenes, Virus and cancers: DNA virus-retroviruses detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases.

**UNIT IV      PRINCIPLES OF CANCER METASTASIS      (10)**

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement

membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

## **UNIT V      CANCER THERAPY**

**(8)**

Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer. Advances in cancer detection. Different forms of therapy, chemotherapy, radiation therapy, immunotherapy, molecular therapy, use of signal targets towards therapy of cancer; Gene therapy.

**Total Hours: 45**

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Ian F.Tannock	The Basic Science of Oncology”	McGraw Hill Professional,	2005
2	Dunmock. N. J and Primrose S. B	Introduction to modern Virology,	Blackwell Scientific Publications, Oxford	1988
3	L.M. Franks, N.M. Teich	Introduction to the Cellular and Molecular Biology of Cancer	Oxford Medical Publications	1991
4	Maly B. W. J	Virology a practical approach	IRL press, Oxford	1987
5	Ruddon, R. W.	Cancer Biology	Oxford University Press	1995

**Course Objectives**

- To illustrate the origin of developmental biology.
- To explain the basic ideas on specifications of germ layers.
- To list the various functions of vertebrates development by its differentiation.
- To discuss the basic theory of morphogenesis and organogenesis.
- To understand embryogenesis and its functions.
- To discuss the different stages of developmental biology.

**Course Outcomes**

1. Summarize about the cell commitment and differentiation in developmental biology.
2. Determine the postulation of germ cells and patterning of vertebrate body plan.
3. Express the functions of cell differentiation in vertebrate development.
4. Explain the concept behind morphogenesis and organogenesis.
5. Describe the various functions and stages in embryogenesis.
6. Summarize and predict the different stages of developmental biology.

**UNIT I INTRODUCTION****(8)**

Origins of developmental biology; Concepts in development – Developmental signals in cell division & differentiation; Role of gene expression in development; Identifying developmental genes, Cell commitment & differentiation; Determination & induction of cell fate, Concept of morphogen & positional information; Model vertebrate organisms: Mouse, Zebrafish, Model invertebrate organisms: *D. melanogaster*, *C. elegans*, Model plant: *A. thaliana*

**UNIT II GERM CELLS AND PATTERNING THE VERTEBRATE BODY PLAN (9)**

Genotypic & phenotypic sex-determination in mammals, *D. melanogaster* and *C. elegans*, Structure & Formation of germ cells, Fertilization; axes & germ layers; Setting up the body axes; the origin & specification of the germ layers.

**UNIT III DEVELOPMENT OF VERTEBRATES****(10)**

Development of the Drosophila, Nematodes & Cellular Slime Molds: Body Plan; Specification of body axes & role of maternal genes; Polarization of body axes during oogenesis; Patterning, Segmentation- & role of pair-rule genes; cell differentiation and aggregation.

**UNIT IV MORPHOGENESIS AND ORGANOGENESIS****(10)**

Morphogenesis; Kinds of cleavage & blastulation; Types of tissue movement in gastrulation; Gastrulation in amphibians & mammals; Neural tube formation & neural crest migration; Cell Differentiation & Organogenesis; Models of cell differentiation; Insect imaginal disc & wing development; metamorphosis.

**UNIT V        EMBRYOGENESIS**

**(8)**

Plant development; Pattern development in early embryogenesis of angiosperms; floral development.

**Total Hours: 45**

**TEXT BOOKS**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
1	Scott F. Gilbert	Developmental Biology	Sinauer Associates,	2013
2	Arumugam. A	Developmental Biology	Saras Publications	1995

### **Course Objectives**

- To explain descriptive views of fire and explosion.
- To illustrate Differentiating relief systems in various explosions.
- To descriminate various hazards and toxicity.
- To evaluate various spills and leakage of liquids.
- To interpret different situations of explosions and toxicity through case studies.
- To discuss the different global and local explosive issues.

### **Course Outcomes**

1. Elaborate the concept of fire and explosion.
2. Learn and evaluate relief systems in various explosions.
3. Explain the hazards and toxicity in various situations.
4. Discuss the various spills and leakage preventive measures.
5. Identify basic views in different situations of explosions and toxicity.
6. Make up perspective techniques and create data on different global and local explosive issues.

## **UNIT I FIRE AND EXPLOSION (9)**

Introduction-Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Industrial hygiene. Factories Act, 1948 and Environment (Protection) Act, 1986 and rules thereof.Shock wave propagation, vapour cloud and boiling liquid expanding vapours explosion (VCE and BLEVE), mechanical and chemical explosion, multiphase reactions, transport effects and global rates.

## **UNIT II RELIEF SYSTEMS (9)**

Preventive and protective management from fires and explosion-inerting, static electricity passivation, ventilation, and sprinkling, proofing, relief systems – relief valves, flares, scrubbers.

## **UNIT III TOXICOLOGY (9)**

Hazards identification-toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices- Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).

## **UNIT IV LEAKS AND LEAKAGES (9)**

Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases.

## **UNIT V CASE STUDIES (9)**

Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

**Total Hours: 45**

**TEXT BOOKS**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
1	Crowl D.A. and Louvar J.F	Chemical Process Safety Fundamentals with Applications	Prentice Hall.	2001
2	Mannan S.	Lee's Loss Prevention in the Process Industries	Butterworth- Heinemann	2005

**Course Objectives**

- To explain the variations of renewable and nonrenewable energy and its usage.
- To classify the different sources for the production of biomass and bioenergy.
- To record the basic notion on assorted properties of fuels.
- To design the bioenergy production through agricultural wastes.
- To differentiate and organize the distinct agricultural wastes used for bioenergy production.
- To understand the basic theory of bioprocess principles.

**Course Outcomes**

1. Compare and contrast energy use as renewable and non-renewable energy.
2. Synthesize the biomass for renewable energy production.
3. Prioritize diverse properties of fuels.
4. Construct and design the bioenergy production through agricultural wastes.
5. Apply the knowledge on downstream processing for bioenergy production.
6. Examine and solve the problems related to bioenergy production.

**UNIT I OVERVIEW OF ENERGY USE (9)**

Fossil fuels - past, present & future, Remedies & alternatives for fossil fuels, Today's energy use, Fossil fuels and environmental impact, Renewable energy source and devices, Solar Energy, wind energy and hydro energy.

**UNIT II BIOMASS AND BIO-ENERGY (9)**

Biomass potential - terrestrial, aquatic and marine - collection- storage and utilization, Dedicated bioenergy crops, Woody biomass, Liquid biofuels, Synthetic fuels from the biomass, biomass to biofuel conversion, Alcohol production - cellulose degradation.

**UNIT III PROPERTIES OF FUELS (9)**

Fuel properties - alcohol, biogas, producer gas, vegetable oil. Combustion - air requirement – Octane and Cetane numbers. Analysis of products of combustion. Fuel blending - fuel efficiency in dual fuel operation, Biogas and producer gas engines.

**UNIT IV AGRICULTURE AS BIOMASS (9)**

Bioenergy from wastes, agricultural wastes and byproducts - sources and availability, utilisation pattern - as fuel, Biochemical conversion of organic wastes, anaerobic digesters, methane production - sludge treatment - suitability of wastes as fuel.

**UNIT V DOWNSTREAM PROCESSING (9)**

Introduction to downstream processing principles, characteristics of biomolecules and bioprocesses. Cell disruption for product release– mechanical, enzymatic and chemical methods, filtration, centrifugation, chromatography, esterification, pyrolysis.

**Total Hours: 45**

**TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Stout. B.A.	Biomass energy	Texas University Press, College Station	1985
2	Chahal.D.S	Food, Feed and Fuel from	Oxford & IBH	1991
		Biomass	Publishing Co. Pvt LTD.	

### REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Chakraverty, A	Biotechnology and other alternate technologies for utilisation of biomass	Oxford and IBH publising Co., New Delhi	1993.
2	Donald. L.Klass and Emert H. George	Fuels from Biomass and wastes	AnnArbo Science Publishers, Inc. Michigan	1981.
3	Chavla, O.P	Advances in Biogas Technology	ICAR Pub	1986

**Course Objectives**

- To define the basic view of tissue culture techniques.
- To illustrate the breeding of farm animals.
- To propose an opinion on transgenic animal technology.
- To explain the characterization techniques for bacterial and viral diseases in animals.
- To justify the basic concept on recombinant cytokines.
- To discuss the diverse techniques on animal cell culturing and its mechanism.

**Course Outcomes**

1. Identify the different views on tissue culturing.
2. Differentiate various breeding farm animals.
3. Illustrate the concept behind transgenic animal technology.
4. Evaluate the bacterial and viral diseases that attack animals.
5. Analyze and categorize the best approach on recombinant cytokines.
6. Discuss the diverse techniques on animal cell culturing and its mechanism.

**UNIT I      ANIMAL CELL CULTURE      (10)**

Introduction to basic tissue culture techniques, equipments and instruments in ATC - chemically defined and serum free media - animal cell cultures - maintenance and preservation – various types of cultures; suspension cultures - continuous flow cultures - immobilized cultures – somatic cell fusion - organ cultures.

**UNIT II      ANIMAL DISEASES AND THEIR DIAGNOSIS      (9)**

Bacterial and viral diseases in animals - monoclonal antibodies – diagnosis - molecular diagnostic techniques; PCR - in-situ hybridization - northern -southern blotting - RFLP.

**UNIT III      THERAPY OF ANIMAL DISEASES      (9)**

Recombinant cytokines – therapeutic applications of monoclonal antibody, vaccines - DNA, sub unit, cocktail vaccines - gene therapy for animal diseases

**UNIT IV      MICROMANIPULATION OF EMBRYOS      (9)**

Micromanipulation technology - equipments - enrichment of x and y bearing sperms from semen samples - artificial insemination - germ cell manipulations – In vitro fertilization - embryo transfer - micromanipulation technology and breeding of farm animals.

**UNIT V      TRANSGENIC ANIMALS      (8)**

Concepts of transgenic animal technology; strategies for the production of transgenic and knock out animals– significance in biotechnology - stem cell cultures and induced pluripotent stem cells in the production of transgenic animals.

### **TEXT BOOKS**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
<b>1</b>	Masters J.R.W	Animal Cell Culture: Practical Approach	Oxford University Press	2000

### **REFERENCE BOOKS**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
<b>1</b>	Ranga M.M.	Animal Biotechnology	Agrobios India Limited	2002
<b>2</b>	Ramadass P, Meera Rani S	Text Book Of Animal Biotechnology	Akshara Printers	1997

**Course Objectives**

- To explain the electromagnetic wave properties.
- To discuss the functional properties of infrared spectroscopy.
- To propose an idea on the instrumentation and physical properties of mass spectrometry.
- To illustrate the electron spin detection through NMR.
- To define the scattering mechanism of X-Ray diffraction.
- To interpret the biological samples functional and physical properties using different advanced analytical instruments.

**Course Outcomes**

1. Define the wave properties of EMR in spectroscopy.
2. Discuss the basic functional and physical properties of molecules through infrared spectroscopy.
3. Outline the instrumentation and molecule properties using mass spectrometry.
4. Evaluate the molecules structure and properties through NMR.
5. Analyze the molecules for its structural properties using X-Ray diffraction.
6. Summarize the mechanism of various advanced analytical instruments.

**UNIT I      SPECTROSCOPY      (8)**

Interaction of radiation with matter, Definition frequency, Wave number, types of electromagnetic radiation, interparticle forces and energies, energy levels. Population of energy levels, Scattering, Absorption and Emission.

**UNIT II      INFRARED SPECTROSCOPY      (9)**

Measurement of Infrared spectrum-Physical basis of infrared spectra, Infrared of Polyatomic molecules, biological examples, infrared of oriented samples.

**UNIT III      MASS SPECTROMETRY      (9)**

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass spectrometry – peptide and protein analysis – carbohydrates and small molecule – specific applications.

**UNIT IV      NUCLEAR MAGNETIC RESONANCE      (10)**

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – multidimensional NMR spectroscopy – determination of macromolecular structure by NMR – magnetic resonance imaging.

## **UNIT V      X-RAY DIFFRACTION**

**(9)**

Scattering by x-rays-diffraction by a crystal – measuring diffraction pattern – Bragg reflection – unit cell – phase problem – anomalous diffraction – determination of crystal structure – electron and neutron diffraction.

**Total Hours: 45**

### **TEXTBOOK**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
<b>1</b>	Campbell I.D and Dwek R.A.	Biological Spectroscopy	Benjamin Cummins and Company	1986.

### **REFERENCE BOOK**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
<b>1</b>	Atkins P.W	Physical Chemistry	Oxford IV Edition	1990

**Course Objectives**

- To identify the basic structural principles of protein.
- To classify the different techniques of mutagenesis in bioimprinting.
- To record the basic notion on enzyme engineering and protein purification.
- To differentiate and organize the distinct metagenomics and ecosystem biology.
- To explain the basic theory of protein engineering in industries.
- To examine the problems related to engineering enzymes.

**Course Outcomes**

1. Compare and contrast structural and functional properties of proteins.
2. Summarize the diverse techniques of mutagenesis.
3. Prioritize diverse methods for protein purification.
4. Construct and design the techniques of metagenomics and ecosystem biology.
5. Apply the knowledge on applications of protein engineering in industries.
6. Examine and solve the problems related to engineering enzymes.

**UNIT- I      BASIC STRUCTURAL PRINCIPLES OF PROTEINS      (9)**

Amino Acids properties (size, solubility, charge, pKa), Kyle-Doolittle (Hydropathy) Index; Peptides as building blocks of proteins; Torsional (dihedral) angles, Ramachandran Plot; Secondary Structures of proteins; Loops – Types and Functions; Biosynthesis and chemical synthesis of Peptides. Lesk, Richardson and Topology Schematics

**UNIT- II      TECHNIQUES OF MUTAGENESIS      (9)**

Rational Design, Non rational design , Mutagenesis library construction- Chemical, Staggered Extension, Random Elongation, Random priming, Error prone PCR , Impact of structure analysis and prediction- structure and modeling, role of biocomputing, denova design, Effect of protein conformation and bioimprinting.

**UNIT- III      ENGINEERING ENZYMES      (9)**

Engineering stability (*Bacillus subtilis* natural protease, *Pseudomonas* isoamylase, carbamylase from *Agrobacterium radiobacter*), specificity and features to ease protein purification, Engineering antibodies- Engineering signal molecules (hormones/ receptors), Engineering protein to facilitate recovery. Affinity purification (Strep-Tag)

**UNIT- IV      METAGENOMICS      (9)**

Metagenomics and ecosystems Biology- conceptual framework, tools and methods- Analyses of metagenomics, Single gene approach, Targeted partial metagenome sequencing, Analyses of metatranscriptome- Limitation in analysing the metatranscriptome- 16s rRNA sequencing and metatranscriptome pyrosequencing, metaproteome-molecular methods to study complex microbial communities, metabolomics- metabolome of an ecosystem and metagenomics.

Metabolomics for natural product perception

**UNIT-V      PROTEIN ENGINEERING IN INDUSTRIES**

**(9)**

Protein engineering for industrial enzymology, Biosensor- chemically engineered electronic protein, genetically fused protein, Gene engineering for molecular networking and protein assembly; molecular bioscreening in oncology- mechanism based drug discovery. Protein engineering in vaccine development.

**Total Hours: 45**

### **TEXTBOOKS**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
1	Lilia Alberghina	Protein Engineering in Industrial Biotechnology	Harwood Academic publications	2005
2	P. C. E. Moody and A. J. Wilkinso	Protein Engineering	IRL Press, Oxford	1990
3	Karen E. Nelson	Metagenomics of Human Body	Springer	2010

### **REFERENCES BOOKS**

<b>S.No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publications</b>
1	T. E. Creighton	Proteins, Structure and Molecular properties	Freeman W. H & Company	1993
2	C. Branden and J. Tooze	Introduction to Protein Structure	Garland Publications	1999

**Course Objectives**

- To define the basic view of infectious diseases in host microbe interactions.
- To illustrate the diverse host defense mechanism and pathogenic strategies.
- To propose an opinion on molecular pathogenesis.
- To explain the characterization techniques for host pathogen interactions.
- To understand the basic concept on modern approaches to control pathogens.
- To explain the diverse pathogens and its controlling measures.

**Course Outcomes**

1. Identify different views on host microbe interactions.
2. Differentiate various host defense mechanisms.
3. Illustrate the concept behind molecular pathogenesis.
4. Evaluating and characterizing host pathogen interactions.
5. Analyze and categorize the best approach to control pathogens.
6. Explain the diverse pathogens and its controlling measures.

**UNIT- I      HOST-MICROBE INTERACTIONS****(7)**

Normal Flora-Protective role-dynamic nature, principles of Infectious diseases-pathogenicity-course of infectious diseases-distribution of the pathogen, establishing the cause of infectious disease-Koch's postulates molecular postulates-mechanisms of pathogenesis. Epidemiology-principles.

**UNIT- II      HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES (10)**

Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

**UNIT- III      MOLECULAR PATHOGENESIS****(10)**

Virulence factors - gene regulation in virulence of pathogens - labile & stable toxins; *Vibrio Cholerae* - Cholera toxin -*E.coli* pathogens: - ETEC – EPEC - EHEC - EIEC Hemolytic Uremic Syndrome - Shigella toxin - Plasmodium Life cycle- Antimalarials based on transport processes - Influenza virus - action of amantidine.

**UNIT- IV      EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS****(9)**

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses.

**UNIT-V****MODERN APPROACHES TO CONTROL PATHOGENS****(9)**

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines

**Total Hours: 45**

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Eduardo A. Groisman	Principles of Bacterial Pathogenesis	Academic Press,	2001
2	Tizard.	Immunology: An introduction	Cengage Learning	1994
3	Peter Williams, Julian Ketley & George Salmond,	Methods in Microbiology: Bacterial Pathogenesis,	Academic Press	1998
4	Abigali A. Salyers and Dixie  D.Whitt,	Bacterial Pathogenesis – A molecular Approach	ASM Press, Washington	2002

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Nester, E. W. Anderson, D. G Roberts, C.E. Jr. and Nester, M. T.	Microbiology: A Human Perspective, Fifth Edition	McGraw- Hill,	2007

**Course Objectives**

- To illustrate about the biosafety in biotechnology.
- To explain basic knowledge on Intellectual property rights.
- To rephrase different views on policies of IPR.
- To solve the IPR issues and Bioethics.
- To list and examine about the case studies of copyright and patents.
- To understand the basics of IPR and ethical issues in biotechnology.

**Course Outcomes**

1. Classify the different techniques involved in biosafety in biotechnology based industries.
2. Manage and organize the knowledge about the intellectual property rights.
3. Label an idea about the policies of IPR.
4. Relate about the IPR issues and bioethics.
5. Diagnose about the case studies on patents.
6. Summarize the basics of IPR and ethical issues in biotechnology.

**UNIT I BIOSAFETY****(8)**

Biosafety – Biotechnology development in India, Safety issues concerning biotechnological products, governing biosafety, Cartagena protocol on biosafety, Conservation of Biodiversity.

**UNIT II INTELLECTUAL PROPERTY RIGHTS****(10)**

Introduction - Invention and Creativity - Intellectual Property (IP) - Importance - Protection of IPR - Basic types of property (i. Movable Property ii. Immovable Property and iii. Intellectual Property). IP - Patents - Copyrights and related rights - Trade Marks and rights arising from Trademark registration - Definitions - Industrial Designs and Integrated circuits - Protection of Geographical Indications at national and International levels - Application Procedures.

**UNIT III IPR – POLICIES****(9)**

International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities -History - General Agreement on Trade and Tariff (GATT). Indian Position Vs WTO and Strategies - Indian IPR legislations - commitments to WTO-Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.

**UNIT IV CASE STUDIES****(9)**

Case Studies on - Patents (Basmati rice, turmeric, Neem, etc.) - Copyright and related rights - Trade Marks - Industrial design and Integrated circuits - Geographic indications - Protection against unfair competition.

## **UNIT V      BIOETHICS**

**(9)**

Bioethics – Disease prevention Vs right to privacy, patentability of DNA, pre implantation embryo diagnosis, Engineered organisms into environment, Genetic tests in diagnostics and therapy.

**Total Hours: 45**

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	V.H Heywood.R.T Watson	Global Biodiversity Assessment	Cambridge University Press	1996
2	Brody BA and Engelhardt	Bioethics : Readings and Cases	Prentice John- Wiley and Sons	2007
3	Joshi. R	Biosafety and Bioethics	Isha Books, New Delhi	2006.

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Subbaram N.R	Handbook of Indian Patent Law and Practice	S. Viswanathan Printers and Publishers Pvt.  Ltd.,	1998.
2	Sasson A	Biotechnologies and Development	UNESCO Publications,	1988.
3	Singh K	Intellectual property rights on Biotechnology	BCIL	2015

**Course Objectives**

- To understand the constituents of food and energy.
- To classify the different sources of microbes in food that assist food spoilage.
- To record the basic notion on fermented food products.
- To differentiate and organize the distinct food additives used.
- To explain the basic theory of food processing and preservation.
- To discuss the problems related to food deterioration and its preventive measures.

**Course Outcomes**

1. Compare and contrast different food constituents and their effectiveness.
2. Summarize the controlling measures for food spoilage.
3. Prioritize diverse properties of fermented foods.
4. Construct and design the food additives for food preservation.
5. Apply the knowledge on basics of food processing and preservation methods.
6. Examine and solve the problems related to food deterioration and its preventive measures.

**UNIT I      FOOD AND ENERGY      (9)**

Constituents of Food- Water : importance, water in food, activity and shelf life of food; Carbohydrates: functional properties of sugars and polysaccharides in food; Lipids: uses, physical and chemical properties; Proteins and amino acids: physical and chemical properties, distribution, functions and functional properties; Vitamins and Minerals: Dietary sources; Nutritive value of foods, food as a source of energy, food health and disease.

**UNIT II      FOOD MICROBIOLOGY      (9)**

Types of micro-organism normally associated with food -mold, yeast, and bacteria. Micro-organisms in natural food products. Biochemical changes caused by micro-organisms. Food poisoning and microbial toxin. Spoilage of vegetables, fruit, meat, poultry , beverages and other food products. Food safety.

**UNIT III      FERMENTATION PRODUCTS      (9)**

Enzymes in foods and food industry, Nature and type of starters, Role of starters in Fermented foods, Fermentation of Milk products-Fermented soy and peanut milk , Idli, Fermented fish products, Pickles, Fermented Olives ; Production of distilled beverage alcohol ,wine, brandy, and beer. Mycoprotein production.

**UNIT IV      FOOD ADDITIVES      (9)**

Chemical and physical methods of food analysis for determination of food composition; Pigments in food, food flavours, food additives and toxicants. Natural sweeteners and artificial sweeteners - role in controlling diseases.

## **UNIT V      FOOD PROCESSING & PRESERVATION**

**(9)**

Basic principles, unit operations Involved in the food processing methods; Objectives, importance and functions of quality control. Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of micro organisms, canning, frozen storage characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

**Total Hours: 45**

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	James M. Jay, Martin J. Loessner David A. Golden	Modern Food Microbiology	Springer Science & Business Media	2005
2	William C.Frazier	Food Microbiology	Tata MC Graw hill	1987

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	H.-D. Belitz, Werner Grosch, Peter Schieberle	Food Chemistry	Springer Science & Business Media	2009
2	B.Sivashankar	Food processing and preservation	Prentice – Hall of India Pvt.Ltd.New Delhi	2002.

## **15BTBT6E08 PROCESS INSTRUMENTATION DYNAMICS AND CONTROL 3 0 0 3 100**

### **Course Objectives**

- To understand the basic concept of transformation and dynamics reactions in chemical system.
- To classify the control systems based on their functions and properties.
- To understand the concept and classification of closed loop system in process instrumentation.
- To discuss the mechanism of control systems in the dynamic reactions.
- To explain the control mechanism in the process instrumentation.
- To tell about the different types and its functional parameters of process instruments.

### **Course Outcomes**

1. Explain the concept behind transformation and dynamic reactions in chemical systems.
2. Summarize the functions of control systems.
3. Prioritize the importance of closed loop systems.
4. Outline the working mechanism of control systems.
5. Tell about the properties of control mechanism.
6. Differentiate the process control instruments.

### **UNIT I INTRODUCTION (9)**

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

### **UNIT II CONTROL SYSTEMS (9)**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

### **UNIT III CLOSED LOOP SYSTEMS (9)**

Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

### **UNIT IV CONTROL MECHANISM (9)**

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of heat exchangers, introduction to microprocessors and computer control of chemical processes.

## **UNIT V      CONTROL INSTRUMENTS**

**(9)**

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency, pH, concentration, electrical and thermal conductivity.

**Total Hours: 45**

### **TEXTBOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Coughnowr and Koppel	Process Systems Analysis and Control	McGraw-Hill	2009
2	George Stephanopolous	Chemical Process Control	Prentice-Hall of India Pvt- Ltd	1990

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Emenule, S.Savas	Computer Control of Industrial Processes	McGraw-Hill	1965
2	Eckman	Industrial Instrumentation''	Wiley	1978.

**Course Objectives**

- To explain the human nervous system,
- To demonstrate about neuro physiology
- To manage and diagnose about neuro pharmacology.
- To categorize the mechanism of neurological behaviour.
- To interpret basic impression about the disorders associated with nervous system.
- To discuss the applications of neurobiology

**Course Outcomes**

1. Outline the basis of central and peripheral nervous system and describe the structure of neurons and supporting cells.
2. Demonstrate the mechanism of action potential conduction and working of voltage dependent channels.
3. Illustrate the concept of synaptic transmission and mechanism of action of neurotransmitters.
4. List the basic mechanisms of sensations and skeletal muscle contraction.
5. Enumerate the mechanisms associated with motivation behaviours.
6. Describe the various disorders of nervous system

**UNIT I      NEUROANATOMY      (9)**

Central and peripheral nervous systems; Structure and function of neurons; types of neurons; Synapses; Glial cells; myelination; Blood Brain barrier; Neuronal differentiation; Characterization of neuronal cells; Meninges and Cerebrospinal fluid; Spinal Cord.

**UNIT II      NEURO PHYSIOLOGY      (9)**

Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission; information representation and coding by neurons.

**UNIT III      NEURO PHARMACOLOGY      (9)**

Synaptic transmission, neurotransmitters and their release; fast and slow neurotransmission; characteristics of neurites; hormones and their effect on neuronal function.

**UNIT IV      APPLIED NEUROBIOLOGY      (9)**

Basic mechanisms of sensations like touch, pain, smell and taste; neurological mechanisms of vision and audition; skeletal muscle contraction.

**UNIT V      BEHAVIOUR SCIENCE      (9)**

Basic mechanisms associated with motivation; control of feeding, sleep, hearing and memory; Disorders associated with the nervous system.

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Gordon M. Shepherd	Neurobiology	Oxford University Press, USA	1994

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Mathews G.G.	Neurobiology	Blackwell Science, UK	2000
2	William Bechtel, George Graham	A Companion to Cognitive Science	Blackwell Science, UK	1999

**Course Objectives**

- To explain the genetic disorders.
- To determine protocol for biological sample diagnosis.
- To discuss the hybridoma technology.
- To distinguish the therapies for various diseases.
- To tell about the generation, differentiation and uses of stem cells.
- To develop biological pharma products using recombinant technology

**Course Outcomes**

1. Outline the basic idea on genetic disorders.
2. Demonstrate the biological sample diagnostic methods.
3. Illustrate the concept behind hybridoma technology.
4. List the detection and therapies of harmful diseases.
5. Explain the generation, differentiation and uses of stem cells.
6. Describe the development of pharmaceutical products using recombinant technology.

**UNIT I GENETIC DISEASES****(9)**

Chromosomal disorders – Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions, Gene controlled diseases – Autosomal and X-linked disorders, Molecular basis of human diseases - Pathogenic mutations. Gain of function mutations: Oncogenes, Huntingtons Disease, Loss of function - Tumour Suppressor Genes,

**UNIT II DIAGNOSTICS****(9)**

Prenatal diagnosis - Invasive techniques - Amniocentesis, Fetoscopy, Non-invasive techniques - Ultrasonography, X-ray, maternal serum and fetal cells in maternal blood. Diagnosis using protein and enzyme markers, DNA/RNA based diagnosis Hepatitis, Microarray technology- genomic and cDNA arrays, application to diseases

**UNIT III HYBRIDOMATECHNOLOGY****(9)**

Monoclonal Antibodies – Production, Target drug delivery using monoclonal antibodies; Human Gene Therapy, Detection and Therapy of Tuberculosis, Yellow Fever, Japanese encephalitis, Dengue fever, Acquired Immune Deficiency Syndrome (AIDS), Cholera, Malaria; Cancer.

**UNIT IV STEM CELL****(9)**

Embronic and adult stem cells, Totipotent, pluripotent and multipotent cells testing and generation of embryonic stem cells, testing of adult stem cells and differentiation, potential uses of stem cells –cell bases therapies, Gene products in medicine – Humulin, erythropoietin, Growth hormone-somatostatin, TPA, Interferon; functional cloning-anti haemophilic factor positional cloning-Dystrophin.

## **UNIT V      PHARMACEUTICAL BIOTECHNOLOGY**

**(9)**

Vaccines- Preparation and testing, standardization and storage study, generation of vaccines- hepatitis, AIDS, Malaria. Production of recombinant pharmaceutical products – Biotechnologically derived products (therapeutic proteins); Study of Haematopoietic growth factors Recombinant coagulation factors and thrombolytic agents.

**Total Hours: 45**

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Berger S.L.,ET.Al	Methods in Enzymology	Academic press Inc	1992
2	De Kalyan kumar	Plant tissue culture	New Central Book Agency (P) Ltd.	1997
3	Freifelder David	Molecular Biology	Narosa Publishing.	1987

**Course Objectives**

- To explain the gene expression and its regulation.
- To determine the methods for the synthesis of primary metabolites.
- To discuss the procedure for biosynthesis of secondary metabolites.
- To distinguish the features of bioconversion.
- To tell about the regulation of enzyme production.
- To summarize the repressions in enzyme production.

**Course Outcomes**

1. Illustrate the gene expression and its regulation.
2. Demonstrate the primary metabolite synthesis.
3. Discuss the methods for secondary metabolites production.
4. Outline the features of bioconversion.
5. Explain the regulation of enzyme production.
6. Describe the repressions in enzyme production.

**UNIT I INTRODUCTION****(9)**

Jacob Monod model for gene expression regulation – Lac operon, catabolite regulation - glucose effect - cAMP deficiency. Regulation of RNA synthesis by amino acid. Feed back regulation, regulation in branched pathways-differential regulation in isozymes, concerted feedback regulation, cumulative feedback regulation, permeability control: passive diffusion, active transport, group transportation.

**UNIT II SYNTHESIS OF PRIMARY METABOLITES****(9)**

Alteration of feedback regulation, limiting accumulation of end products, feedback resistant mutants, alteration of permeability for metabolites.

**UNIT III BIOSYNTHESIS OF SECONDARY METABOLITES****(9)**

Producers of secondary metabolites, Precursor effects, trophophase- idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism.

**UNIT IV BIOCONVERSIONS****(9)**

Advantages of Bioconversions, specificity, yields, factors important for bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

## **UNIT V      REGULATION OF ENZYME PRODUCTION**

**(9)**

Strain selection, improving fermentation, recognizing growth cycle peak, induction, feedback repression, catabolite repression, mutants resistant to repression, gene dosage.

**Total Hours: 45**

### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Peter F. Stanbury, Stephen J. Hall & A. Whitaker	Principles of Fermentation Technology	Butterworth- Heinemann	2005
2	G.Stephanopoulos , AristosA. Aristidou, Jens Hoiris Nielson	Metabolic Engineering: Principles and Methodologies	Academicpress	1998

### REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Wang D.I.C., Cooney C.L., Demai A.L., Dunnill P., Humphrey A.E., Lill M.D	Fermentation and Enzyme Technology	JohnWiley and Sons	1980
2	Cruger, W and Crueger, A	Biotechnology: A Textbook of Industrial Microbiology	Panama Publishing Corporation	2003
3	Zubay, G.L	Principles of Biochemistry	WCB Publishers, London	1995

**Course Objectives**

- To explain basic knowledge on soil microbes and its characteristics.
- To demonstrate the effects of xenobiotic compounds.
- To discuss various methods for industrial waste water management.
- To explain the effects of various industrial wastes and to infer basic concepts for its management.
- To outline the natural and engineered bio-treatment methods to remediate the pollutants.
- To discuss the different environmental issues using biotechnology.

**Course Outcomes**

1. Summarize the characteristics of soil microbes and its interactions.
2. Evaluate the different xenobiotics present and methods to degrade them.
3. Describe the industrial waste management systems.
4. List the opportunities in waste treatment industries and its management.
5. Recognize natural and engineered biotreatment methods to remediate pollutants.
6. Identify and list different environmental issues and its remedy.

**UNIT I INTRODUCTION (8)**

Microbial flora of soil, growth and ecological adaptations of soil microorganisms, interactions among soil microorganisms, biogeochemical role of soil microorganisms.

**UNIT II DEGRADATION OF XENOBIOTIC COMPOUNDS (9)**

Aromatics - benzene, pentachlorophenol, Polyaromatic hydrocarbons (PAHs) – naphthalene, , Polychlorinated biphenyls (PCBs) hexachloro biphenyl, Pesticides-DDT and Surfactants–LAS

**UNIT III INDUSTRIAL WASTE WATER MANAGEMENT (10)**

Wastewater characteristics – physical, chemical and biological, Biological processes - unit operations, aerobic treatment processes, activated sludge process–characteristics of activated sludge and process configuration, anaerobic treatment by methanogenesis

**UNIT IV TREATMENT OF INDUSTRIAL WASTES (9)**

Dairy, Paper & Pulp, Textile, leather, hospital and pharmaceutical industrial waste management, e-waste-radioactive and nuclear power waste management.

## **UNITV      DEVELOPMENTS PERTAINING TO ENVIRONMENTAL BIOTECHNOLOGY (9)**

Solid waste management, Role of biosensors in Environmental monitoring, Heavy metal pollution and their control strategies, Prevention of environmental damage with respect to nitrogen fixation, Bioremediation, Production of bioelectricity from microbial fuel cell (MFC), Improvement of water quality by denitrification, Role of biotechnology on agricultural chemical use.

**Total Hours: 45**

### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	BruceE. Rittmann and perr L. Mccarty	Environmental Biotechnology: Principle and Applications	McGraw Hill	2001
2	Mecalf and Eddy	Waste water Engineering: Treatment Disposal Reuse	Mc Graw Hill	1991
3	DesW. Connell,	Basic concepts of Environmental chemistry	Lewis publishers	2005

### REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Alan Scragg	Environmental Biotechnology	Oxford University press	2005
2	Prescott, Harley, Klein	Microbiology	WCB publishers	1996

**Course Objectives**

- To explain basic knowledge on genome organization of prokaryotes and eukaryotes.
- To discuss the effects of cytogenetic mapping.
- To construct various methods for gene finding and annotations in functional genomics.
- To explain the effects of various protein level estimation in proteomics
- To understand the different protein analysis techniques.
- To outline the post translational modification and other protein interactions.

**Course Outcomes**

1. Summarize the characteristics of genomic organization of prokaryotes and eukaryotes.
2. Evaluate the different physical mapping techniques.
3. Discuss the gene findings in functional genomics.
4. Explain the protein estimation through different techniques.
5. Recognize different protein analysis techniques.
6. Identify and list different protein interactions.

**UNIT I OVERVIEW OF GENOMES OF BACTERIA, ARCHAE AND EUKARYOTA (9)**

Genome organization of prokaryotes and eukaryotes, gene structure of bacteria, archaebacterial and eukaryotes, Human genome project, Introduction of functional and comparative genomics.

**UNIT II PHYSICAL MAPPING TECHNIQUES (9)**

Cytogenetic mapping, radiation hybrid mapping, Fish, STS mapping, SNP mapping optical mapping, Top down and bottom up approach, linking and jumping of clones, gap closure, pooling strategies, genome sequencing.

**UNIT III FUNCTIONAL GENOMICS (9)**

Gene finding; annotation; ORF and functional prediction; Subtractive DNA library screening; differential display and representational difference analysis; SAGE.

**UNIT IV PROTEOMICS TECHNIQUES (9)**

Protein level estimation; Edman protein microsequencing; protein cleavage; 2 D gel electrophoresis; metabolic labeling; detection of proteins on SDS gels. Mass spectrometry- principles of MALDI- TOF; Tandem MS-MS; Peptide mass fingerprinting.

**UNIT V PROTEIN PROFILING (9)**

Post translational modification; protein-protein interactions; glycoprotein analysis; phosphor protein analysis.

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Cantor and Smith	Genomics	John Wiley & Sons	1999
2	Pennington and Dunn	Proteomics	BIOS Scientific Publishers	2001
3	T.ABrown	Genomes	Bios Scientific Publishers Ltd	2002

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Liebler	Introduction to Proteomics	Humana Press	2002
2	Hunt and Livesey	Functional Genomics	Oxford University press	2000
3	Primrose and Twyman	Principles of genome analysis and genomics	Blackwell Publishing Co	2003

**Course Objectives**

- To discuss the mass and energy balance.
- To explain the scale up of equipments.
- To describe the scale down of equipments.
- To explain design of equipments.
- To understand the facility design with safety.
- To outline the process economics in biological products production.

**Course Outcomes**

1. Calculate the mass and energy balance.
2. Evaluate the scaling up process for equipments.
3. Discuss the scale down process for equipments.
4. Describe the design of equipments.
5. Tell about the facility design in euipmentation.
6. Summarize the process economic calculations in plant design.

**UNIT I      MASS AND ENERGY BALANCE      (9)**

Introduction: General design information - Material and energy balance calculations - Process Flow sheeting.

**UNIT II      SCALE UP AND SCALE DOWN OF EQUIPMENTS      (9)**

Heat and Mass Transfer studies: Effect of scale on oxygenation, mixing, sterilization, pH, temperature, inoculum development, nutrient availability and supply. Bioreactor scale-up - constant power consumption per volume, mixing time, impeller tip speed (shear) - mass transfer coefficients. Scale up of downstream processes - Adsorption (LUB method), Chromatography (constant resolution etc.), Filtration (constant resistance etc.) - Centrifugation (equivalent times etc.) - Extractors (geometry based rules) - Scale-down related aspects.

**UNIT III      DESIGN OF EQUIPMENTS      (9)**

Selection of bioprocess equipment (upstream and downstream) - Specifications of bioprocess equipment - Mechanical design of reactors, heat transfer and mass transfer equipment. Design considerations for maintaining sterility of process streams and process equipment - Piping and instrumentation - Materials of construction for bioprocess plants.

**UNIT IV      FACILITY DESIGN      (9)**

Facility design aspects - Utility supply aspects - Equipment cleaning aspects - Culture cell banks - cGMP guidelines – Validation - Safety.

## **UNIT V      ECONOMICS AND CASE STUDY**

**(9)**

Process economics - Case studies. Commodity chemicals and production of pharmaceutical products.

**Total Hours: 45**

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Robert H. Perry and Don W. Gree (eds.)	Perry's Chemical Engineers' Handbook	McGraw Hill Book Co	1997
2	Shuler M and Kargi F	Bioprocess Engineering: Basic Concepts	Prentice Hall, Englewood Cliffs, NJ	2002
3	Max S. Peters and Klaus, D. Timmerhaus	Plant Design and Economics for Chemical Engineers	McGrawHill Book Co	1991

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Coulson J.M. and J. F. Richardson (Eds.) R.K.Sinnott	Chemical Engineering, Volume 6: An Introduction to Chemical Engineering Design	Asian Books Private Limited, New Delhi	1983
2	Joshi M. V. and V.V.Mahajani	Process Equipment Design	Macmillan India Ltd	2000
3	Michael R. Ladisch	Bioseparations Engineering: Principles, Practice and Economics	Wiley	2001

**Course Objectives**

- To explain the general properties of viruses.
- To discuss the cultivation of viruses.
- To describe the viral genetics.
- To tell about the structure and properties of DNA and RNA viruses.
- To infer the knowledge on mechanism and action of viral vaccines and antivirals.
- To outline the modern approaches of virus control.

**Course Outcomes**

1. Summarize the general properties of viruses.
2. List the cultivation methods of viruses.
3. Discuss the genetic importance of viruses.
4. Describe the action mechanism of DNA and RNA virus.
5. Explain the production and importance of viral vaccines and antivirals.
6. Summarize the modern approaches of viral control.

**UNIT I      GENERAL PROPERTIES OF VIRUSES      (8)**

Early development of virology – properties of viruses: morphology, structure and shape–chemical properties – Resistance – viral agglutination – viral multiplication.

**UNIT II      CULTIVATION OF VIRUSES & VIRAL GENETICS      (9)**

Cultivation of viruses: Animal inoculation – cell culture – tissue culture types, detection of virus growth in cell cultures – Virus purification – viral assay – viral genetics –non genetic interactions - Bacteriophages.

**UNIT III      DNA AND RNA VIRUSES      (10)**

DNA viruses: Morphology, properties and pathogenesis – pox viruses – herpes viruses –adeno viruses. RNA viruses – entero viruses – polio virus – influenza – rabies virus –hepatitis viruses.

**UNIT IV      VIRAL VACCINES AND ANTIVIRALS      (9)**

Conventional vaccines -killed and attenuated, modern vaccines—recombinant proteins, subunits, DNA vaccines, peptides, immuno modulators (cytokines), vaccine delivery and adjuvants, Interferons, designing and screening for antivirals, mechanisms of action, antiviral libraries, antiretrovirals—mechanism of action and drug resistance.

**UNIT V      MODERN APPROACHES OF VIRUS CONTROL      (9)**

Anti-sense RNA, siRNA, ribozymes, in silico approaches for drug designing

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Ranga MM	Animal biotechnology	Agrobios India Limited	2002
2	Ramadass P, Meera Rani S	Text Book of Animal Biotechnology	Akshara Printers	1997

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Masters JRW	Animal Cell Culture: Practical Approach	Oxford University Press	2000

**Course Objectives**

- To explain the general concepts of pharmacology.
- To discuss the systemic pharmacology with drug action.
- To describe the experimental pharmacology in drug discovery.
- To tell about the general aspects on the pharmacognosy.
- To infer the knowledge on methods and quality control for following pharmacognosy.
- To discuss the protocol for isolation of phytochemicals.

**Course Outcomes**

1. Tell about the basics of pharmacology in drug action.
2. Explain the systemic pharmacology.
3. Discuss the methods for experimental pharmacology.
4. Describe the action of drugs in pharmacognosy.
5. Outline the methods for isolation of phytochemicals.
6. Understand the characterization of phytochemicals.

**UNIT I BASICS OF PHARMACOLOGY (9)**

General concepts of Pharmacology, ADME process, drug action- mechanism, factors affecting drug action. Dose-effect relationship

**UNIT II SYSTEMIC PHARMACOLOGY (9)**

Drugs Affecting the Central Nervous System, Cardiovascular and Renal Systems, Immune system, Respiratory System, Gastrointestinal System and Nutrition, Endocrine System, Integumentary system and Eyes/Ears. Drugs affecting uterine motility, Chemotherapy of parasite infections, Chemotherapy of microbial diseases. Antineoplastic agents, Immunomodulators. Drugs acting on blood and blood forming organs

**UNIT III EXPERIMENTAL PHARMACOLOGY (9)**

Experimental methodologies involved in the discovery of drugs (*in vivo*, *in vitro*, *ex vivo*). Animal handling and animal care. Methods of anaesthetising animals and methods of euthanasia. Restraining and blood collecting methods.

**UNIT IV PHARMACOGNOSY (9)**

General aspects of sources of natural medicinal products. Marine Pharmacognosy and its applications. General cultivation of medicinal plants, their merits and Demerit -a. General aspects, b. Factors involved, c. Methods used to improve the Quality and d. Pest control. Role of natural pesticides – Preparation and uses.

## **UNIT V      ISOLATION AND CHARACTERIZATION OF PHYTOCHEMICALS (9)**

General methods and Principles of extraction methods, types of extraction and their merits and demerits. Selection and purification of solvents for extraction, methods of isolation, purification and identification of phytoconstituents.

**Total Hours: 45**

### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Bertram G. Katzung	Basic & clinical pharmacology	Mc Graw Hill	2004
2	Richard A. Harvey PhD, Pamela C. Champ	Lippincott's Illustrated Reviews: Pharmacology	Wolters Kluwer	2008

### REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	G.E. Trease, W.C. Evans	Pharmacognosy	ELBS	2002
2	Varro E.Tyler, Lynn. R.Brady, James E.Robbers	Pharmacognosy	Lee & Febiger	1988
3	T.E. Wallis	Text Book of Pharmacognosy	CBS Pub	1985

**Course Objectives**

- To explain basic knowledge on definition and scope of stem cells.
- To demonstrate the structural and functional principles of in vitro fertilization.
- To discuss the various identification and cell differentiation of somatic stem cells.
- To explain the effects of stem cell in drug discovery and tissue engineering.
- To outline the basic concepts of cellular therapy and gene therapy of stem cells.
- To compile the application of stem cells.

**Course Outcomes**

1. Summarize the characteristics stem cells.
2. Evaluate the different structural and functional parameters of invitro fertilization.
3. List the properties of adult stem cells in differentiation.
4. Explain the uses of stem cells in drug discovery and tissue engineering.
5. Recognize various stem cell therapies.
6. Summarize the application of stem cells.

**UNIT I      STEM CELLS AND CELLULAR PEDIGREES      (9)**

Scope of stem cells – definition of stem cells – concepts of stem cells – differentiation, maturation , proliferation , pluripotency, self – maintenance and self – renewal – problems in measuring stem cells – preservation protocols.

**UNIT II      EMBRYONIC STEMCELLS      (9)**

In vitro fertilization –culturing of embryos-isolation of human embryonic stem cells – blastocyst – inner cell mass – growing ES cells in lab – laboratory tests to identify ES cells – stimulation ES cells for differentiation – properties of ES cells.

**UNIT III      ADULT STEM CELLS      (9)**

Somatic stem cells – test for identification of adult stem cells – adult stem cell differentiation – trans differentiation – plasticity – different types of adult stem cells.

**UNIT IV      STEM CELL IN DRUG DISCOVERY AND TISSUE ENGINEERING      (9)**

Target identification – Manipulating differentiation pathways – stem cell therapy Vs cell protection - stem cell in cellular assays for screening – stem cell based drug discovery, drug screening and toxicology.

**UNIT V      POTENTIAL USES OF STEM CELLS      (9)**

Cellular therapies – vaccines – gene therapy – immunotherapy – tissue engineering – blood and bone marrow – Fc cells.

## TEXT BOOKS

S. No.	Author (s) Name	Title of the book	Publisher	Year of Publication
1	CS Potten	Stem cells	Elsevier	1997
2	Kursad and Turksen	Embryonic Stem cells	Humana Press.	2002
3	Robert Paul Lanza	Essentials of stem cell biology,	O'Reilly	2006
4	Clive Svendsen , Allison D.Ebert.	Encyclopedia of stem cell research vol 1 & 2	Sage pub	2008

**Course Objectives**

- To present basic knowledge about the various cloning vectors and its features.
- To demonstrate the various techniques and enzymes involved in cloning.
- To explain and practice diverse concepts on expression vectors for cloning.
- To practice the basic views on preparation of genomic and cDNA library.
- To identify and organize differing views on applications of gene cloning in rDNA research.
- To compile the basic concepts of rDNA technology.

**Course outcomes**

1. Compose about basic concepts about the features of cloning vectors.
2. Assemble different techniques and enzymes involved in cloning.
3. Classify about expression vectors for cloning.
4. List the techniques in preparation of genomic and cDNA library.
5. Propose knowledge on applications for rDNA research.
6. Summarize concepts of rDNA technology.

**UNIT I      CLONING VECTORS      (9)**

Ideal features of cloning vectors – plasmids and bacteriophages – cloning vectors for E.coli ; pBR322, pUC vectors, M13 and other plasmid vectors – Cosmids, Phagemids – vectors for Bacillus, Streptomyces Restriction mapping and analysis

**UNIT II      ENZYMES AND TECHNIQUES FOR CLONING      (9)**

DNA modifying enzymes – ligases – Nucleic acid probe preparation; Radioactive and nonradioactive labels – Hybridization techniques – PCR; different types and applications – DNA sequencing – DNA fingerprinting – RFLP, RAPD – chromosome walking.

**UNIT III      EXPRESSION VECTORS      (9)**

Expression vectors in prokaryotes – Expression vectors in Eukaryotes-Yeast cloning vectors – selectable markers for eukaryotes – SV40, Papilloma, Retrovirus, Baculoviral vectors – mammalian cell expression system – Gene transfer techniques – Agrobacterial plasmids – Ti plasmid and viral vectors – cloning in plants.

**UNIT IV      GENOMIC AND cDNA LIBRARY      (9)**

Different strategies for in vitro and in vivo cloning – Preparation of rDNA, Preparation of cDNA and genomic DNA libraries – screening procedures – linkers, adapters, homopolymer tailing and TA cloning – gene transfer technologies – Mutagenesis – site directed mutagenesis – application.

## **UNIT V      APPLICATION OF GENE CLONING**

**(9)**

Fusion protein- down-stream processing of recombinant proteins Applications in medicine – Gene therapy- Diagnostics, pathogenesis, recombinant vaccines –humanized antibodies and their applications genetically modified food – bioremediation with recombinant micro organisms– forensic science – genetic diversity – Agriculture, crop improvement – production of biosensors, enzymes – safety guidelines in rDNA research – containment and disposal.

**Total Hours: 45**

## **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Jeremy W. Dale, Malcolm von Schantz, Nicholas Plant	From Genes to Genomes: Concepts and Applications of DNA Technology	Wiley- Blackwell	2011
2	Sandy B. Primrose and Richard Twyman	Principles of Gene Manipulation and Genomics	Wiley	2009
3	Michael R. Green and Joseph Sambrook	Molecular Cloning: A Laboratory Manual	Cold Spring Harbor Press	2012

## **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	T. A. Brown	Gene Cloning and DNA Analysis: An Introduction	Blackwell	2010
2	Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick	Lewin's GENES XI	Jones & Bartlett Learning	2012

**Course Objectives**

- To illustrate the scope and importance of crude drugs.
- To understand the basic ideas on cultivation and utilization of medicinal and aromatic plants.
- To list the various functions of plant tissue culture as a source.
- To label the basic theory of methods of drug evaluation.
- To develop a picture about applications of phytochemicals in industry and healthcare.
- To discuss the different stages of developments in using phytochemicals and medicinal plants.

**Course Outcomes**

1. Summarize about the importance of crude drugs in different medicinal system.
2. Determine the modern cultivation techniques through plants.
3. Express the functions of plant tissue culturing.
4. Be aware of the conceptualization behind various methods for drug evaluation.
5. Describe the various functions and application of phytochemicals in different industries.
6. Summarize and predict the different stages of developments in using phytochemicals and medicinal plants.

**UNIT I      CRUDE DRUGS      (9)**

Crude Drugs – Scope & Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection & processing of Crude Drugs. Indian System of medicine: Ayurveda, Siddha and Unani and its significance

**UNIT II      MEDICINAL & AROMATIC PLANTS      (9)**

Cultivation and Utilization of Medicinal & Aromatic Plants in India. Genetics as applied to Medicinal herbs. Modern Biotechnological tools and its influence in Medical and Aromatic plant cultivation.

**UNIT III      TISSUE CULTURE OF MEDICINAL PLANTS      (9)**

Plant Tissue Culture as source of medicines, Secondary metabolite production in plants; Plant Tissue Culture for enhancing secondary metabolite production (*Withania somnifera*, *Rauwolfia serpentina*, *Catharanthus roseus*, *Andrographis paniculata*, *Dioscorea* sp.); Anticancer, Antiinflammatory, Antidiabetic, Analgesic drugs, Biogenesis of Phytopharmaceuticals.

**UNIT IV      ANALYSIS OF PHYTOCHEMICALS      (9)**

Methods of Drug evaluation (Morphological, Microscopic, Physical & Chemical). Preliminary screening, Assay of Drugs – Biological evaluation / assays, Microbiological methods. Types of Phytochemicals: Glycosides - extraction methods (Aloe); Volatile Oils - extraction methods (Clove); Alkaloids - extraction methods (Cinchona); Flavonoids extraction methods, Resins- extraction methods; Lectins.

## **UNIT V      APPLICATIONS OF PHYTOCHEMICALS**

**(9)**

Application of phytochemicals in industry and healthcare; Biocides, Biofungicides, Biopesticides. Nutraceuticals and their significance.

**Total Hours: 45**

### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	C. K. Kokate, A. P. Purohit & S. B. Gokhale	Pharmacognosy	NiraliPrakashan	1996
2	Paul M. Dewick	Natural Products in medicine: A Biosynthetic approach	Wiley	2009

### REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Hornok, L.	Cultivation & Processing of Medicinal Plants	Wiley & Sons	1992
2	Trease & Evans	Pharmacognosy	Harcourt Brace & Company	1989

**Course Objectives**

- To illustrate the modification of biomolecules.
- To describe the chemical reactions of active biomolecules.
- To list the importance and uses of bioconjugate reagents.
- To infer the chemical modifications of enzymes and nucleic acids.
- To tell about the enzyme and nucleic acid conjugation
- To discuss the various applications of bioconjugation of molecules.

**Course Outcomes**

1. Tell about the modifications of common biomolecules.
2. Determine the basic chemical reactions for active groups.
3. Express the functions of bioconjugate reagents.
4. Summarize the steps for enzyme and nucleic acid modification.
5. Describe the protocol for enzyme and nucleic acid conjugation.
6. Summarize applications of bioconjugation.

**UNIT I FUNCTIONAL TARGETS****(9)**

Modification of Amino Acids, Peptides and Proteins Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

**UNIT II CHEMISTRY OF ACTIVE GROUPS****(9)**

Amine reactive chemical reactions–Thiol reactive chemical reactions–carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions–aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

**UNIT III BIOCONJUGATE REAGENTS****(9)**

Zero length crosslinkers – Homo bifunctional crosslinkers–Hetero bifunctional crosslinkers–Trifunctional crosslinkers – Cleavable reagent systems–tags and probes.

**UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION****(9)**

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes– chemical modification of nucleic acids – biotin labeling of DNA – enzyme conjugation to DNA – Fluorescence of DNA.

**UNIT V BIOCONJUGATE APPLICATIONS****(9)**

Preparation of Hapten - carrier Immunogen conjugates – antibody modification and conjugation – Immunotoxin conjugation techniques–liposome conjugation and derivatives-Colloidal–gold-labeled proteins–modification with synthetic polymers.

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	G.T.Hermanson	Bioconjugate Techniques	AcademicPress	2013

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	RavinNarain	Chemistry of Bioconjugates: Synthesis, Characterization, and Biomedical Applications	Wiley	2013

**Course Objectives**

- To explain basic knowledge on antigen structure and preparation.
- To discuss the structural and functional principles of antibodies and immunodiagnosis.
- To construct various parameters of B cells and T cells.
- To explain the effects of preparation and storage of tissues in immunopathology.
- To outline the basic concepts of preparations of vaccine in molecular immunology.
- To discuss the different techniques for antigen and antibody synthesis.

**Course Outcomes**

1. Summarize the characteristics of different methods of antigen production.
2. Evaluate the different structural and functional principles of antibodies and immunodiagnosis.
3. List the various parameters of B cells and T cells.
4. Explain the preparation and storage of antibodies and immunodiagnosis.
5. Recognize basic concepts of vaccine preparation in molecular immunology.
6. Identify and list different techniques for antigen and antibody synthesis.

**UNIT I ANTIGENS****(7)**

Types of antigens, their structure, preparation of antigens for raising antibodies, handling of animals, adjuvants and their mode of action.

**UNIT II ANTIBODIES & IMMUNODIAGNOSIS****(10)**

Monoclonal and polyclonal antibodies – their production and characterization, Western blot analysis, Immunoelectrophoresis, SDS-PAGE - purification and synthesis of antigens, ELISA – principle and applications, radioimmunoassay (RIA) - principles and applications, nonisotopic methods of detection of antigens-enhanced chemiluminescence assay.

**UNIT III ASSESSMENT OF CELL MEDIATED IMMUNITY****(10)**

Identification of lymphocytes and their subsets in blood. T cell activation parameters, estimation of cytokines, macrophage activation, macrophage microbicidal assays, in-vitro experimentation – application of the above technology to understand the pathogenesis of infectious diseases.

**UNIT IV IMMUNOPATHOLOGY****(9)**

Preparation and storage of tissues, identification of various cell types and antigens in tissues, isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells, immune cytochemistry – immunofluorescence, immune enzymatic and immunoferritin techniques, immunoelectron microscopy.

## **UNIT V      MOLECULAR IMMUNOLOGY**

**(9)**

Preparation of vaccines, application of recombinant DNA technology for the study of the immune system, production of anti idiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies and other immunological reagents, immuno therapy with genetically engineered antibodies – Tetramer, recombinant vaccines.

**Total Hours: 45**

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Talwar G.P., and Gupta S.K	A hand book of practical and clinical immunology (Vol 1&2)	CBS Publications	1992
2	WeirD.M	Practical Immunology	Blackwell Scientific Publications, Oxford	1990

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Austin J.M. and Wood K.J.	Principle of cellular and molecular immunology	Oxford university press	1993

**Course Objectives**

- To explain the various cell types and their advances in tissue engineering.
- To demonstrate the various biomaterials for tissue engineering.
- To explain and practice diverse concepts on tissue engineering and tissue creation.
- To discuss the techniques in tissue typing.
- To practice the basic views on gene therapy.
- To identify and organize differing views on advances on tissue engineering.

**Course outcomes**

1. Compose about basic concepts in tissue engineering
2. Assemble different biomaterials for tissue engineering
3. Classify about methods for Tissue Engineering.
4. List the techniques in tissue typing
5. Explain the principles of gene therapy
6. Summarize the concepts of tissue engineering in different fields.

**UNIT I      INTRODUCTION TO TISSUE ENGINEERING      (9)**

Cell therapies. Tissue Constructs, Organ Modules, Cosmetic Measures. Concepts of Tissue Creation: Sources, Stem Cells, Cells from Tissues, Culture Methods for Tissue Engineering. Maturation of Tissue Constructs. Musculo– skeletal tissue engineering; Modifications of tissue ring; Receptors ligand interaction; Receptor.

**UNIT II      BIOMATERIALS FOR TISSUE ENGINEERING      (9)**

Biomaterials: Degradable polymeric scaffolds, Acellular Bio- Matrices, Biological derived polymers in tissue engineering: Natural BD Polymers & Synthetic BD polymers, Cell seeding of scaffolds, Cell source: Allogenic cells, Autologous cells & stem cells. Bioreactors used in tissue engineering: Nail Naughton's Bioreactor, Pulsatile Bioreactor.

**UNIT III      BIOLOGICAL STUDY OF DIFFERENT CELL TYPES      (9)**

Cell line, Establishment of cell lines, Different cell types: Endothelial cell, Fibroblast cells, Epithelial cell, Myoblast cells, chromaffin cell, Smooth muscle cells & plasma cell.

**UNIT IV      PRINCIPLES AND PRACTICE GENE THERAPY      (9)**

Introduction to gene therapy, Requirements of gene therapy, Genetic defects, Target cells for gene therapy, process of gene therapy, Factors responsible for gene therapy for making effective treatment of genetic disease, Recent developments in gene therapy research, ethical considerations of gene therapy.

## **UNIT V        ADVANCES IN TISSUE ENGINEERING**

**(9)**

Development of artificial tissues; Transplantation biology: Tissue typing, Techniques of tissue typing, Minor histocompatibility antigens, Immuno-suppression, Side effects of immuno- suppression.

**Total Hours: 45**

### TEXT BOOKS

S. No.	Author (s) Name	Title of the book	Publisher	Year of Publication
1	Bhojwani, S. S. Razdan, M. K.	Plant Tissue Culture (Theory and Practice)	Elseveir	1996
2	Ranga , M. M	Animal Biotechnology	Agrobios	2010
3	Watson, J. D. and Gilman, M.	Recombinant DNA	Scientific American Books	1992

**Course Objectives**

- To understand the variations of stoichiometry and kinetics of biochemical operations.
- To classify the different activities of microbes in waste water treatment.
- To record the basic notion on design and evaluation of growth process.
- To differentiate and organize the distinct methods for modeling reactors..
- To explain the basic applications of bioreactors.
- To discuss the problems related to biochemical operations in different industries.

**Course Outcomes**

1. Compare and contrast fundamentals and properties of biochemical operations.
2. Demonstrate various waste water treatment activities through biological methods.
3. Prioritize design and evaluation of growth process in bioreactors.
4. Construct and design the methods for modeling bioreactors.
5. Apply the knowledge on applications of modeling bioreactors.
6. Examine and solve the problems related to biochemical operations in different industries.

**UNIT I      BIOCHEMICAL OPERATIONS      (8)**

Classification of Biochemical operations, fundamentals of biochemical operations, Stoichiometry and Kinetics of Biochemical Operations.

**UNIT II      REACTORS IN WASTE WATER TREATMENT      (10)**

Theory, modeling of ideal suspended Growth Reactors, Modeling Suspended Growth Systems. Aerobic Growth of Heterotrophs in a single Continuous Stirred Tank, Reactor Receiving Soluble Substrate, Multiple Microbial Activities in a Single Continuous Stirred Tank Reactor, Multiple Microbial Activities in Complex Systems, Techniques for Evaluating Kinetics and Stoichiometric parameters.

**UNIT III      PROCESSES IN WASTE WATER TREATMENT      (9)**

Applications: Suspended Growth Reactors, Design and Evaluation of Suspended Growth Processes, Activated Sludge, Biological Nutrient Removal, Aerobic – digestion, Anaerobic Processes, Lagoons.

**UNIT IV      MODELING OF REACTORS      (9)**

Theory: Modeling of Ideal Attached Growth Reactors, Bio- film Modeling. Aerobic Growth of Biomass in Packed Towers, Aerobic Growth of Heterotrophs in Rotating Disc Reactors, Fluidized Bed Biological Reactors.

**UNIT V      APPLICATIONS OF BIOREACTORS      (9)**

Attached Growth Reactors, Trickle Filter, Rotating Biological Contactor, Submerged Attached Growth Bioreactors, Future Challenges, Fate and Effects of Xenobiotic Organic Chemicals.

### **TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	M. Henze	Biological Wastewater Treatment: Principles, Modelling and Design	IWA Publishing	2008
2	Graty. C.P.L.Daigger, G and Lim, H.C	Biological Wastewater Treatment	Marcel Dekker	1998

### **REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Mizahi A	Biological Waste Treatment	John Wiley Sons Inc	1989

**Course Objectives**

- To understand the basic properties of biomaterials.
- To explain the biocompatibility of biomaterials.
- To discuss the properties of various implant materials.
- To infer the basic knowledge on various polymeric implant materials.
- To explain about the tissue replacement implants.
- To describe the functions and importance of artificial organs.

**Course Outcomes**

1. Summarize the basic properties of biomaterials.
2. Discuss the biocompatibility of biomaterials.
3. List the properties and importance of various implant materials.
4. Explain the properties and functions of polymeric implant materials.
5. Tell about the tissue replacement implants.
6. Describe the importance and functions of artificial organs.

**UNIT I      STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY      (9)**

Definition and classification of bio-materials, mechanical properties, visco elasticity, wound healing process, body response to implants, blood compatibility.

**UNIT II      IMPLANT MATERIALS      (9)**

Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite glass ceramics carbons, medical applications.

**UNIT III      POLYMERIC IMPLANT MATERIALS      (9)**

Polymerisation, polyolefin, polyamides, Acrylic, polymers, rubbers, high strength thermoplastics, medical applications.

**UNIT IV      TISSUE REPLACEMENT IMPLANTS      (9)**

Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.

**UNIT V      ARTIFICIAL ORGANS      (9)**

Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis, Dental Implants.

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Park J.B	Biomaterials Science and Engineering	Plenum Press	1984
2	Rater B.D	Biomaterials Sciences – An Introduction to Materials in Medicine	Academic Press	2004
3	Joon Bu Park, Joseph D. Bronzino	Biomaterials: principles and applications'	CRC press, USA	2003

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	TeohSweeHin, SweeHinTeoh	Engineering materials for biomedical applications	World Scientific Publishing Co, USA	2004
2	Sujata V. Bhat	Biomaterials	Narosa Publishing House, New Delhi	2002

**Course Objectives**

- To understand the basic concept on animal cell as bioreactors.
- To explain the gene expression and cell based expression.
- To describe the media preparation for animal cells to grow.
- To infer the basic knowledge on cellular metabolism for obtaining optimum yield.
- To explain the various downstream processing for cell culture production.
- To discuss the characterization techniques for the produced recombinant products.

**Course Outcomes**

1. Summarize the basic concepts on animal cell as bioreactor.
2. Discuss the gene expression and cell based expression.
3. Describe the generation of biomass as media source for cells to grow.
4. Explain the cellular metabolism for optimum yield.
5. Tell about the basic downstream process for purification.
6. Describe the characterization of produced recombinant products.

**UNIT I INTRODUCTION (9)**

Introducing animal cells as bioreactors-genetically engineered microbial system –limitations-Animal cell technology for Industrial products-

**UNIT II ENGINEERING OF CELLS (9)**

Engineering cells for maximum expression- transient expression system- stable expression system- dominant control regions- Factors governing heterologous gene expression- production of heterologous protein using lymphoid cell based expression system- improving translational efficiency

**UNIT III GENERATION OF BIOMASS (9)**

Generation of Biomass-media for animal cell culture- serum free media- medium design- Engineering a new medium-Fermentor design for animal cell culture-suspension cell culture- Immobilised cells

**UNIT IV CELLULAR METABOLISM AND OPTIMUM YIELD (9)**

Cellular metabolism for optimum yields-Effect of culture condition on protein glycosylation-culture parameters that affect yield

**UNIT V DOWNSTREAM PROCESSING (9)**

Downstream processing- production of effective and safe biopharmaceuticals-challenges in purification-Characterisation of recombinant protein production-regulatory aspects of using cells as bioreactors-viral contamination of animal cell derived pharmaceuticals and prevention

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	. R.IanFreshney	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications	Wiley- Blackwell	2010
2	Glyn Stacey, John Davis	Medicines from Animal Cell Culture	John Wiley & Sons, Ltd.	2007
3	Terence Cartwright	Animal cells as bioreactors	Cambridge  University Press.	2009

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Basant Kumar Sinha and RineshKumar	Principles of Animal cell culture	International book distributing Co.ltd.	2008.
2	Jeffrey W.Pollard and John M.Walker	Animal cell culture.	Springer- Verlag.	1990

**Course Objectives**

- To explain basic knowledge on nanotechnology.
- To demonstrate the structural and functional principles of bionanotechnology.
- To discuss various methods for microfluidic components.
- To explain the effects of various protein and DNA based nanostructures.
- To outline the basic concepts of nanoparticles in cancer therapy.
- To identify the different nanoparticles using different controlling measures.

**Course Outcomes**

1. Summarize the characteristics different nanoparticles.
2. Evaluate the different structural and functional principles of biotechnology.
3. Explain the microfluidic devices.
4. Discuss the protein and DNA based nanostructures.
5. Recognize cancer curing nanoparticles.
6. Identify and list different nanoparticles for different controlling measures.

**UNIT-I INTRODUCTION TO NANOTECHNOLOGY (9)**

Background and definition of nanotechnology, chemical bonds in nanotechnology – Scales at the bio-nano interface – Basic capabilities of nanobiotechnology and nanomedicine – Biological tradition and mechanical tradition biotechnology – Applications in biotechnology.

**UNIT-II STRUCTURAL AND FUNCTIONAL PRINCIPLES OF BIONANOTECHNOLOGY (9)**

Biomolecular structure and stability – Protein folding – Self-assembly – Self-organization –Molecular recognition – Flexibility – Information – Driven nanoassembly – Energetics –Chemical transformation – Regulation – Biomaterials – Biomolecular motors – Traffic across membranes – Biomolecular sensing – Self-replication – Machine-phase bionanotechnology.

**UNIT-III MICROFLUIDICS MEETS NANO (9)**

Concepts and advantages of microfluidic devices – Materials and methods for the manufacture of microfluidic component – Fluidic structures – Surface modifications – Lab-on-a-chip for biochemical analysis.

**UNIT-IV PROTEIN-BASED NANOSTRUCTURES (9)**

S-Layers – Engineered nanopores – Microbial nanoparticle production – Magnetosomes –Nanoscale magnetic iron minerals in bacteria – Nanoparticle – Biomaterial hybrid systems.

**UNIT-V                      DNA-BASED NANOSTRUCTURES**

**(9)**

DNA-Protein nanostructures – Biomimetic fabrication of DNA based metallic nanowires and networks –  
DNA-Gold nanoparticle conjugates – Nanoparticles as non-viral transfection agents.

**Total Hours: 45**

**TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Niemeyer, C.M. and Mirkin, C.A	Nanobiotechnology: Concepts, Applications and Perspectives	Wiley-VCH	2004
2	Goodsell, D.S.	Bionanotechnology	John Wiley and Sons, Inc	2004

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Shoseyov, O. and Levy, I	Nanobiotechnology: Bioinspired Devices and Materials of the Future	Humana Press	2007
2	Bhushan, B.	Springer Handbook of Nanotechnology	Springer-Verlag Berlin Heidelberg	2004
3	Freitas Jr R.A	Nanomedicine	Landes Biosciences	2004
4	Kohler, M. and Fritzsche, W.	Nanotechnology – An Introduction to Nanostructuring Techniques	Wiley-VCH	2004

**Course Objectives**

- To explain descriptive views of clinical practices and its scope.
- To illustrate Differentiating ethical theories and foundations of clinical trials.
- To discuss various evolution and regulation of clinical research.
- To evaluate various designing protocols and amendments of clinical research.
- To interpret different biostatistics and data management.
- To create data on different clinical research.

**Course Outcomes**

1. Elaborate the concept of scope and types of clinical research.
2. Evaluate the ethical theories of clinical research.
3. Discuss the history and regulation of clinical research.
4. Explain the various protocol developments in clinical research.
5. Identify basic views in different situations of biostatistics in clinical trials.
6. Make up perspective techniques and create data on different clinical research.

**UNIT I      INTRODUCTION TO CLINICAL RESEARCH      (9)**

Definition, Types and Scope of Clinical Research, Good Clinical Practices - Introduction to study designs and clinical trials - Careers in Clinical Research.

**UNIT II      ETHICS IN CLINICAL RESEARCH      (9)**

Ethical Theories and Foundations, Ethics Review Committee, Ethics and Historically derived principles - Nuremberg Code, Declaration of Helsinki, Belmont Report, Equipoise, Informed consent, Integrity & Misconduct.

**UNIT III      REGULATIONS IN CLINICAL RESEARCH      (9)**

Evolution and History of Regulations in Clinical Research, Patents US Regulatory Structure, IND, NDA, ANDA, Post Drug Approval Activities, PMS, FDA Audits and Inspections EU Regulatory Affairs, EMEA Organization and Function, INDIAN Regulatory system, Schedule Y- Rules and Regulations, Description of trial phases (Phase 0, Phase I, II, III, and IV), Trial contexts (types of trials: pharma, devices, etc.), Trial examples

## UNIT IV CLINICAL RESEARCH METHODOLOGY AND MANAGEMENT (9)

Designing of Protocol, CRF, e-CRF, IB, ICF, SOP ; Study Protocol -Introduction, background, Objectives - Eligibility, Design, Randomization - Intervention details, assessments and data collection, case report forms –Violations -. Amendments. Study/ Trial Design- Phase I designs - Dose-finding designs. Phase II designs - Pilot studies, Single arm, Historical control designs. Phase III designs - Factorial designs, Crossover designs, Multicenter studies, Pilot studies. Phase IV designs- Preparation of a successful clinical study, Study management, Project management Documentation, Monitoring, Audits and Inspections, Pharmacovigilance training in clinical research budgeting in clinical research, Supplies and vendor management.

## UNIT V BIostatistics AND DATA MANAGEMENT (9)

Introduction to Power and Sample Size- Hypothesis testing, P-values, confidence intervals, General power/sample size, estimating effect size, Matching sample size calculations to endpoints. Importance of statistics in clinical research Statistical considerations at the design, analysis and reporting stage Data management - Data collection, Paper or electronic, Parsimony, Data validation, SAE reconciliation, query management Software considerations. Data Monitoring, Trial Conduct - Data quality assurance, Data delinquency, Data Monitoring, d. Trial Conduct, Occurrence and control of variation and bias.

**Total Hours: 45**

### TEXT BOOKS

S. No.	Author (s) Name	Title of the book	Publisher	Year of Publication
1	Friedman,L. M., Furberg, C. and DeMets, D.	Fundamentals of Clinical Trials (4th Edition)”	Springer	2010
2	Machin, D. and Fayers, P	Randomized Clinical Trials: Design, Practice and Reporting	Wiley-Blackwell	2010
3	Piantadosi, S.	Clinical Trials: A Methodologic Perspective	John Wiley & Sons	2005

**Course Objectives**

- To explain descriptive properties of seawater.
- To illustrate differentiating marine organisms and their industrial applications.
- To discriminate various pollution controlling marine organisms.
- To evaluate various marine toxins used in pharmaceutical industries.
- To interpret recombinations in marine aquaculture.
- To understand the usage of marine organism for different situations.

**Course Outcomes**

1. Discuss the basic knowledge on biogeochemical cycles.
2. Organize and manage marine organism in different industries.
3. Organize and manage pollution controlling measures through marine organisms.
4. Perceive the basics on combining marine toxins in pharma industries.
5. Compile different proteins of marine organism to develop a new variety.
6. Explain how to use marine organism for different situations.

**UNIT I      INTRODUCTION TO MARINE ENVIRONMENT      (9)**

World oceans and seas – ocean currents – physical and chemical properties of sea water – abiotic and biotic factors of the sea – ecological divisions of the sea – history of marine biology – biogeochemical cycles – food chain and food web.

**UNIT II      MARINE ORGANISMS AND THEIR INDUSTRIAL APPLICATIONS      (9)**

Phytoplanktons – zooplanktons – nektons – benthos – marine mammals – marine algae – mangroves – coral reefs – algal products, fuels from algae, algal cell culture

**UNIT III      MARINE ENVIRONMENTAL BIOTECHNOLOGY      (9)**

Marine pollution – biological indicators (marine micro , algae) – biodegradation & bioremediation – marine fouling and corrosion.

**UNIT IV      MARINE PHARMACOLOGY      (9)**

Medicinal compounds from marine flora and fauna – marine toxins , anti cancer agents, antiviral and antimicrobial agents. Marine Toxins

**UNIT V      AQUACULTURE TECHNOLOGY      (9)**

Importance of coastal aquaculture – marine fishery resources – common fishing crafts and gears – Aqua farm design and construction, transgenic fish.

**Total Hours: 45**

## TEXT BOOKS

S. No.	Author (s) Name	Title of the book	Publisher	Year of Publication
1	M.Fingerman , R . Nagabhushanam	Recent advances in marine biotechnology volume 3	Mary Frances Thomson	1999
2	M.Fingerman , R . Nagabhushanam	Recent advances in marine biotechnology volume 2	Science publishers	1999
3	E. W. Becker	Microalgae: Biotechnology and Microbiology	Cambridge University Press	1994
	Jasper S. Lee, Michael E. Newman	Aquaculture: An Introduction	Interstate Publishers, Incorporated	1992

## Course Objectives

- To explain basic theory and needs for forensic activities.
- To illustrate different procedures and necessity for forensic criminalistics.
- To discriminate various evidences for analyzing the biological samples.
- To evaluate various forensic samples using different assays.
- To interpret the functions of digital imaging in forensic.
- To understand the forensic ethics.

## Course Outcomes

1. Discuss the basic knowledge on forensic activities.
2. Analyze the forensic criminalities.
3. Describe the analysis for the evidences of forensic samples.
4. Perceive the procedure for forensic sample analyzing using different assays.
5. Compile different properties and functions of digital imaging in forensic.
6. Explain the forensic ethics.

## UNIT I INTRODUCTION (9)

Introduction, definition and scope, History and Development of Forensic science, basic Principles of Forensic Science. Organization of crime Laboratory services, services provided by full service crime laboratories, Physical Science unit, Biological Unit, Firearms Unit, Documentation Examination Unit-Function and Duties Performed by each unit and lab.

## UNIT II FORENSIC CRIMINALISTICS (9)

Forensic Criminalistics in forensic science, The Crime Scene investigation Making and recording observations (including sketches with measurements and digital photographs), Chain of Custody, Locard Exchange principle, Evidences and Collection techniques, Firearms, Trace evidence and contact evidence- targeting potential traces, recovery of trace material assessment of significance- Hair, fiber and Paint. Marks and impressions, Drug of abuse. Ploygraphy.

## UNIT III FORENSIC BIOLOGY (9)

Forensic Pathology: Rigor mortis, Lovor mortis, Algor mortis. Forensic Anthropology, Forensic Toxicology- Alcohol & it relationship to human anatomy & metabolism, Testing for drugs and poisons using pH. TLC, immunoassay, & chemical tests, Forensic Entomology, Forensic Psychiatry, Forensic Odontology, Forensics Engineering, forensic serology, Wild Life forensic, DNA Analysis, Dactyloscopy, Finger prints: history, fundamental principle of Fingerprints, Classification and patterns, AFIS, Mrthod of Detecting fingerprint.

#### UNIT IV FORENSIC DIGITAL IMAGING

(9)

Introduction, Digital cameras and forensic imaging, image acquisition technique. Methods and applications, Authenticity, image processing. Technical investigation on image storage media. Digital image processing- sharpening, contrast, blur smoothing, digital videos and scanners, presenting pictures in courtroom, internet crime. Forgery and steganography, Voice analysis. Detecting compression and forgeries and Maintaining Records, Hand Writing analysis. Computerized facial reconstruction.

#### UNIT V FORENSIC ETHICS

(9)

Introduction and importance of Professional ethics in Forensic Science, organizational forensic Science ethics, Code of ethics in Forensic Science Practice. Standard for Good Forensic practice. Ethical problems in ethical forensic sciences. Ethical Dilemmas

**Total Hours: 45**

#### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Jay Siegal, Geoffrey Knuper, Pekku Saukko	Encyclopedia of Forensic Sciences, Three-volume SET1- 3	Elsevier book publication	2000
2	Max M. Houck	Forensic Science: Modern methods of solving problems	Praeger West Port London	2007
3	Ayn Embarras, Seddon, Allan D. Pals	Forensic Science	Salem Press, Inc. Pasadena, California	2009
4	Jami J. St Clair	Crime Laboratory Management	Academic Press	2002

#### REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Richard Saperstein	Criminalistics: An Introduction to Forensic Science	Prentice Hall	2001
2	David Ellen	The Scientific Examination of Documents Methods and Techniques	Taylor and Francis	2003

**Course Objectives**

- To explain cell disruption techniques.
- To illustrate different chromatographic methods for separation of active components.
- To discriminate separation techniques for analyzing the biological samples.
- To discuss the importance of separation of biomolecules from a mixture..
- To describe the isolation, purification and behavior of biomolecules.
- To understand the basic downstream process for treating the samples.

**Course Outcomes**

1. Discuss the basic knowledge on forensic activities.
2. Analyze the forensic criminalities.
3. Describe the analysis for the evidences of forensic samples.
4. Perceive the procedure for forensic sample analyzing using different assays.
5. Compile different properties and functions of digital imaging in forensic.
6. Explain the forensic ethics.

**UNIT I CELL DISRUPTION (9)**

Mechanical and enzymatic methods of cell disruption, importance of cell disruption in product release, homogenization, ultrasonication, extraction, absorption, adsorption.

**UNIT II CHROMATOGRAPHIC METHODS (9)**

Chromatographic methods, paper chromatography, thin layer chromatography, gas chromatography, GLC, HPLC, affinity chromatography, ion exchange chromatography, reverse phase chromatography

**UNIT III SEPARATION TECHNIQUES (9)**

Basic separation techniques: sedimentation, centrifugation, ultra centrifugation, gradient centrifugation, filtration, micro/ ultra filtration, use of membranes (semi permeable) in purification, reverse osmosis. Separation of bioconversion products/ secondary metabolites e.g. Steroids and antibiotics.

**UNIT IV PHYSICO-CHEMICAL SEPARATION (9)**

Importance of separation techniques in biotechnology, its scope from research to industry, chemical, physical and biochemical aspects of separation and isolation, purification of biomolecules. Behavior of biomolecules in body fluids

**UNIT V DOWNSTREAM PROCESSES (9)**

Leaching, crystallization, lyophilization, drying. Chemistry of extraction, selection of solvent, use of solvent extraction in antibiotic separation, affinity extraction/ chromatography. Industrial applications with examples.

**TEXTBOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	P.A. Belter, E.L. Cussler And Wei-Houhu	Bioseparations – Downstream Processing For Biotechnology	Wiley Interscience Pub	1988
2	R.O. Jenkins, (Ed.)	Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series	Butterworth-Heinemann	1992

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	R.K. Scopes	Protein Purification – Principles And Practice	Narosa Pub	1994
2	Roger.G . Harrison , Paul Todd , Scott R.Rudge and DemetriP.Petrides	Bioseparation Science and Engineering	Oxford University Press	2003

## **OPEN ELECTIVES**

## **OPEN ELECTIVES OFFERED BY BIOTECHNOLOGY**

**Course Objectives:**

- To impart basic knowledge in bioprocess Engineering
- To design the bioreactors for various operations.
- To understand the principle and working of heat transfer equipments.
- To extend the knowledge in principle of heat transfer inside a bioreactor
- To construct the equipments used in mass transfer operations.
- To learn the equipments used in separation process.

**Course Outcomes:**

- Summarize the basic concepts in bioprocess Engineering.
- Design the bioreactors for various operations.
- Develop the heat transfer equipments for Bioprocess Engineering.
- Elaborate the principle of heat transfer in bioreactor.
- Construct the equipments used in mass transfer operations.
- Categorize the equipments used in separation process.

**UNIT I      ENGINEERING PROPERTIES AND STORAGE TANK      (9)**

Introduction to various mechanical properties of material to be used material of construction, design of cylindrical storage tank.

**UNIT II      REACTOR DESIGN      (9)**

Design of Airlift fermentor, Bubble column reactor and Continuous stirred tank reactor.

**UNIT III      HEAT TRANSFER EQUIPMENTS**

(9) Design of Shell and tube Heat exchanger, Double pipe heat exchanger, long tube vertical evaporator and forced circulation evaporator.

**UNIT IV      MASS TRANSFER EQUIPMENTS      (9)**

Design of Bollmann extractor, fractionating column, packed tower and spray tray absorber

**UNIT V      SEPERATION EQUIPMENTS**

(9) Design of plate and frame filter press, leaf filter, rotary drum filter, disc bowl centrifuge, rotart drum drier and Swenson –walker crystallizer.

**TEXT BOOKS:**

S.No	Author(s) Name	Title of the book	Publisher	Year of Publications
1	James Edwin Bailey, David F. Ollis	Biochemical Engineering Fundamentals	McGraw-Hill	2007
2	Don W. Green, Robert H. Perry	Chemical Engineer Hand book	The McGraw- Hill	2008
			Companies, Inc.	

**REFERENCE BOOKS**

S.No	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Pauline. M. Doran	Bioprocess Engineering Principles	Academic Press	2013

**Course Objectives**

- To learn the scope and importance of food processing.
- To impart basic knowledge in different food processing methods carried out in the food tech companies.
- To extend the brief knowledge in food conservation operations.
- To study the methods of food preservation by cooling.
- To familiarize the students on the concepts of preservation methods for fruits.
- To create deeper understanding on preservation methods for vegetables.

**Course Outcomes**

- Describe the scope and importance of food processing.
- Outline the various processing methods for foods.
- Extend the knowledge in food conservation operations.
- Describe the methods of food preservation by cooling.
- Summarize the preservation methods for fruits.
- Demonstrate the preservation methods for vegetables.

**UNIT I SCOPE AND IMPORTANCE OF FOOD PROCESSING (9)**

Properties of food- Physical, thermal, mechanical, sensory. Raw material Preparation - Cleaning, sorting, grading, peeling.

**UNIT II PROCESSING METHODS (9)**

Heating- Blanching and Pasteurization. Freezing- Dehydration- canning- additives- fermentation- extrusion cooking- hydrostatic pressure cooking- dielectric heating- micro wave processing and aseptic processing – Infra red radiation processing- Concepts and equipment used.

**UNIT III FOOD CONVERSION OPERATIONS (9)**

Size reduction- Fibrous foods, dry foods and liquid foods- Theory and equipments- membrane separation- filtration- equipment and application.

**UNIT IV FOOD PRESERVATION BY COOLING (9)**

Refrigeration, Freezing-Theory, freezing time calculation, methods of freezing, freezing equipments, freeze drying, freeze concentration, thawing, effect of low temperature on food. Water activity, methods to control water activity.

## **UNIT V      PRESERVATION METHODS FOR FRUITS AND VEGETABLES (9)**

Pre processing operations - preservation by reduction of water content: drying / dehydration and concentration – chemical preservation – preservation of vegetables by acidification, preservation with sugar - Heat preservation– Food irradiation- Combined preservation techniques.

## TEXT BOOKS

S.No	Author(s) Name	Title of the book	Publisher	Year of Publications
1	R. Paul Singh, Dennis R. Heldman	Introduction to food engineering.	Academic Press	2001
2	P.Fellows.	Food Processing Technology, Principles and practice.	Wood head Publishing Ltd	2000
3	Mircea Enachescu Dauthy	Fruit and Vegetable Processing	FAO agricultural services bulletin	1995

## REFERENCE BOOKS

S.No	Author(s) Name	Title of the book	Publisher	Year of Publications
1	M.A. Rao, Syed S.H. Rizvi, Ashim K. Datta	Engineering properties of foods	CRC Press	2005
2	B. Sivasankar	Food processing and preservation	PHI Learning Pvt. Ltd	2002

**Course Objectives**

- To learn the scope and importance of Molecular modeling.
- To impart basic knowledge in quantum mechanics.
- To familiarize the students on the concepts of molecular mechanics.
- To extend the brief knowledge in molecular dynamics simulation.
- To study the drug design by using modeling tools.
- To understand molecular docking and ligand based drug design methods

**Course Outcomes**

- Summarize the importance of Molecular modeling.
- Extend the knowledge in quantum mechanics
- Analyze the general features of molecular mechanics.
- Illustrate the molecular dynamics by using simple models.
- Outline the drug design by using modeling tools.
- Describe the molecular docking and ligand based drug design methods

**UNIT-I      MOLECULAR MODELLING      (9)**

Introduction to concept of molecular modeling, molecular structure and internal energy, applications of molecular graphics, coordinate systems, potential energy surfaces, discussion of local and global energy minima

**UNIT-II      QUANTUM MECHANICS      (9)**

Introduction to the computational quantum mechanics; one electron atom, many electronic atoms and molecules, Hartree Fock equations; calculating molecular properties using ab initio and semi empirical methods.

**UNIT-III      MOLECULAR MECHANICS      (9)**

Molecular mechanics; general features of molecular mechanics force field, bond stretching, angle bending, torsional terms, non – bonded interactions; force field parameterization and transferability; energy minimization; derivative and non – derivative methods, applications of energy minimization.

**UNIT-IV      MOLECULAR DYNAMICS      (9)**

Molecular dynamics simulation methods; molecular dynamics using simple models, molecular dynamics with continuous potential, setting up and running a molecular dynamic simulation, constraint dynamics; Monte Carlo simulation; Monte Carlo simulation of molecules.

## **UNIT-V     MODELLING AND DRUG DESIGN**

**(9)**

Macromolecular modeling, design of ligands for known macro molecular target sites, Drug- receptor interaction, classical SAR /QSAR studies and their implications to the 3 D modeler, 2-D and 3-D database searching, pharmacophore identification and novel drug design, molecular docking, Structure-based drug design for all classes of targets.

### TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Andrew Leach	Molecular Modelling: Principles and Applications	Prentice Hall	2001
2	N. Claude Cohen	Guidebook on Molecular Modeling in Drug Design	Academic Press	1996

### REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Yvonne C. Martin, editor, Peter Willett	Designing bioactive molecules : three- dimension techniques and applications	Washington, DC : American Chemical Society	1998
2	Matthew F. Schlecht	Molecular Modeling on the PC	Wiley- Blackwell; H	1998

**Course Objectives**

- To impart basic knowledge in Bioremediation.
- To study the different bio filters and bio film processes.
- To understand the concept of bioremediation for soil environment.
- To extend the knowledge in filtration processes of bioremediation.
- To learn about the bioremediation of metals.
- To apply the concept of bioremediation to reduce pollution.

**Course Outcomes:**

- Summarize the basic concepts in Bioremediation.
- Design the bio filters and bio film processes.
- Elaborate the concept of bioremediation for soil environment.
- Construct the filtration processes of bioremediation.
- Describe the bioremediation of metals.
- Outline the concept of bioremediation to reduce pollution.

**UNIT-I OVERVIEW OF BIOREMEDIATION (9)**

Pollution: Types and its consequences, History of bioremediation, Sources of contamination, Bioremediation processes, Environments where bioremediation is used, Microbiology of bioremediation.

**UNIT-II BIOFILM PROCESSES (9)**

Trickling Filters and Biological Towers, Rotating Biological Contactors, Granular Media Filters, Fluidized-bed Reactors, Hybrid Biofilm Processes

**UNIT-III BIOREMEDIATION FOR SOIL ENVIRONMENT (9)**

Environment of Soil Microorganisms, Soil Organic Matter and Characteristics, Soil Microorganisms Association with Plants, Pesticides and Microorganisms, Petroleum Hydrocarbons and Microorganisms, Industrial solvents and Microorganism, Biotechnologies for Ex-Situ Remediation & in-Situ Remediation of Soil Phytoremediation Technology for Soil Decontamination

**UNIT-IV BIOREMEDIATION FOR AIR AND WATER ENVIRONMEN (9)**

Atmospheric Environment for Microorganisms, Microbial Degradation of Contaminants in Gas Phase, Biological Filtration Processes for Decontamination of Air Stream- Biofiltration, Biotrickling Filtration, Bioscrubbers, Contaminants in Groundwater, Landfill Leachate Biotreatment Technologies, Industrial Wastewater Biotreatment Technologies, Biotreatment of Surface Waters

## **UNIT-V        BIOREMEDIATION OF METALS**

**(9)**

Microbial Transformation of Metals, Biological Treatment Technologies for Metals Remediation, Bioleaching        and        Biobenificiation,        Bioaccumulation, Oxidation/Reduction Processes, Biological Methylation

## TEXT BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Rittmann, B.E., and McCarty, P.L.,	Environmental Biotechnology : Principles and Applications.	McGraw Hill,	2001
2	John Cookson	Bioremediation Engineering: Design and Applications	McGraw- Hill Education	1995

## REFERENCE BOOKS

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Prescott, L. M., Harley, and Klein, D. A	Microbiology	McGraw- Hill Higher Education	2008

**Course Objectives**

- To learn the molecular structure of biological systems.
- To impart basic knowledge in conformation of nucleic acids.
- To familiarize the students on the concepts of conformation of proteins.
- To extend the brief knowledge in kinetics of ligand interactions.
- To understand the techniques for the study of biological structure & function.
- To study the transport and dynamics properties of biological systems.

**Course Outcomes**

- Summarize the importance of molecular structure of biological systems.
- Extend the knowledge in conformation of nucleic acids.
- Analyze the concepts of conformation of proteins.
- Illustrate the kinetics of ligand interactions.
- Outline the techniques for the study of biological structure & function.
- Describe the transport and dynamics properties of biological systems.

**UNIT I      MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS      (9)**

Intramolecular bonds – covalent – ionic and hydrogen bonds – biological structures -general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

**UNIT II      CONFORMATION OF NUCLEIC ACIDS      (9)**

Primary structure – the bases – sugars and the phosphodiester bonds- double helical structure – A, B and Z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids.

**UNIT III      CONFORMATION OF PROTEINS      (9)**

Conformation of the peptide bond – secondary structures – ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index.

**UNIT IV      ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS      (9)**

Kinetics of ligand interactions; Biochemical kinetics studies, uni-molecular reactions, simple bi molecular multiple intermediates, steady state kinetics, catalytic efficiency, relaxation spectrometry, ribonuclease as an example.

**UNIT V      APPLIED TECHNIQUES      (9)**

Techniques for the study of biological structure & function: Size and shape of macromolecules – methods of direct visualization macromolecules as hydrodynamic particles – macromolecules diffusion – ultra centrifugation – viscometry x-ray crystallography determination of molecular structures, X-ray fibre diffraction electron microscopy neutron scattering – light scattering.

**TEXT BOOKS:**

S.No	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Roland Glaser	Biophysics	Springer Science & Business Media	2001
2	Michel Daune	Molecular Biophysics: Structures in Motion	Oxford University Press	1999
3	Charles R. Cantor	Biophysical Chemistry, Part 2: Techniques for the Study of Biological Structure and Function	W. H. Freeman and Company	1980

**Course Objectives**

- To understand the available tools and databases for performing research in bioinformatics.
- To expose students to sequence alignment tool in bioinformatics.
- To construct the phylogenetic trees for evolution.
- To get familiar with the 3D structure of protein and classification.
- To acquire basic knowledge in protein secondary structure prediction.
- To extend the brief knowledge in Micro array data analysis.

**Course Outcomes**

- Summarize the basic concepts and importance of Bioinformatics in various sectors.
- Demonstrate the sequence alignment tool in bioinformatics.
- Construct the phylogenetic trees for evolution.
- Analyze the three dimensional protein structure and classification using various tools.
- Illustrate the protein secondary structure prediction by comparative modeling.
- Extend the knowledge in micro array technology and applications of bioinformatics in various sectors.

**UNIT I OVERVIEW OF BIOINFORMATICS****(9)**

The scope of bioinformatics; bioinformatics & the internet; useful bioinformatics sites. Data acquisition: sequencing DNA, RNA & proteins; determination of protein structure; gene & protein expression data; protein interaction data. Databases – contents, structure & annotation: file formats; annotated sequence databases; miscellaneous databases.

**UNIT II RETRIEVAL OF BIOLOGICAL DATA****(9)**

Data retrieval with Entrez & DBGET/ LinkDB; data retrieval with SRS (sequence retrieval system). Searching sequence databases by sequence similarity criteria: sequence similarity searches; amino acid substitution matrices; database searches, FASTA & BLAST; sequence filters; iterative database searches & PSI-BLAST. Multiple-sequence alignment, gene & protein families: multiple-sequence alignment & family relationships; protein families & pattern databases; protein domain families.

**UNIT III PHYLOGENETICS****(9) Phylogenetics,**

cladistics & ontology; building phylogenetic trees; evolution of macromolecular sequences. Sequence annotation: principles of genome annotation; annotation tools & resources.

**UNIT IV STRUCTURAL BIOINFORMATICS****(9)** Conceptual

models of protein structure; the relationship of protein three-dimensional structure to protein function; the evolution of protein structure & function; obtaining, viewing & analyzing structural data; structural alignment; classification of proteins of known three-dimensional structure: CATH & SCOP; introduction to protein structure prediction; structure prediction by comparative modeling; secondary structure prediction; advanced protein structure prediction & prediction strategies.

**UNIT V MICROARRAY DATA ANALYSIS****(9)**

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling & SAGE. Bioinformatics in pharmaceutical industry: informatics & drug discovery; pharmainformatics resources. Basic principles of computing in bioinformatics: running computer software; computer operating systems; software downloading & installation; database management.

**TEXTBOOK**

S. No.	Author (s) Name	Title of the book	Publisher	Year of Publication
1	Dan E. Krane, Michael L. Rayne	Fundamental Concepts of Bioinformatics	Pearson education	2004
2	Andreas D. Baxevanis, B. F. Francis Ouellette	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins	Wiley-Interscience	2004
3	David W. Mount	Sequence and Genome Analysis	Cold Spring Harbor Laboratory	2004
4	Jonathan Pevsner	Bioinformatics and Functional Genomics	Wiley-Liss	2003

**REFERENCE BOOKS**

S. No.	Author (s) Name	Title of the book	Publisher	Year of Publication
1	Michael J. Korenberg	Microarray Data Analysis: Methods and Applications	Springer Science & Business Media	2007

**Course Objectives**

- To impart the skills in the field of nano biotechnology and its applications.
- To acquire knowledge in the nano particles and its significance in various fields.
- To extend the knowledge in types and application of nano particles in sensors.
- To equip students with clinical applications of nano devices.
- To understand the ethical issues in nanotechnology.
- To describe deeper understanding of the socio-economic issues in nanobiotechnology.

**Course Outcomes**

- Develop skills in the field of nano biotechnology and its applications.
- Summarize the nanoparticles and its significance in various fields.
- Extend the knowledge in types and application of nano particles in sensors.
- Summarize the ethical issues in nanotechnology.
- Outline the clinical applications of nano devices.
- Describe the socio-economic issues in nanobiotechnology.

**UNIT I INTRODUCTION****(9)**

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Nanotechnology in Different, Fields: Nanobiotechnology, Materials, Medicine, Dental care.

**UNIT II NANO PARTICLES****(9)**

Introduction, Types of Nanoparticles, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrications- MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

**UNIT III APPLICATIONS****(9)**

Nanomedicine, Nanobiocensor and Nanofluidics. Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems. Nano-Biodevices and Systems. Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for in vivo drug delivery- Future nanomachine.

**UNIT IV    NANOBIOTECHNOLOGY****(9)**

Clinical applications of nanodevices. Artificial neurons. Real-time nanosensors- Applications in cancer biology. Nanomedicine. Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nanocarbon tubules. Nanosurgical devices.

**UNIT V    ETHICAL ISSUES IN NANOTECHNOLOGY****(9)**

Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Nanomedicine Applied in Nonmedical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economic challenges.

**TEXT BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Niemeyer, C.M. and Mirkin, C.A	Nanobiotechnology: Concepts, Applications and Perspectives	Wiley- VCH	2004
2	Goodsell, D.S.	Bionanotechnology	John Wiley and Sons, Inc	2004

**REFERENCE BOOKS**

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publications
1	Shoseyov, O. and Levy, I	Nanobiotechnology: Bioinspired Devices and Materials of the Future	Humana Press	2007
2	Bhushan, B.	Springer Handbook of Nanotechnology	Springer- Verlag Berli Heidelberg	2004
3	Freitas Jr R.A	Nanomedicine	Landes Biosciences	2004
4	Kohler, M. and Fritzsche, W.	Nanotechnology – An Introduction to Nanostructuring Techniques	Wiley- VCH	2004

**OPEN ELECTIVES OFFERED BY SCIENCE &  
HUMANITIES**

**OBJECTIVES:**

- To develop analytical skills for solving engineering problems
- To teach the students the basic concepts of LPP,
- To learn the techniques to solve transportation and Assignment problems
- To make the students to study about the Integer Programming and Network Analysis
- To Analyse the results and propose recommendations to the decision-making processes in Management Engineering
- To acquaint the student to solve problems in different environments and develop critical thinking

**INTENDED OUTCOMES:**

- To define and formulate linear programming problems and appreciate their limitations.
- To solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
- To be able to build and solve Transportation Models, Assignment Models,
- To construct linear integer programming models and discuss the solution techniques.
- To formulate and solve problems as networks and graphs.
- To be able to solve problems in different environments and develop critical thinking

**UNIT I LINEAR PROGRAMMING PROBLEM**

Formulation of LPP - Graphical Method - Simplex Method - Artificial variable technique and two phase simplex method. Duality - Dual and simplex method - Dual Simplex Method .

**UNIT II TRANSPORTATION PROBLEM**

Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

**UNIT III ASSIGNMENT PROBLEM**

Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

**UNIT IV INTEGER PROGRAMMING**

Integer Programming Problem – Gomory's fractional cut Method – Branch Bound Method

## UNIT V NETWORK ANALYSIS

PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis.

### TEXT BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Hamdy Taha. A.	Operations Research	Prentice – Hall of India Private Limited, New Delhi .	2010
2	Kanti Swarup, Manmohan, Gupta	Operations Research	Sultan Chand & Sons	2008

### REFERENCES:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Natarajan A.M., Balasubramani P.,	Operations Research	Pearson Education,	2003
2	Srinivasan G	Operations Research	Eastern Economy Edition	2007
3	Winston	Operations Research,	Cengage Learning	2004

### WEBSITES:

1. <a href="http://www.mathcentre.ac.uk">www.mathcentre.ac.uk</a>
2. <a href="http://www.mathworld">www.mathworld</a> . Wolfram.com
3. <a href="http://www.mit.edu">www.mit.edu</a>

**OBJECTIVES:**

- To kindle analytical skills for solving engineering problems
- To impact the knowledge about inventory models
- To learn replacement models and simulation models
- To provide techniques for effective methods to solve nonlinear programming and decision making.
- To analyse the results and propose recommendations to the decision-making processes in Management Engineering
- To enhance the students to solve problems using non integer programming.

**INTENDED OUTCOMES:**

The students will

- To be able to solve simple models in Inventory problems and Replacement problems.
- To understand different queuing situations and find the optimal solutions using models for different situations.
- Simulate different real life probabilistic situations using Monte Carlo simulation technique.
- To be able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
- **Convert** and **solve** the practical situations into replacement models.
- To understand how to model and solve problems using non integer programming.

**UNIT – I INVENTORY MODELS**

Economic order quantity models-techniques in inventory management-ABC analysis.

**UNIT – II NON LINEAR PROGRAMMING**

Khun-tucker conditions with non-negative constraints- Quadratic programming- Wolf's modified simplex method.

**UNIT – III SIMULATION MODELS**

Elements of simulation model -Monte Carlo technique – applications. Queuing model: problems involving  $(M/M/1): (\infty/FIFO)$  ,  $(M/M/c): (\infty/FIFO)$  Models.

**UNIT -IV DECISION MODELS**

Decision Analysis – Decision Making environment – Decisions under uncertainty – Decision under risk – Decision – Tree Analysis.

## UNIT -V REPLACEMENT MODELS

Models based on models that gradually deteriorate with time-whose maintenance cost increase with time-Replacement of items that fail suddenly and completely.

### TEXT BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Hamdy Taha. A.	Operations Research	Prentice – Hall of India Private Limited, New Delhi .	2010
2	Kanti Swarup, Manmohan, Gupta	Operations Research	Sultan Chand & Sons	2008

### REFERENCES:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Natarajan A.M., Balasubramani P., Thamilarasi A	Operations Research	Pearson Education,	2003
2	Srinivasan G	Operations Research	Eastern Economy Edition	2007
3	Winston	Operations Research, Applications and Algorithms	Cengage Learning	2004

### WEBSITES:

1. <a href="http://www.mathcentre.ac.uk">www.mathcentre.ac.uk</a>
2. <a href="http://www.mathworld">www.mathworld</a> . Wolfram.com
3. <a href="http://www.mit.edu">www.mit.edu</a>

**OBJECTIVES:**

- To gain knowledge in measures of central tendency.
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.
- To acquire the knowledge on random process in engineering disciplines.

**OUTCOMES:**

- Learners acquire skills in handling situations involving more than one random variable and functions of random variables.
- The students will have an exposure of various distribution functions, correlation and spectral densities.
- To understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- To understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- To apply the concept random processes in engineering disciplines.
- To understand and apply the concept of correlation and spectral densities.

**UNIT-I MEASURES OF CENTRAL TENDENCY AND PROBABILITY**

Measures of central tendency – Mean, Median, Mode - Standard Deviation

Probability - Random variable - Axioms of probability - Conditional probability - Total probability – Baye's theorem.

**UNIT- II STANDARD DISTRIBUTIONS**

Functions of a random variable - Binomial, Poisson, Uniform, Exponential,

Gamma(one Parameter only) and Normal distributions - Moment generating functions,

Characteristic function and their properties – Chebyshev's inequality.

### **UNIT -III      TWO DIMENSIONAL RANDOM VARIABLES**

Joint distributions - Marginal and conditional distributions - Probability mass function - Probability density functions – Covariance - Correlation and regression

### **UNIT- IV      CLASSIFICATION OF RANDOM PROCESS**

Definition and examples - first order, second order, strictly stationary, wide – sense stationary and Ergodic processes - Markov process - Binomial, Poisson and Normal processes - Sine wave process.

### **UNIT -V      CORRELATION AND SPECTRAL DENSITIES**

Auto correlation - Cross correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function - Linear time invariant system - System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

**TEXT BOOK:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Peebles Jr, P.Z	Probability Random Variables and Random Signal Principles	Tata McGraw-Hill Publishers, New Delhi.	2002

**REFERENCES:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Henry Stark and John W. Woods	Probability and Random Processes with Applications to Signal Processing	Pearson Education, Third edition, Delhi	2002
2	Ochi, M.K	Applied Probability and Stochastic Process	John Wiley & Sons, New York	1990
3	Ross, S	A first Course in Probability	Pearson Education, New Delhi (Chap 2 to 8)	2002
4	Gupta, S.C. and Kapur, V.K	Fundamentals of Mathematical Statistics	Sultan Chand and Sons, New Delhi.	2007
5	Veerarajan,T.	Probabilitiy, Statistics and Random process	Tata McGraw-Hill Publications, Second Edition, New Delhi	2002

**WEBSITES:**

1. <a href="http://www.cut-theknot.org/probability.shtml">www.cut-theknot.org/probability.shtml</a> 2. <a href="http://www.mathcentre.ac.uk">www.mathcentre.ac.uk</a> 3. <a href="http://www.mathworld">www.mathworld</a> . Wolfram.com
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**OBJECTIVES:**

- To gain knowledge in measures of central tendency and probability.
- To introduce the concept of random variable and functions of random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To introduce the basic concepts of classifications of design of experiments
- To sampling distributions and statistical techniques used in engineering and management problems.

**OUTCOMES:**

- The student gain the knowledge in measures of central tendency and probability
- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

**UNIT-I MEASURES OF CENTRAL TENDENCY AND PROBABILITY**

Measures of central tendency – Mean, Median, Mode and Standard Deviation – SPSS Software Demonstration.

Probability - Random variable - Axioms of probability - Conditional probability - Total probability – Baye's theorem - Probability mass function - Probability density functions.

**UNIT- II STANDARD DISTRIBUTIONS**

Functions of a random variable - Binomial, Poisson, Uniform, Exponential, Gamma, and Normal distributions - Moment generating functions, Characteristic function and their properties.

### **UNIT- III      TWO DIMENSIONAL RANDOM VARIABLES**

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem.

### **UNIT- IV      TESTING OF HYPOTHESIS**

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

### **UNIT- V      DESIGN OF EXPERIMENTS**

Analysis of variance – One way classification – CRD – Two way classification – RBD - Latin square.

*Note: Use of approved statistical tables permitted in the examination.*

**TEXT BOOKS:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Gupta, S.C. and Kapur, V.K	Fundamentals of Mathematical Statistics	Sultan Chand and Sons, New Delhi.	2007
2	<a href="#">Athanasios Papoulis</a> and S Pillai	Probability Random variables and Stochastic Processes	McGraw-Hill Publications, New Delhi.	2002

**REFERENCES:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Walpole, R.E., Myers, R.H., Myers, R.S.L and Ye, K	Probability and Statistics for Engineers and Scientists	Pearsons Education, Delhi.	2002
2	Lipschutz, S. and Schiller, J	Schaum's outlines - Introduction to Probability and Statistics	McGraw-Hill, New Delhi.	1998
3	Ross, S	A first Course in Probability	Pearson Education, Delhi (Chapters 2 to 8). New Delhi	2002
4	Johnson, R.A	Miller & Freund's Probability and Statistics for Engineers	Pearson Education, Delhi (Chapters 7, 8, 9, 12)	2000

**WEBSITES:**

1.	<a href="http://www.cut-theknot.org/probability.shtml">www.cut-theknot.org/probability.shtml</a>
2.	<a href="http://www.mathcentre.ac.uk">www.mathcentre.ac.uk</a>
3.	<a href="http://www.mathworld">www.mathworld</a> . Wolfram.com

**OBJECTIVES:**

- To understand the fundamental knowledge of probability theory.
- To introduce the concept of random variable and functions of random variables.
- To introduce the basic concepts of two dimensional random variables.
- To introduce the concepts of random processes and Markov chain
- To understand the different Queuing models and solve problems
- **To** understand and characterize phenomena which evolve with respect to time in a probabilistic manner.

**OUTCOMES:**

- The student gain the knowledge in measures of central tendency and probability
- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of two dimensional random variables and apply in engineering applications.
- Understand the concepts of random process and markov chains
- They will be able to solve the Queuing models
- The students understand and characterize phenomena which evolve with respect to time in a probabilistic manner.

**UNIT- I      PROBABILITY AND RANDOM VARIABLE**

Axioms of probability - Conditional probability - Total probability – Baye’s theorem- Random variable - Probability mass function - Probability density function - Properties - Moments - Moment generating functions and their properties.

**UNIT- II      STANDARD DISTRIBUTIONS**

Functions of a random variable - Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties.

**UNIT- III      TWO DIMENSIONAL RANDOM VARIABLES**

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and regression - Transformation of random variables - Central limit theorem.

#### **UNIT -IV      RANDOM PROCESS AND MARKOV CHAINS**

Classification - Stationary process - Markov process - Poisson process - Birth and death process - Markov chains - Transition probabilities - Limiting distributions.

#### **UNIT-V      QUEUEING THEORY**

Markovian models - M/M/1, M/M/C, finite and infinite capacity - M/M/ $\infty$  queues - Finite source model - M/G/1 queue (steady state solutions only) - Pollaczek - Khintchine formula - Special cases.

**TEXT BOOKS:**

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Ross,S	A first course in probability	Pearson Education, Delhi	2002
2	Medhi,J	Stochastic Process	New Age Publishers ,New Delhi	2009

**REFERENCES:**

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Veerarajan,T	Statistics and Random Processes	Tata McGraw-Hill, 2 <sup>nd</sup> Edition, New Delhi.	2003
2	Allen,O	Probability, Statistics and Queuing Theory	Academic press, New Delhi.	1999
3	Gross,D. and Harris, C.M	Fundamentals of Queuing theory	John Wiley and Sons, New York.	1998
4	Taha,H.A	Operations Research - An Introduction	Pearson Education Edition Asia, Delhi.	2002

**WEBSITES:**

1. <a href="http://www.mathcentre.ac.uk">www.mathcentre.ac.uk</a>
2. <a href="http://www.mathworld">www.mathworld</a> . Wolfram.com
3. <a href="http://www.mit.edu">www.mit.edu</a>

**COURSE OBJECTIVES:**

- Be able to understand basic knowledge of fuzzy sets and fuzzy logic
- Be able to apply basic knowledge of fuzzy operations.
- To know the basic definitions of fuzzy relations
- Be able to apply basic fuzzy inference and approximate reasoning
- To know the applications of fuzzy Technology.
- To acquire the knowledge on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology

**COURSE OUTCOME:**

- To gain the main subject of fuzzy sets.
- To understand the concept of fuzziness involved in various systems and fuzzy set theory.
- To gain the methods of fuzzy logic.
- To comprehend the concepts of fuzzy relations.
- To analyze the application of fuzzy logic control to real time systems.
- The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.

**UNIT I**

Fuzzy Sets : Basics Classical sets vs Fuzzy Sets – Need for fuzzy sets – Definition and Mathematical representations – Level Sets – F u z z y functions - Zadeh's Extension Principle

**UNIT II**

Operations on Fuzzy Sets Operations on  $[0,1]$  – Fuzzy negation, triangular norms, tconorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

**UNIT III**

Fuzzy Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

**UNIT IV**

Possibility Theory Fuzzy Measures – Evidence Theory – Necessity and Belief Measures – Probability Measures vs Possibility Measures

**UNIT V**

Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

**TEXT BOOKS:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	George J Klir and Bo Yuan	Fuzzy Sets and Fuzzy Logic : Theory and Applications	Prentice Hall NJ	1995

**REFERENCES:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	H.J. Zimmermann	Fuzzy Set Theory and its Applications	Allied Publishers New Delhi	1991
2	Kevin M Passino and Stephen Yurkovich	Fuzzy Control	Addison Wesley Longman	1998
3	Michal Baczynski and Balasubramaniam Jayaram	Fuzzy Implications	Springer Verlag, Heidelberg	2008

**WEBSITES:**

1. <a href="http://www.mathcentre.ac.uk">www.mathcentre.ac.uk</a>
2. <a href="http://www.mathworld">www.mathworld</a> . Wolfram.com
3. <a href="http://www.doc.ic.ac.uk">www.doc.ic.ac.uk</a>
4. <a href="http://www.calvin.edu/~pribeiro/othrlnks/Fuzzy/fuzzysets.htm">www.calvin.edu/~pribeiro/othrlnks/Fuzzy/fuzzysets.htm</a>

**COURSE OBJECTIVES:**

- To understand the proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics.
- To Learn about special type of matrices that are relevant in physics and then learn about tensors.
- To introduce the Special functions like Bessel, Legendre , Hermite and Laguerre functions and their recurrence relations
- To introduce the concepts of fuzzy relations.
- To make the students to analyse the application of fuzzy logic control to real time systems.
- To acquaint the students to have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.

**COURSE OUTCOME:**

- Students will demonstrate proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics.
- Learn about special type of matrices that are relevant in physics and then learn about tensors.
- Get introduced to Special functions like Bessel, Legendre , Hermite and Laguerre functions and their recurrence relations
- Learn different ways of solving second order differential equations and familiarized with singular points and Frobenius method.
- Students will master in calculus of variations and linear integral equations.
- The students will have the knowledge on Mathematical Physics and that knowledge will be used by them in different engineering and technology applications.

**UNIT I        TENSORS**

Definition of tensor - rank, symmetric tensors, contraction, quotient rule - tensors with zero components, tensor equations, metric tensors and their determinants - pseudo tensors

**UNIT II        DIFFERENTIAL EQUATIONS-SERIES SOLUTIONS**

Series Solution : Classification of singularities of an ordinary differential equation  
- Series solution-Method of Frobenius - indicial equation - examples

**UNIT III       SPECIAL FUNCTIONS**

Basic properties (Recurrence and Orthogonality relations, series expansion) of Bessel, Legendre , Hermite and Laguerre functions – Generating Function

#### UNIT IV CALCULUS OF VARIATIONS

Concept of variation and its properties – Euler’s equation – Functional dependant on first and higher order derivatives – Functional dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric Problems – Direct methods – Ritz and Kantorovich methods.

#### UNIT V LINEAR INTEGRAL EQUATIONS

Introduction – conversion of a linear differential equation to an integral equations and vice versa – conversion of boundary value problem to integral equations using Green’s function – solution of a integral equation – integral equations of the convolution type – Abel’s integral equations – integro–differential equations – integral equations with separable kernels – solution of Fredholm equations with separable kernels.

#### REFERENCES:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Dr. Grewal B.S.	Higher Engineering Mathematics	40 <sup>th</sup> edition, , Khanna Publishers	2011
2	Stephenson, G, Radmore, P.M	Advanced Mathematical Methods for Engineering and Science students	Cambridge University Press	1999
3	Andrews, Larry C.	Special Function for Engineers and Applied Mathematicians	Macmillan, New York	1985
4	Murray R Spiegel, Seymour Lipschutz, Dennis Spellman	Vector Analysis	Tata Mc Graw Hill Education Pvt. Ltd., New Delhi	2010

#### WEBSITES:

1. <http://www.doitpoms.ac.uk/>
2. [www.phys.uu.nl/~thoof/lectures/specialfct.pdf](http://www.phys.uu.nl/~thoof/lectures/specialfct.pdf)
3. <http://www.math.umn.edu/~olver/pdn.html>
4. <http://tutorial.math.lamar.edu/classes/DE.aspx>

**OBJECTIVES:**

- To introduce the concepts of special functions.
- To find the solutions to partial differential equations and their applications
- To study about mathematical physics and perturbation techniques
- To learn replacement models and simulation models
- To provide techniques for effective methods to solve nonlinear programming and decision making
- To understand how to model and solve problems using non integer programming.

**OUTCOMES:**

- Students know the concepts of improper integrals, Beta and Gamma functions.
- The students acquire sound knowledge of techniques in solving PDE that model engineering problems.
- Identify the situations where singular perturbations are needed. They will be able to use various modifications of matched asymptotic expansions techniques to derive asymptotic solutions.
- Able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
- **Convert** and **solve** the practical situations into replacement models.
- Understand how to model and solve problems using non integer programming.

**UNIT I INTRODUCTION TO SOME SPECIAL FUNCTIONS**

Gamma function, Beta function, Bessel function, Error function and complementary Error function, Heaviside's function, pulse unit height and duration function, Sinusoidal Pulse function, Rectangle function, Gate function, Dirac's Delta function, Signum function, Saw tooth wave function, Triangular wave function, Half wave rectified sinusoidal function, Full rectified sine wave, Square wave function.

**UNIT II PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS**

Formation PDEs, Solution of Partial Differential equations  $f(x,y,z,p,q) = 0$ , Nonlinear PDEs first order, Some standard forms of nonlinear PDE, Linear PDEs with constant coefficients, Equations reducible to Homogeneous linear form, Classification of second order linear PDEs. Separation of variables use of Fourier series, D'Alembert's solution of the wave equation, Heat equation: Solution by Fourier series and Fourier integral

### **UNIT – III    PERTURBATION TECHNIQUES**

Singular perturbations (algebraic example). Notion of the boundary layer. Inner and outer solutions. Overlap region. Matching of the asymptotic expansions. Ordinary differential equations with singular perturbations. Methods to determine location of the boundary layer.

### **UNIT -IV    SIMULATION MODELS**

Elements of simulation model -Monte Carlo technique – applications. Queuing model: problems involving  $(M|M|1):(\infty\backslash\text{FIFO})$  ,  $(M|M|c):(\infty\backslash\text{FIFO})$  Models.

### **UNIT V        DECISION MODELS**

Decision Analysis – Decision Making environment – Decisions under uncertainty – Decision under risk – Decision – Tree Analysis.

**REFERENCES:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Kreyszig,E	Advanced Engineering Mathematics	John Wiley & Sons, New Delhi.	2007
2	Gupta, A.S.	Calculus of Variations with Applications	Prentice Hall of India Pvt. Ltd., New Delhi	1997
3	Sankara Rao, K.	Introduction to Partial Differential Equations	Prentice Hall of India Pvt. Ltd., New Delhi	1997
4	Ali H Nayfeh	Perturbation Methods	John Wiley & Sons, New Delhi.	2008
5	Hamdy Taha. A.	Operations Research	Prentice – Hall of India Private Limited, New Delhi .	2010

**WEBSITES:**

1. [www.phys.uu.nl/~thoof/lectures/specialfct.pdf](http://www.phys.uu.nl/~thoof/lectures/specialfct.pdf)
2. [www.maths.manchester.ac.uk/~bl/teaching/math34011/](http://www.maths.manchester.ac.uk/~bl/teaching/math34011/)
3. [pubsonline.informs.org/journal/opre](http://pubsonline.informs.org/journal/opre)

**Course Objectives**

- To introduce the basic concepts of vector space
- To know the fundamentals of linear Algebra
- To solve system of linear equations
- To study about the linear transformations
- To introduce the concepts of inner product spaces
- To give the knowledge on the importance of Linear Algebra.

**COURSE OUTCOMES:**

The student will be able to

- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Apply the fundamental concepts in their respective engineering fields
- Solve the system of linear equations
- Visualize linear transformations as matrix form
- Recognize the underlying theory of vector spaces over a field and inner product spaces over real or complex numbers
- Articulate the importance of Linear Algebra and its applications in branches of Mathematics

**UNIT I VECTOR SPACES**

General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space,

**UNIT II EIGEN VALUES AND EIGEN VECTORS**

Eigen values and Eigen vectors - diagonalization - Power method - QR decomposition

**UNIT III SYSTEM OF LINEAR EQUATIONS**

Direct methods, Gauss elimination method, Gauss Jordan method, Crout's method, iterative methods, Gauss-Jacobi method, Gauss-Seidel method, convergence criteria.

**UNIT IV LINEAR TRANSFORMATIONS**

Linear Transformations - The Null Space and Range - Isomorphisms - Matrix Representation of Linear Transformations – Similarity - Eigenvalues and Eigenvectors Eigen values and Eigen vectors - Diagonalization

## UNIT V INNER PRODUCT SPACES

The Dot Product on  $\mathbb{R}^n$  and Inner Product Spaces - Orthonormal Bases - Orthogonal Complements - Application : Least Squares Approximation - Diagonalization of Symmetric M - Application: Quadratic Forms

### REFERENCES:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Kreyszig,E	Advanced Engineering Mathematics	John Wiley & Sons, New Delhi.	2007
2	Anton and Rorres	Elementary Linear Algebra, Applications version	Wiley India Edition	2010
3	Jim Defranza, Daniel Gagliardi	Introduction to Linear Algebra with Application	Tata McGraw-Hill	2009

### WEBSITES:

1. [www.sosmath.com](http://www.sosmath.com)
2. [www.linear.ups.edu](http://www.linear.ups.edu)
3. [www.mathworld.wolfram.com](http://www.mathworld.wolfram.com)
4. [www.tutorial.math.lamar.edu](http://www.tutorial.math.lamar.edu)

**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS  
(ONLY FOR BE CSE STUDENTS)****OBJECTIVES:**

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the basic concepts of PDE for solving standard partial differential equations
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.
- To develop the use of effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

**OUTCOMES:**

- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- The learners can equip themselves in the transform techniques and solve partial differential equations
- Understand how to solve the given standard partial differential equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

**UNIT- I      FOURIER SERIES**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

**UNIT -II      FOURIER TRANSFORM**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

### **UNIT- III      PARTIAL DIFFERENTIAL EQUATIONS**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

### **UNIT- IV      APPLICATIONS      OF      PARTIAL      DIFFERENTIAL EQUATIONS**

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

### **UNIT- V      Z -TRANSFORM AND DIFFERENCE EQUATIONS**

Z-transform - Elementary properties – Inverse Z – transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z - transform.

**TEXT BOOK:**

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Grewal, B.S.	Higher Engineering Mathematics	Khanna Publishers, Delhi.	2011
2	Kandasamy,P., Thilagavathy,K. and Gunavathy,K.	Engineering Mathematics Volume III.	S. Chand & Company Ltd., New Delhi.	1996

**REFERENCES:**

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Venkateswarlu S	Engineering Mathematics, Vol I	Anuratha Agencies and Publishers, Kumbakonam.	2003
2	Narayanan, S., Manicavachagom Pillay, T.K. and Ramaniah, G	Advanced Mathematics for Engineering Students. Volumes II and III,	Viswanathan S Printers and Publishers Pvt. Ltd. Chennai.	2002
3	Bali N P.	A text book of Engineering Mathematics	Laxmi Publications Pvt. Ltd.	1986
4	Ramana B V	Higher Engineering Mathematics	Tata Mc Graw Hill Publishing Co. Ltd. New Delhi.	2007

**WEBSITES:**

<ol style="list-style-type: none"> <li>1. <a href="http://www.sosmath.com">www.sosmath.com</a></li> <li>2. <a href="http://mathworld.wolfram.com/FourierSeries.html">http://mathworld.wolfram.com/FourierSeries.html</a></li> <li>3. <a href="http://www.math.umn.edu/~olver/pdn.html">http://www.math.umn.edu/~olver/pdn.html</a></li> <li>4. <a href="http://tutorial.math.lamar.edu/classes/DE/IntroPDE.aspx">http://tutorial.math.lamar.edu/classes/DE/IntroPDE.aspx</a></li> </ol>
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**OBJECTIVES:**

- To Develop abilities to write technically and expressively,
- To Recognize writing as a constructive, meaningful process,
- To Practise using reading strategies for effective writing.
- To equip them to write for academic as well as work place context.
- To enable students to be familiar with structure and style of formal written communication
- To Improve their writing skills and be ready with documents related ideas and notions.

**OUTCOMES:**

- Construct simple sentences, correct common grammatical errors in written English.
- Build confidence in English language by imbibing lexical and syntax rules.
- Enrich their reading ability for effective writing.
- Know the value of LSRW skills in document writing.
- Understand the structure, content and format of technical documents.
- Improve their writing skills and be ready with documents related ideas and notions.

**UNIT – I      BASICS OF WRITING**

Introduction to Technical Writing – Importance of Writing – Characteristics of Writing– Audience Recognition/ Analysis – Appropriateness of language — Conciseness and Flow– Bias free and plain writing – Impersonal and Formal Language -Techniques of Technical Writing– Overcoming writer’s block – Prioritizing for effective writing– Avoiding plagiarism.

**UNIT – 2      PARAGRAPHS AND ESSAYS**

Expressing Ideas – Paragraph construction – Cohesion and Coherence – Adequate development – Kinds of paragraphs – Writing drafts – Paragraph length and pattern – Types of Essays – Characteristics of Essays – Salient point of sentence constructions.

### **UNIT – 3      LETTERS, MEMOS AND EMAIL**

Formal written correspondence – Types of messages – Business letters – Structure of letters – Language in letters – Tense in letters – Cover letters – Resumes – Curriculum vitae – Memos – Emails – Email Etiquette – Effectiveness and purpose.

### **UNIT – 4      THE    ART    OF    CONDENSATION    AND    TECHNICAL PROPOSALS**

Steps to Effective précis writing – Guidelines – Technical Proposals – Types of Proposals – Characteristics – Body of the Proposals – Style and appearance – Evaluation of proposals – Proof Reading – Book /Film Review – Travelogue – Dialogue Writing.

### **UNIT – 5      REPORTS AND RESEARCH ARTICLES**

Discussion of newspaper articles -Objectives of Reports – Characteristics of Reports – Structure of Reports – Types of Reports – Writing an article – Writing research articles – Essential features of Dissertation – Organizing the structure of thesis and articles – Writing technical description.

#### **TEXT BOOKS**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	<a href="#">V.N. Arora</a> & <a href="#">Lakshmi Chandra</a>	Improve Your Writing: Revised First Edition	OUP	2014

#### **REFERENCES:**

<b>S.NO</b>	<b>AUTHOR(S) NAME</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1	Crème, P. and M. Lea.	Writing at University: A guide for students.	OUP	2003
2	Graham King	Collins Improve Your Writing	Collins; First edition	2009
3	David Morley	The Cambridge Intro. To Creative Writing	Cambridge	2008

**OBJECTIVES:**

- To inculcate the basics of brief history of Earth sciences
- To divulge knowledge on the basics of structure of earth and earth's gravitational field.
- To disseminate the fundamentals of magnetic field and thermal distribution of earth.
- To introduce the concepts of seismology and seismic waves .
- To impart the basic knowledge of oceans
- To Apply the knowledge gained from this course to solve the relevant problems in engineering stream.

**OUTCOME:**

- Gain knowledge on the basics of history of Earth sciences.
- Acquire knowledge on concepts of structure of earth and earth's gravitational field.
- Have adequate knowledge on the concepts of magnetic field and thermal distribution of earth
- Obtain knowledge on the basics of seismic waves.
- Understand the basics of oceans and properties of sea water.
- Apply the knowledge gained from this course to solve the relevant problems in engineering stream.

**UNIT I ORIGIN OF EARTH**

A brief history of the development of Earth Sciences and of Geophysics in particular, An overview of Geophysical methods and their essential features, Problems of inversion and non-uniqueness in Geophysics, Origin & evolution of Solar system, Earth and Moon structure,. Kepler's law of planetary motion, A review of the Earth's structure and composition

**UNIT II STRUCTURE OF EARTH**

Chemical composition of Earth, Rheological behavior of crust and upper mantle, viscoelasticity and rock failure criteria, Geochronology: Radiometric dating and their advantages, meaning of radiometric ages, Major features of the Earth's gravitational field and relationship with tectonic processes in the crust and upper mantle, concept of isostasy, mathematical concept of Airy and Pratt hypotheses of isostasy

### **UNIT III     MAGNETIC FIELD AND THERMAL DISTRUBUTION OF EARTH**

Origin of geomagnetic field, polar wandering, secular variations and westward drift, reversals of geomagnetic field, sun spot, solar flares, geomagnetic storms, sea- floor spreading, Paleomagnetism and its uses, Thermal history of the Earth, sources of heat generation and temperature distribution inside the earth, convection in the mantle

### **UNIT IV   SEISMOLOGY**

Earthquake seismology, Earthquakes and its classifications, Global seismicity and tectonics, Earth's internal structure derived from seismology, Earthquake mechanism and Anderson's theory of faulting, Continental drift and plate tectonics: its historical perspective and essential features, present day plate motions, Triple junctions, oceanic ridges, Benioff zones, trenches and island arcs, hot spots, Mantle Plume, Mountain building, origin of Himalaya, Geodynamics of Indian subcontinent.

### **UNIT V OCEANS**

Physical properties of seawater and methods of determination, distribution of salinity in the oceans, factors affecting salinity, water masses and water type, TS Diagram, Circulation of currents in major ocean waves. Tides: Dynamical and equilibrium theory of tides. Marine pollution, steps to control marine pollution, Laws of seas, Coastal zone management

**TEXT BOOK:**

S.No	Author(s) Name	Title of the book	Publisher	Year of Publication
1	B.F. Howell	Introduction to Geophysics	McGraw-Hill	2012

**REFERENCES:**

S.No	Author(s) Name	Title of the book	Publisher	Year of Publication
1	W. Lowrie	Fundamentals of Geophysics	Cambridge University Press,	2007
2	J.A. Jacobs, R.D. Russel	Physics and Geology	McGraw-Hill	2002

**WEBSITES:**

1. <a href="http://www.ocw.mit.edu">www.ocw.mit.edu</a> 2. <a href="http://www.physicsclassroom.com">www.physicsclassroom.com</a> 3. <a href="http://www.nptel.ac.in">www.nptel.ac.in</a> 4. <a href="http://www.physics.org">www.physics.org</a>
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**COURSE OBJECTIVES:**

- To disseminate the fundamentals of acoustic waves. (K)
- To inculcate the characteristics of radiation and reception of acoustic waves. (K)
- To divulge knowledge on the basics of pipe resonators and filters.(S)
- To introduce the features of architectural acoustics.(S)
- To impart the basic knowledge of transducers and receivers.(K)
- To Apply the knowledge inputs of the course for engineering applications.

**COURSE OUTCOME:**

- Develop the idea of the fundamentals of acoustic waves.
- Apply the concepts of radiation and reception of acoustic waves.
- Explain the basic ideas of pipe resonators and filters.
- Illustrate the basics of architectural acoustics..
- Illustrate the transducers and receivers and its applications in various electronic devices.
- Apply the knowledge inputs of the course for engineering applications.

**UNIT I INTRODUCTION**

Acoustics waves – Linear wave equation – sound in fluids – Harmonic plane waves – Energy density – Acoustics intensity – Specific acoustic impedance – spherical waves – Describer scales. Reflection and Transmission: Transmission from one fluid to another normal and oblique incidence –method of images.

**UNIT II RADIATION AND RECEPTION OF ACOUSTIC WAVES**

Radiation from a pulsating sphere – Acoustic reciprocity – continuous line source radiation impedance - Fundamental properties of transducers. Absorption and attenuation of sound. Absorption from viscosity – complex sound speed and absorption – classical absorption coefficient

**UNIT III PIPES RESONATORS AND FILTERS**

Resonance in pipes - standing wave pattern absorption of sound in pipes – long wavelength limit – Helmholtz resonator - acoustic impedance - reflection and transmission of waves in pipe - acoustic filters – low pass, high pass and band pass. Noise, Signal detection, Hearing and speech. Noise, spectrum level and band level – combining band levels and tones – detecting signals in noise – detection threshold – the ear – fundamental properties of hearing – loudness level and loudness – pitch and frequency – voice.

## **UNIT IV      ARCHITECTURAL ACOUSTICS**

Sound in enclosure – A simple model for the growth of sound in a room – reverberation time - Sabine, sound absorption materials – measurement of the acoustic output of sound

sources in live rooms – acoustics factor in architectural design. Environmental Acoustics: Weighted sound levels speech interference – highway noise – noise induced hearing loss – noise and architectural design specification and measurement of some isolation design of portions.

## **UNIT V      TRANSDUCTION**

Transducer as an electrical network – canonical equation for the two simple transducers transmitters – moving coil loud speaker – loudspeaker cabinets – horn loud speaker, receivers – condenser – microphone – moving coil electrodynamic microphone piezoelectric microphone – calibration of receivers

### **TEXT BOOK:**

	Author(s) Name	Title of the book	Publisher	Year of Publication
	Lawrence E.Kinsler, Austin R.Frey,	Fundamentals of Acoustics	4th edition, John Wiley & Sons	2013

### **REFERENCES:**

	Author(s) Name	Title of the book	Publisher	Year of Publication
	L. Beranek	Acoustics	Academic Press	2012

### **WEBSITES:**

1. [www.acousticalsociety.org](http://www.acousticalsociety.org)
2. [www.acoustics-engineering.com](http://www.acoustics-engineering.com)
3. [www.nptel.ac.in](http://www.nptel.ac.in)
4. [www.ocw.mit.edu](http://www.ocw.mit.edu)

**OBJECTIVES:**

- To understand about the fuel
- To study about the alcohols and its importance in engine
- To gain knowledge on the fuel gas and oils
- To get the information on fuel cell
- To understand electric, hybrid and solar cars
- To Develop their knowledge in studies of vegetable oils

**OUTCOMES:**

- Students will know about the basic concepts of alternate fuels
- Students will know about the basic concepts of alcohols.
- Students will understand about fuel gas and oils
- Students can enrich their knowledge about the alternate fuels and energy systems
- Develop their knowledge in studies of vegetable oils
- Students knows about the importance of electric, hybrid and solar cars

**UNIT I INTRODUCTION**

Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources and significance.

**UNIT II ALCOHOLS**

Properties as engine fuel, alcohols and gasoline blends, performance in SI engines, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, DEE properties performance analysis, performance in SI & CI Engines.

**UNIT III NATURAL GAS, LPG, HYDROGEN AND BIOGAS**

Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG & LPG in SI & CI engines, performance and emission of LPG. Hydrogen storage and handling, performance and safety aspects. Production of Biogas and its applications

**UNIT IV VEGETABLE OILS**

Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, biodiesel and its characteristics.

**UNIT V ELECTRIC, HYBRID, FUEL CELL AND SOLAR CARS**

Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicles.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1.	Richard.L.Bechfold	Alternative Fuels Guide Book	SAE International Warren dale	1997
2.	Jain, P.C. and Monika Jain	Engineering Chemistry.	Dhanpat Rai Publishing Company (P) Ltd., New Delhi.	2009

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1.	Nagpal	Power Plant Engineering	Khanna Publishers	1991
2.	Saeid Mokhatab William A Poe	Hand book of Natural Gas Transmission and Processing, 2 <sup>nd</sup> edition.	Gulf Professional Publisher, USA	2012

**WEBSITES:**

1. [www.fao.org/docrep/t4470e/t4470e08.htm](http://www.fao.org/docrep/t4470e/t4470e08.htm)
2. <http://www.exergy.se/goran/hig/ses/06/alternative%20fuels>
3. <http://www.alternative-energy-news.info/technology/transportation/hybrid-cars/>

**OBJECTIVES:**

- To make the students conversant with basics of Solid wastes and its classification.
- To make the student acquire sound knowledge of different treatments of solid wastes.
- To acquaint the student with concepts of waste disposals.
- To develop an understanding of the basic concepts of Hazardous waste managements.
- To acquaint the students with the basics of energy generation from waste materials.
- To get the information on energy conservation.

**OUTCOMES:**

- Outline the basic principles of Solid waste and separation of wastes (K)
- Identify the concepts of treatment of solid wastes (S)
- Identify the methods of wastes disposals. (S)
- Examine the level of Hazardousness and its management. (S)
- Examine the possible of the energy production using waste materials. (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I SOLID WASTE**

Definitions – Sources, Types, Compositions, Properties of Solid Waste – Municipal Solid Waste – Physical, Chemical and Biological Property – Collection – Transfer Stations – Waste Minimization and Recycling of Municipal Waste

**UNIT II WASTE TREATMENT**

Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/ Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

**UNIT III WASTE DISPOSAL**

Sanitary Land Fill Method of Solid Waste Disposal – Land Fill Classification, Types, Methods & Siting Consideration – Layout & Preliminary Design of Land Fills – Composition, Characteristics generation, Movement and Control of Landfill Leachate & Gases – Environmental Monitoring System for Land Fill Gases, Waste landfill Remediation

**UNIT IV HAZARDOUS WASTE MANAGEMENT**

Definition & Identification of Hazardous Waste – Sources and Nature of Hazardous Waste – Impact on Environment – Hazardous Waste Control – Minimization and Recycling - Assessment of Hazardous Waste Sites – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure, Remediation, risk assessment.

## UNIT V ENERGY GENERATION FROM WASTE

Thermal conversion Technologies – Pyrolysis systems, Combustion systems, Gasification systems, Environment control systems, energy recovery systems. Biological & chemical conversion technologies – Aerobic composting, low solids. Anaerobic digestion, high solids anaerobic digestion, Energy production from biological conversion products, other biological transformation processes. Chemical transformation processes.

### TEXT BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	Dara.S.S,Mishra.D.D	A Text book of Environmental chemistry and pollution control	S.Chand and company Ltd	2011

### REFERENCE BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	Nagpal H.Theisen, S. Vigil	Integrated Solid Waste management- Engg. Principles and management issues	George Tchobanoglous, McGraw Hill	1993
2.	Parker, Colin, & Roberts	Energy from Waste – An Evaluation of Conversion Technologies	Elsevier Applied Science, London	1985
3.	Shah, L Kanti	Basics of Solid & Hazardous Waste Management Technology	Prentice Hall	1999

### WEBSITES:

- 1.[www.iitk.ac.in/3inetwork/html/reports/IIR2006/Solid\\_Waste](http://www.iitk.ac.in/3inetwork/html/reports/IIR2006/Solid_Waste).
- 2.<http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/>
- 3.[www.alternative-energy-news.info/technology/garbage-energy/](http://www.alternative-energy-news.info/technology/garbage-energy/)
- 4.[nzic.org.nz/ChemProcesses/environment/](http://nzic.org.nz/ChemProcesses/environment/)

**OBJECTIVES:**

- To make the students conversant about the green chemistry
- To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
- To acquaint the student with concepts of green technology.
- To develop an understanding of the basic concepts of renewable energy resources.
- To acquaint the students with the basic information on catalysis.
- To inculcate the chemical principles in the field of engineering and technology

**OUTCOMES:**

- Outline the basic principles of green chemistry (K)
- Examine the different atom efficient process and synthesis elaborately (S)
- Apply the concepts combustion of green technology (S)
- Identify and apply the concepts of renewable energy (S)
- Apply the concepts of green catalysts in the synthesis (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I INTRODUCTION TO GREEN CHEMICAL PRINCIPLES** Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorosolvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

**UNIT II ATOM EFFICIENT PROCESSES**

Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis

**UNIT III BIOTECHNOLOGY AND GREEN CHEMISTRY**

Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air. Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

**UNIT IV RENEWABLE RESOURCES**

Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion

## **UNIT V CATALYSIS IN GREEN CHEMISTRY**

Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

**15BESH0E17, 15BTSH0E17**

**APPLIED ELECTROCHEMISTRY 3 0 0 3 100**

**OBJECTIVES:**

- To make the students conversant with **the information on electrochemical material.**
- To make the student acquire sound knowledge of **conducting polymers.**
- To acquaint the student with concepts of Energy storage devices.
- To develop energy storage devices.
- To impart knowledge on basic principals of solar cells and its applications
- To inculcate the chemical principles in the field of engineering and technology

**OUTCOMES:**

- Outline the basic principles of chemistry in electrochemical material (K)
- Examine the properties of conducting polymers (S)
- Apply the concepts of electrochemistry in storage devices. (S)
- Identify the concepts of storage devices and its applications. (S)
- Apply the suitable materials for the manufacturing of storage devices. (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I METAL FINISHING**

Fundamental principles, surface preparation-Electroplating of copper, nickel, chromium, zinc and precious metals (gold & silver)- Electroplating for electronic industry- Alloy plating, brass plating- Electro less plating of nickel- anodizing – Electroforming – Electro winning

**UNIT II CONDUCTING POLYMERS AND ELECTROCHEMICALS**

Electropolymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers- poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

**UNIT III BATTERIES AND POWER SOURCES-I**

Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

**UNIT IV BATTERIES AND POWER SOURCES-II**

Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

## UNIT V ELECTROCHEMICAL MATERIAL SCIENCE

Solar cells- Preparation of CdS/Cu<sub>2</sub>S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics.

### TEXT BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	D.Pletcher and F.C.Walsh	Industrial electrochemistry	Chapman and Hall, London	1990
2.	A.T.Khun	Industrial Electrochemistry	Elsevier Publishers	1972

### REFERENCE BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	M.M.Baizer	Organic electrochemistry	Dekker Inc. New York	1983
2.	M. Barak	Electrochemical power sources	IEEE series, Peter Peregrinus Ltd, Steverage, U.K.	1997
3.	K.L. Chopra and I. Kaur	Thin film devices and their application	Plenum Press, New York.	1983
4.	Bruno Scrosati	Applications of Electroactive polymers	Chapman & Hall, London	1993

### WEBSITES:

1. <http://www.anoplate.com/finishes/>
2. <http://hyperphysics.phy-astr.gsu.edu/hbase/electric/battery.html>
3. [http://inventors.about.com/od/sstartinventions/a/solar\\_cell.htm](http://inventors.about.com/od/sstartinventions/a/solar_cell.htm)

**OBJECTIVES:**

- To make the students conversant with **cement and lime** and its uses.
- To make the student acquire sound knowledge of abrasives and refractories.
- To acquaint the student with concepts of inorganic chemicals.
- To develop an understanding of the basic concepts explosives.
- To acquaint the students with the basics of agriculture chemicals.
- To inculcate the chemical principles in the field of engineering and technology

**OUTCOMES:**

- Outline the basic chemistry of **cement and lime** (K)
- Examine the uses of abrasives and refractories (S)
- Identify the usage of the inorganic chemicals. (S)
- Identify the concepts of explosives and smoke screens (S)
- Identify the usage of the **agriculture** chemicals (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I CEMENT AND LIME**

Manufacture of Portland cement – setting and hardening of Portland cement – regauging cement – effect of fineness on setting and hardening – freezing – high early strength cement – high alumina cement Lime – raw materials- manufacture – slaking – lime mortar – types of lime – high – calcium or fat lime – calcium lime or lean lime – magnesian lime – dolomitic lime – hydraulic lime.

**UNIT II ABRASIVES AND REFRACTORIES**

Abrasives – hard abrasives – siliceous abrasives – soft abrasives – artificial abrasives – uses. Refractories – definition – classification – acid refractories – basic refractories – neutral refractories – properties – uses.

**UNIT III INORGANIC CHEMICALS**

Common salt and soda ash – Manufacture – Different grades – products – alkalis –  $\text{Na}_2\text{CO}_3$ , Caustic soda and chlor-alkali industry – manufacture principles of electrolytic process – chlorine – storage. Hydrochloric acid – manufacture – absorption – uses, Sulphur and sulphuric acid – extraction of sulphur – manufacture of  $\text{H}_2\text{SO}_4$  – chamber – contact processes – industrial uses.

**UNIT IV EXPLOSIVES**

Explosives – uses – properties and tests – explosives for war – nitrocellulose – picric acid and T.N.T. – industrial explosives – nitroglycerin and dynamites – black powder – smoke screens – incendiaries – gas mask.

## **UNIT V AGRICULTURE CHEMICALS**

Fertilizers – organic and inorganic – ammoniated superphosphates, sodium nitrate, solid pellets – potassium salts – pesticides – fungicides – herbicides – their preparations and characteristics – environmental impacts.

**TEXT BOOKS:**

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	B.K. Sharma	Industrial Chemistry	Goel Publishing House, Meerut	2000
2.	D.Pletcher and F.C.Walsh	Industrial electrochemistry	Chapman and Hall, London	1990

**REFERENCE BOOKS:**

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	B.N.Chakrabarty	Industrial Chemistry	Oxford and IBH Publishing CO. New Delhi.	1998
1.	R.N. Sherve	Chemical process industries	McGraw-Hill, Kugakuisha Ltd., Tokyo.	1984
2.	James A. Kent	Hand Book of Industrial Chemistry, 9th edition	New York, Van Nostrand Reinhold.	1992
3.	S.D. Shukla and G.N. Pandey	A text book of chemical technology	Vikas publishing house pvt. Ltd, New Delhi.	1979

**WEBSITES:**

1. <http://en.wikipedia.org/wiki/Cement>
2. <http://www.hon.ch/HONselect/Selection/D01.html>
3. <http://fas.org/man/dod-101/navy/docs/fun/part12.htm>
4. <http://toxics.usgs.gov/topics/agchemicals.html>

**OPEN ELECTIVES OFFERED BY COMPUTER  
SCIENCE ENGINEERING**

**COURSE OBJECTIVES:**

- To learn how to use and manipulate several core data structures: Lists, Dictionaries, Tuples, and Strings
- To study decision structures and loops
- To understand the process and skills necessary to effectively deal with problem solving in relation to writing programs
- To understand the process and skills necessary to effectively deal with problem solving
- To discuss in relation to writing programs
- To study various program object and graphics based on python

**COURSE OUTCOMES:**

Upon completion of the course, students will be able to:

- Develop algorithmic solutions to simple computational problems Read, write, execute by hand simple Python programs
- Structure simple Python programs for solving problems
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries
- Read and write data from/to files in Python Programs
- Understand various program object and graphics based on python

**UNIT I Fundamentals****9**

The Universal Machine-Program power- What is Computer Science?-Hardware Basics- Programming Languages-Python-Inside Python program-Software Development Process- Example program- Elements of programs- Output statements- Assignment Statements- Data types-Type conversions

**UNIT II Decision Structures and Loops****9**

Simple Decisions-Two-way decisions-Multi-way decisions-Exception handling-for loops-indefinite loops-common loop patterns-Booleans

**UNIT III Functions****9**

Function of functions-Functions and Parameters-Function that returns values-Function that modifies parameters-Functions and program structures

**UNIT IV Sequences****9**

String data type- String Processing-List as sequences-String Representation-String Methods-I/O as String manipulation-File Processing

**UNIT V Objects and Graphics****9**

Overview-Object of Objects-Simple Graphics Programming-Using Graphical Objects-Choosing Coordinates- Interactive Graphics-Graphics module reference

**Total Hours: 45**

**References:**

1. John Zelle, “ Python Programming: An Introduction to Computer Science”, 2<sup>nd</sup> Edition, Franklin & Associates, 2009
2. Mark Lutz, “Learning Python”, OReily, 2013
3. David Beazly & Brian K. Jones, “Python Cookbook”, OReily, 2013

**15BEC SOE02**

**Internet Programming**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To study concepts of Internet, IP addresses and protocols
- To explain the concept of web page development through HTML
- To introduce the PERL and explore its current strengths and Weaknesses
- To write working Java code to demonstrate the use of applets for client-side programming
- To study Internet telephony and various multimedia applications
- To Elaborate on the principles of web page development

**COURSE OUTCOMES:**

Upon completion of this course, the student will be able to:

- Learn the advanced concepts & techniques of Internet and Java.
- Analyze the requirements for and create and implement the principles of web page development
- Understand the concepts of PERL
- Implement client-side programming using java applets
- Generate internet telephony based upon advanced concepts
- Develop applications on internet programming based on java applets and scripts

**UNIT I Introduction**

**9**

Introduction - Network of Networks, Intranet, Extranet and Internet. World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing- Classful and Classless Addressing, Subnetting

**UNIT II HTML**

**9**

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps- map, area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts- Introduction- Environment Variable, GET and POST Methods.

**UNIT III PERL**

**9**

Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets- Container Class, Components, Applet Life Cycle, Update method, Applications.

**UNIT IV Client-Server programming****9**

Client-Server programming In Java - Java Socket, Java RMI. Threats - Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks- Network security techniques- Password and Authentication- VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall- Introduction, Packet filtering, Stateful, Application layer, Proxy.

**UNIT V Internet Telephony****9**

Introduction, VoIP- Multimedia Applications- Multimedia over IP: RSVP, RTP, RTCP and RTSP- Streaming media, Codec and Plugins, IPTV- Search Engine and Web Crawler- Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

**Total Hours: 45****References:**

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013.
2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.

**COURSE OBJECTIVES:**

- To impart the fundamental concepts of Computer Animation and Multimedia
- To study the graphic techniques and algorithms using flash
- Explain various concepts available in 3D animation
- Explain various devices available for animation
- To study the multimedia concepts and various I/O technologies for concept development
- To understand the three-dimensional graphics and their transformations

**COURSE OUTCOMES**

Upon completion of this course, the student will be able to:

- Develop their creativity using animation and multimedia
- Understand the concepts of Flash and able to develop animation using it
- Understand about various latest interactive 3D animation concepts
- Know the various devices and software available in motion capture
- Understand the concept development process
- Develop an interactive multimedia presentation by using multimedia devices and identify theoretical and practical aspects in designing multimedia applications surrounding the emergence of multimedia technology.

**UNIT I Introduction****9**

What is mean by Animation – Why we need Animation – History of Animation– Uses of Animation – Types of Animation – Principles of Animation – Some Techniques of Animation – Animation on the WEB – 3D Animation – Special Effects -Creating Animation.

**UNIT II Creating Animation in Flash****9**

Introduction to Flash Animation – Introduction to Flash – Working with the Timeline and Frame-based Animation - Working with the Timeline and Tween-based Animation – Understanding Layers - Action script.

**UNIT III 3D Animation & its Concepts****9**

Types of 3D Animation – Skeleton & Kinetic 3D Animation – Texturing & Lighting of 3D Animation – 3D Camera Tracking – Applications & Software of 3D Animation.

**UNIT IV Motion Caption****9**

Formats – Methods – Usages – Expression – Motion Capture Software's – Script Animation Usage – Different Language of Script Animation Among the Software.

**UNIT V Concept Development****9**

Story Developing –Audio & Video – Color Model – Device Independent Color Model – Gamma and Gamma Correction - Production Budgets- 3D Animated Movies.

**Total Hours: 45**

**References:**

1. Principles of Multimedia – Ranjan Parekh, 2007, TMH. (Unit I, Unit V)
2. Multimedia Technologies – Ashok Banerji, Ananda Mohan Ghosh – McGraw Hill Publication.
3. Computer Graphics, Multimedia and Animation-Malay K. Pakhira, PHI Learning Pvt Ltd, 2010
4. Encyclopedia of Multimedia and Animations-Pankaj Dhaka, Anmol Publications-2011

**COURSE OBJECTIVES:**

- To study the basic parts of computer in detail
- Introduce various peripheral devices available for computer and its detailed working concepts
- Overview of various interfaces and other hardware overview
- Assemble/setup and upgrade personal computer systems and discuss about power supplies and the skills to trouble-shoot various power-related problems.
- To study basic concepts and methods in troubleshooting
- To study the installation/connection and maintenance of computer and its associated peripherals.

**COURSE OUTCOME:**

Upon completion of this course, the student will be able to:

- Identify the main components for the PC, familiarize themselves with PC memories such as RAM and ROM devices and so on.
- Identify various peripheral devices available and its working
- Understand various concepts of hardware and its interface and control
- Perform basic installation of PC. Importance of maintenance is understood
- Understand Various faults and failures are identified and troubleshooting in detail
- Understand overall PC hardware, interfacing, maintenance and troubleshooting

**UNIT I Introduction****9**

Introduction - Computer Organization – Number Systems and Codes – Memory – ALU – CU – Instruction prefetch – Interrupts – I/O Techniques – Device Controllers – Error Detection Techniques – Microprocessor – Personal Computer Concepts – Advanced System Concepts – Microcomputer Concepts – OS – Multitasking and Multiprogramming – Virtual Memory – Cache Memory – Modern PC and User.

**UNIT II Peripheral Devices****9**

Introduction – Keyboard – CRT Display Monitor – Printer – Magnetic Storage Devices – FDD – HDD – Special Types of Disk Drives – Mouse and Trackball – Modem – Fax-Modem – CD ROM Drive – Scanner – Digital Camera – DVD – Special Peripherals.

**UNIT III PC Hardware Overview****9**

Introduction – Hardware BIOS DOS Interaction – The PC family – PC hardware – Inside the System Box – Motherboard Logic – Memory Space – Peripheral Interfaces and Controllers – Keyboard Interface – CRT Display interface – FDC – HDC.

**UNIT IV Installation and Preventive Maintenance****9**

Introduction – system configuration – pre installation planning – Installation practice – routine checks – PC Assembling and integration – BIOS setup – Engineering versions and compatibility – preventive maintenance – DOS – Virus – Data Recovery.

## **UNIT V      Troubleshooting**

**9**

Introduction – computer faults – Nature of faults – Types of faults – Diagnostic programs and tools – Microprocessor and Firmware – Programmable LSI's – Bus Faults – Faults Elimination process – Systematic Troubleshooting – Symptoms observation and analysis – fault diagnosis – fault rectification – Troubleshooting levels – FDD, HDD, CD ROM Problems.

**Total Hours: 45**

**References:**

1. B. Govindarajalu, "IBM PC Clones Hardware, Troubleshooting and Maintenance", 2/E, TMH, 2002.
2. Peter Abel, Niyaz Nizamuddin, "IMB PC Assembly Language and Programming", Pearson Education, 2007
3. Scott Mueller, "Repairing PC's", PHI, 1992

**COURSE OBJECTIVES:**

- To understand the basic requirements, installation and structure of gaming using Java
- Discuss various aspects of safe cracker projects
- Discuss various aspects of match game projects
- Discuss various aspects of pizza delivery projects
- Discuss various aspects of moon landing projects
- Discuss the process of development of gaming using Java

**COURSE OUTCOMES:**

Upon completion of the course, students will be able to:

- Interpret various concepts of gaming based on Java
- Design the frame and code to develop safe cracker project
- Design the frame and code to develop match game project
- Design the frame and code to develop pizza delivery project
- Design the frame and code to develop moon landing project
- Design and develop various games using Java

**UNIT I Introduction****9**

Introducing Games with Java- Requirements-Installing Netbeans IDE-Structure of Java Program-Structure of Java GUI-Swing controls-Stopwatch Project-Creating Frames-Adding Controls-Adding Event methods-Writing Code

**UNIT II Safecracker Project****9**

Frame design-Grid Bag Layout Manager-Code Design-Adding Sounds-Tic Tac Toe Project-Frame Design-Code Design-Adding Events-Adding Sounds

**UNIT III Match Game Project****9**

Preview-Frame Design-Photo Selection-Code Design-Timer Objects- Adding Delays-one player Solitaire game-Computer Moves

**UNIT IV Pizza Delivery Project****9**

Preview- Frame Design-Adding Clock-Game Design-Multiple Frames GUI- Leap Frog Project-Preview-Frame Design-Code Design- Introduction to OOP-Sprite Class-Collision detection between objects- Updating Scores

**UNIT V Moon Landing Project****9**

Preview-Frame Design- Code Design- Graphics Methods- Graphics 2D Objects-Stroke and Paint Objects-Shapes and Drawing Methods-Line, Rectangle and Ellipse-Scrolling Background-Sprite Animation

**Total Hours:**  
**45**

**References:**

1. Philip Conrod, Lou Tylee, "Programming Games with Java",2013
2. Timothy M.Right, "Fundamental 2D Game Programming with Java",Cengage Learning PTR,2015
3. Wayne Holder,Doug Bell, "Java Game Programming for Dummies",

**OPEN ELECTIVES OFFERED BY ELECTRICAL AND  
ELECTRONICS ENGINEERING**

**Course Objectives**

- To understand the basic concepts of electric hybrid vehicle.
- To gain the knowledge about electric propulsion unit.
- To gain the concept of Hybrid Electric Drive-Trains.
- To gain the different Energy Management Strategies.
- To study about the efficiency manipulation in drives
- To understand and gain the knowledge about various energy storage devices

**Course Outcomes:**

- Summarize the basic concepts in bioprocess Engineering.
- Explain the concept of Hybrid Electric Vehicles.
- Understand the concept of Hybrid Electric Drive-Trains.
- Identify the different Energy Management Strategies.
- Understand the concept of different Energy Storage devices.
- Analyze the different motor drives used in Hybrid Electric Vehicles.

**UNIT I INTRODUCTION**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

**UNIT II HYBRID ELECTRIC DRIVE-TRAINS**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

**UNIT III ELECTRIC PROPULSION UNIT**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

**UNIT IV ENERGY STORAGE**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

**UNIT V ENERGY MANAGEMENT STRATEGIES**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

**TEXT BOOK**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Iqbal Hussein	Electric and Hybrid Vehicles: Design Fundamentals	CRC Press	2003

**REFERENCES**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design	CRC Press	2004
2	James Larminie, John Lowry	Electric Vehicle Technology Explained	Wiley	2003

**Course Objectives:**

- To gain the knowledge about energy management.
- To understand the basic concepts in economic analysis in energy management.
- To understand the basic principles of energy audit.
- To gain the knowledge about the basic concept of types of Energy Audit
- To gain and Evaluate the different energy efficient motors
- Understand the concept of Energy conservation.
- To study about the behavior changes of PF requirement in motor currents

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Understand the concept of Energy Management.
- Analyze the different methods for economic analysis
- Knowledge about the basic concept of Energy Audit and types.
- Evaluate the different energy efficient motors
- Understand the concept of Energy conservation.
- Investigate the different methods to improve power factor.

**UNIT I ENERGY MANAGEMENT**

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting –Energy Auditor and Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management.

**UNIT II ECONOMIC ASPECTS AND ANALYSIS**

Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.

**UNIT III BASIC PRINCIPLES OF ENERGY AUDIT**

Energy audit – definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – energy saving potential, energy audit of process industry, thermal power station, building energy audit.

**UNIT IV ENERGY EFFICIENT MOTORS**

**Electric Motors:** Factors affecting efficiency - Energy efficient motors - constructional details, characteristics - voltage variation –over motoring – motor energy audit-

**Energy conservation:** Importance-energy saving measures in DG set-fans and blowers pumps- air conditioning system- energy efficient transformers.

**UNIT V POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS**

Power factor - methods of improvement, location of capacitors, p.f with non linear loads, effect of

harmonics on p.f,- p.f motor controllers –Energy efficient lighting system design and practice-lighting control– Measuring Instruments – wattmeter, data loggers, thermocouples, pyrometers, lux meters, tong testers, application of PLCs.

### Text Book

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Murphy W.R. and G.Mckay Butter worth	<i>Energy Management</i>	<i>Heinemann Publications</i>	2007

### Reference Books

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	John.C.Andreas	Energy Efficient Electric Motors	Marcel Dekker Inc Ltd – 3rd edition	2005
2	W.C.Turner Steve Doty	Energy Management Handbook	John Wiley and Sons, 7th Edition	2009
3	Paul o' Callaghan	Energy Management	Mc-Graw Hill Book Company – 1st edition	1998

**Course Objectives**

- It deals with various types of Sensors & Transducers and their working principle
- It deals with resistive transducers
- It deals with capacitive transducers
- It deals with inductive transducers
- It deals with some of the miscellaneous transducers
- It deals with characteristics of transducers

**Course Outcomes (COs)**

At the end of the course the student will be able to

1. understand all types of sensors and transducers.
2. Justify the concept and working principle of different transducers and sensors
3. Justify the transducers that will be utilised in the electrical industries
4. Identify recent developments in transducer domain
5. Discover the knowledge for small technology up gradations in it
6. Analysis the real time application.

**UNIT I INTRODUCTION OF TRANSDUCERS**

Transducer – Classification of transducers – Basic requirement of transducers.

**UNIT II CHARACTERISTICS OF TRANSDUCERS**

Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order and second order transducers – Response to impulse, step, ramp and sinusoidal inputs.

**UNIT III RESISTIVE TRANSDUCERS**

Potentiometer –Loading effect – Strain gauge – Theory, types, temperature compensation – Applications – Torque measurement – Proving Ring – Load Cell – Resistance thermometer – Thermistors materials – Constructions, Characteristics – Hot wire anemometer.

**UNIT IV INDUCTIVE AND CAPACITIVE TRANSDUCER**

Self inductive transducer – Mutual inductive transducers– LVDT Accelerometer – RVDT – Synchros – Microsyn – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.

**UNIT V MISCELLENEOUS TRANSDUCERS**

Piezoelectric transducer – Hall Effect transducers – Smart sensors – Fiber optic sensors – Film sensors – MEMS – Nano sensors, Digital transducers.

## TEXT BOOKS

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Sawhney A.K	A Course in Electrical and Electronics Measurements and Instrumentation	18th Edition, Dhanpat Rai & Company Private Limited	2007
2	Renganathan. S	Transducer Engineering	Allied Publishers, Chennai	2003

## REFERENCES

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Doebelin. E.A	Measurement Systems – Applications and Design	Tata McGraw Hill, New York	2000
2	Patranabis. D	Sensors and Transducers	Prentice Hall of India	1999
3	John. P, Bentley	Principles of Measurement Systems	III Edition, Pearson Education	2000
4	Murthy.D.V.S	Transducers and Instrumentation	Prentice Hall of India	2001

**Course Objectives**

- To understand the basic principles of PLC systems.
- To gain the knowledge about data handling functions.
- To gain the knowledge of storage techniques in PLC
- To acquire the knowledge about how to handle the data and functions
- To study about flow charts of ladder and spray process system
- To understand the principles of PID.

**Course Outcome**

- At the end of the course the student will be able to understand the registers and functions in PLC and they are able to do the program.
- To acquire the knowledge of storage techniques in PLC
- Students know how to handle the data and functions
- Students know about advanced controller in PLC applications
- Students gather real time industrial application of PLC
- Students gathered and evaluate the flow charts of ladder and spray process system

**UNIT I INTRODUCTION**

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment  
Programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

**UNIT II PLC PROGRAMMING**

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

**UNIT III REGISTERS AND PLC FUNCTIONS**

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

**UNIT IV DATA HANDLING FUNCTIONS**

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

**UNIT V PID PRINCIPLES**

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

### TEXT BOOKS

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	JR Hackworth and F.D Hackworth – Jr	Programmable Logic Controllers – Programming Method and Applications	Pearson	2006

### REFERENCES

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	John Webb and Ronald A Reiss	Programmable Logic Controllers – Principle and Applications	Fifth edition, PHI	
2	W.Bolton	Programmable Logic controller	Elsevier Newnes Publications, Fourth Edition	2006

### WEBSITE

<http://www.mikroe.com/old/books/plcbook/chapter1/chapter1.htm>, - Introduction to programmable Logic controller

**Course Objectives**

- To gain the knowledge about environmental aspects of energy utilization.
- To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
- To study about solar energy collectors and its storages
- To study about the inter connected system in wind power
- To understand the basic principles fuel cell, Geo thermal power plants.
- To gain the knowledge about hydro energy.

**Course Outcomes**

At the end of this course, students will demonstrate the ability to

- Analyze the Energy Scenario in india
- Understand the concept of Solar Energy
- Understand the concept of Wind Energy
- Understand the concept of Hydro Energy
- Analyze the different energy sources
- Students gathered the real time inter connected system modelling in wind power

**UNIT I INTRODUCTION**

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2003.

**UNIT II SOLAR ENERGY**

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

**UNIT III WIND ENERGY**

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

**UNIT IV HYDRO ENERGY**

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

**UNIT V OTHER SOURCES**

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

## TEXT BOOKS

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Rai.G.D	Non-conventional resources of energy	Khanna publishers ,Fourth edition	2010
2	Khan.B.H	Non-Conventional Energy Resources	The McGraw Hills, Second edition	2009

## REFERENCES

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Rao.S. & Parulekar	Energy Technology	Khanna publishers, Fourth edition	2005
2	Godfrey Boyl	Renewable Energy: Power sustainable future	Oxford University Press, Third edition	2012
3	John W Twidell and Anthony D Weir	Renewable Energy Resources	Taylor and Francis	2006
4	Mittal K.M	Non-Conventional Energy Systems	Wheeler Publishing Co. Ltd	1997

## WEBSITES

1. [www.energycentral.com](http://www.energycentral.com)
2. [www.catelectricpowerinfo.com](http://www.catelectricpowerinfo.com)

## Course Objectives

- To study the state variable analysis
- To provide adequate knowledge in the phase plane analysis and also describing function analysis.
- To study the analysis discrete time systems using conventional techniques.
- To analyze the stability of the systems using different techniques.
- To study the design of optimal controller.
- To study the types of compensators

## Course Outcomes

At the end of the course the student will be able to

- understand the state variable analysis, Z- transform, state equation
- Construct the frequency response of the system using various plots
- Correlate the time and frequency domain specifications and effect of compensation
- Design the different types of compensators using frequency response plots to stabilize the control system
- Explain the state variable representation of physical systems with the effects of state feedback its assessment for linear-time invariant systems.

## UNIT 1 STATE VARIABLE ANALYSIS

Concept of state – State Variable and State Model – State models for linear and continuous time

systems – Solution of state and output equation – controllability and observability - Pole Placement

– State observer Design of Control Systems with observers

## UNIT II PHASE PLANE AND DESCRIBING FUNCTION ANALYSIS

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearising

non-linear systems - Construction of phase portraits – Singular points – Limit cycles Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.

## UNIT III Z-TRANSFORM AND DIGITAL CONTROL SYSTEM

Z transfer function – Block diagram – Signal flow graph – Discrete root locus – Bode plot.

## **UNIT 1V            STATE-SPACE DESIGN OF DIGITAL CONTROL SYSTEM**

State equation – Solutions – Realization – Controllability – Observability – Stability  
– Jury's test.

## **UNIT V                OPTIMAL CONTROL**

Introduction -Decoupling - Time varying optimal control – LQR steady state optimal control  
–  
Optimal estimation – Multivariable control design.

### **TEXT BOOKS**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	I.J. Nagrath and M. Gopal	Control Systems Engineering	New Age International Publishers	2003
2	Ashish Tewari	Modern control Design with Matlab and Simulink	John Wiley, New Delhi	2002
3	Benjamin C. Kuo	Digital Control Systems	Oxford University Press	1992
4	George J. Thaler	Automatic Control Systems'	Jaico Publishers	1993

### **REFERENCES**

<b>S. No.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	George J. Thaler	Automatic Control Systems	Jaico Publishers	1993
2	M.Gopal	Modern control system theory	New Age International Publishers	2002
3	Gene F. Franklin, J. David Powell and Abbasemami-Naeini	Feedback Control of Dynamic Systems	Fourth edition, Pearson Education, Low price edition	2002
4	Raymond T. Stefani & Co	Design of feedback Control systems	Oxford University	2002

**OPEN ELECTIVES OFFERED BY ELECTRONICS AND  
COMMUNICATION ENGINEERING**

**Course Objectives**

- To introduce students to the embedded systems, its hardware and software.
- To introduce devices and buses used for embedded networking.
- To study about task management
- To learn about semaphore management and message passing
- To study about memory management
- To imparts knowledge on

**Course Outcomes**

At the end of the course the students will be able to

- Understand overview of embedded systems architecture
- Acquire knowledge on embedded system, its hardware and software.
- Gain knowledge on overview of Operating system
- Discuss about task Management
- Gain knowledge about semaphore management and message passing.
- Gain knowledge about memory management.

**UNIT - I INTRODUCTION TO EMBEDDED SYSTEM**

Introduction - Embedded systems description, definition, design considerations & requirements - Overview of Embedded system Architecture (CISC and RISC) - Categories of Embedded Systems - embedded processor selection & tradeoffs - Embedded design life cycle - Product specifications - hardware/software partitioning - iterations and implementation - hardware software integration - product testing techniques – ARM 7

**UNIT - II OPERATING SYSTEM OVERVIEW**

Introduction – Advantage and Disadvantage of Using RTOS – Multitasking – Tasks - Real Time Kernels – Scheduler - Non-preemptive Kernels - Preemptive Kernels – Reentrancy- Reentrant Functions – Round Robin Scheduling - Task Priorities - Static Priorities – Mutual Exclusion – Deadlock – Intertask Communication – Message Mailboxes – Message Queues - Interrupts - Task Management – Memory Management - Time Management – Clock Ticks.

**UNIT - III TASK MANAGEMENT**

Introduction -  $\mu$ C/OS-II Features - Goals of  $\mu$ C/OS-II - Hardware and Software Architecture – Kernel Structures: Tasks – Task States – Task Scheduling – Idle Task – Statistics Task – Interrupts Under  $\mu$ C/OS-II – Clock Tick -  $\mu$ C/OS-II Initialization. Task Management: Creating Tasks – Task Stacks – Stack Checking – Task's Priority – Suspending Task – Resuming Task. Time Management: Delaying a Task – Resuming a Delayed Task – System Time. Event Control Blocks- Placing a Task in the ECB Wait List – Removing a Task from an ECB wait List .

**UNIT - IV SEMAPHORE MANAGEMENT AND MESSAGE PASSING**

Semaphore Management: Semaphore Management Overview – Signaling a Semaphore. Message Mailbox Management: Creating a Mailbox – Deleting Mailbox – Waiting for a Message box – Sending Message to a Mailbox- Status of Mailbox. Message Queue Management: Creating Message Queue – Deleting a Message Queue – Waiting for a Message at a Queue – Sending Message to a Queue – Flushing a Queue.

## UNIT - V MEMORY MANAGEMENT

Memory Management: Memory Control Blocks – Creating Partition- Obtaining a Memory Block – Returning a Memory Block .Getting Started with  $\mu$ C/OS-II – Installing  $\mu$ C/OS-II – Porting  $\mu$ C/OS-II: Development Tools – Directories and Files – Testing a Port - IAR Workbench with  $\mu$ C/OS-II -  $\mu$ C/OS-II Porting on a 8051 CPU – Implementation of Multitasking - Implementation of Scheduling and Rescheduling – Analyze the Multichannel ADC with help of  $\mu$ C/OS-II.

### REFERENCES

S.NO	Author(s) Name	Title of the book	Publisher	Year of publication
1	Jean J. Labrosse	MicroC/OS – II The Real Time Kernel	CMP BOOKS	2009
2	David Seal	ARM Architecture Reference Manual.	Addison-Wesley	2008
3	Steve Furbe,	ARM System-on-Chip Architecture,	Addison-Wesley Professional, California	2000

**Course Objectives**

- To study about various speakers and microphone
- To learn the fundamental of television systems and standards
- To learn the process of audio recording and reproduction
- To study various telephone networks
- To discuss about the working of home appliances
- To familiarize with TV services like ISDN.

**Course Outcomes**

At the end of the course the students will be able to

- Understand working of various type of loud speakers
- Acquire knowledge on various types of picture tubes
- Demonstrate the working of various optical recording systems
- Distinguish various standards for color TV system
- Acquire knowledge on various telecommunication networks
- Demonstrate the working of various home appliances

**UNIT I LOUDSPEAKERS AND MICROPHONES**

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters - Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones.

**UNIT – II TELEVISION STANDARDS AND SYSTEMS**

Components of a TV system – interlacing – composite video signal. Colour TV – Luminance and Chrominance signal; Monochrome and Colour Picture Tubes - Colour TV systems – NTSC, PAL, SECAM - Components of a Remote Control.

**UNIT – III OPTICAL RECORDING AND REPRODUCTION**

Audio Disc – Processing of the Audio signal – read out from the Disc – Reconstruction of the audio signal – Video Disc – Video disc formats- recording systems – Playback Systems.

**UNIT – IV TELECOMMUNICATION SYSTEMS**

Telephone services - telephone networks – switching system principles – PAPX switching – Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network. Wireless Local Loop. VHF/UHF radio systems, Limited range Cordless Phones; cellular modems

**UNIT – V HOME APPLIANCES**

Basic principle and block diagram of microwave oven; washing machine hardware and software; components of air conditioning and refrigeration systems.

**Text Book:**

1. S.P.Bali, “Consumer Electronics”, Pearson Education, 2005.

## Course Objectives

- To familiar with the important concepts applicable to small electronic devices, their fabrication, characterization and application
- To have a solid understanding of Nanotechnology concepts.
- To introduce the basic concepts of Nanotechnology and its applications in various domain
- To understand the molecular structure of carbon nano tube
- To educate how to use Nanotechnology to solve real-world problems
- To familiar with the structure and application of carbon nano tube

## Course Outcomes

At the end of the course the students will be able to

- Understand the basic concepts of Nanotechnology and its applications in various domain
- Ability to develop how to use Nanotechnology to solve real- world problems
- Understand solid understanding of Nanotechnology concepts
- Understand the important concepts applicable to small electronic devices, their fabrication, characterization and application
- Understand the molecular structure of carbon nano tube
- Familiar with the structure and application of carbon nano tube

## UNIT I-LIMITATIONS OF CMOS

Fundamentals of MOSFET devices - Scaling of CMOS – Limitations – Alternative concepts in materials – **Structures of MOS devices:** SOI MOSFET, FINFETS, Dual Gate MOSFET, Ferro electric FETs.

## UNIT II-MICRO AND NANO FABRICATION

Optical Lithography – Electron beam Lithography – Atomic Lithography – Molecular beam epitaxy - Nano lithography.

## UNIT III-CHARACTERIZATION EQUIPMENTS

Principles of Electron Microscopes – Scanning Electron Microscope – Transmission Electron Microscope - Atomic Force Microscope – Scanning Tunneling Microscope.

## UNIT IV-NANO DEVICES – I

Resonant tunneling diodes – Single electron devices – Josephson junction – Single Flux Quantum logic – Molecular electronics.

## UNIT V-NANO DEVICES – II

**Quantum computing:** principles – Qbits – Carbon nanotubes (CNT): Characteristics, CNTFET, Application of CNT - Spintronics: Principle, Spin valves, Magnetic Tunnel Junctions, SpinFETs, MRAM

## TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Rainer Waser (Ed)	Nano electronics and information technology	Wiley- VCH. 3 <sup>rd</sup> Edition	2012

**REFERENCES:**

<b>S.NO.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of publication</b>
1	Thomas Heinzl	A Microscopic Electronics in Solid State Nanostructure	Wiley- VCH	2008
2	Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse	Nanotechnology – (Basic Science and Emerging Technologies	Overseas Press	2002
3	Mark Ratner, Daniel Ratner	Nanotechnology: A Gentle introduction to the Next Big idea	Pearson education	2003

**Course Objectives**

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques
- To study the image compression procedures.
- To study the image segmentation and representation techniques.
- To study the video processing fundamentals
- To know the concepts of motion estimation

**INTENDED OUTCOMES:**

- Understand the image fundamentals and mathematical transforms necessary for image processing.
- Understand the image enhancement techniques
- Understand the image compression procedures.
- Understand the image segmentation and representation techniques.
- Understand the video processing fundamentals
- Understand motion estimation concepts

**UNIT I FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS** Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform, Discrete Wavelet transforms.

**UNIT II IMAGE PROCESSING TECHNIQUES**

Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters, Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering.

**UNIT III IMAGE SEGMENTATION AND COMPRESSION**

Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards.

**UNIT IV BASICS OF VIDEO PROCESSING**

Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations.

**UNIT V 2-D MOTION ESTIMATION**

Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

## **TEXTBOOKS**

1. Gonzalez and Woods ,”Digital Image Processing “, 3<sup>rd</sup> edition Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, ”Video processing and communication “,1<sup>st</sup> edition PHI

## **REFERENCE BOOKS**

1. M. Tekalp ,”Digital video Processing”, Prentice ll International
2. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", JohnWiley & Sons
3. Chris Solomon, Toby Breckon , "Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons,

**Course Objectives**

- To learn the processing steps in fabrication of VLSI devices.
- To learn the concepts of assembling and packaging for VLSI devices.
- To impart a good knowledge in reactive plasma etching techniques and equipment.
- To familiarize the students with the NMOS and CMOS IC technology.
- To make the student acquire reactive Plasma Etching techniques and Equipment.
- To acquaint the student with the VLSI assembly technology and package fabrication technology

**Course outcomes**

After completing this course, the students will be able to

- List out various fabrication techniques
- Understand the etching principle in IC fabrication
- Gain knowledge on deposition and diffusion methods
- Understand the process simulation and integration.
- Assembling and packing techniques
- various technologies used for fabricating VLSI devices

**UNIT 1**

Introduction to MOS Technologies: MOS, CMOS, BiCMOS Technology, Trends and Projections. Basic Electrical Properties of MOS, CMOS & BiCMOS Circuits:  $I_{ds}$ - $V_{ds}$  relationships, Threshold Voltage  $V_t$ ,  $G_m$ ,  $G_{ds}$  and  $\omega_o$ , Pass Transistor, MOS, CMOS & Bi CMOS Inverters,  $Z_{pu}/Z_{pd}$ , MOS Transistor circuit model, Latch-up in CMOS circuits.

**UNIT II:**

Layout Design And Tools: Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools.

Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

**UNIT III:**

Combinational Logic Networks: Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.

**UNIT IV:**

Sequential Systems: Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design validation and testing.

**UNIT V:**

Floor Planning & Architecture Design: Floor planning methods, off-chip connections, High-level synthesis, Architecture for low power, SOCs and Embedded CPUs, Architecture testing.

**TEXT BOOKS:**

1. Essentials of VLSI Circuits and Systems, K. Eshraghian Eshraghian. D, A.Pucknell, 2005, PHI.
2. Modern VLSI Design - Wayne Wolf, 3rd ed., 1997, Pearson Education.

**REFERENCES:**

1. Principals of CMOS VLSI Design – N.H.E Weste, K.Eshraghian, 2nd ed., Adisson Wesley.

**Course Objectives**

- To study materials used for MEMS and its working
- To study the fabrication process used for MEMS
- To study the packaging process used for MEMS
- To familiarize the students with various micro actuators and micro sensors.
- To learn the survey of materials central to micro engineering.
- To impart good knowledge in micro system packaging materials

**Course Outcomes**

At the end of the course the students will be able to

- Appreciate the underlying working principles of MEMS devices.
- Understand the working of Micro sensors and actuators
- Explain the IC fabrication processes
- Gain knowledge on bulk manufacturing
- Understand the Design of Micro systems.
- Design and model MEMS devices.

**UNIT I-INTRODUCTION TO MEMS AND MICRO FABRICATION**

History of MEMS Development, Characteristics of MEMS-Miniaturization - Micro electronics integration - Mass fabrication with precision. Sensors and Actuators- Energy domain. Sensors, actuators Micro fabrication - microelectronics fabrication process- Silicon based MEMS processes- New material and fabrication processing- Points of consideration for processing. Anisotropic wet etching, Isotropic wet etching, Dry etching of silicon, Deep reactive ion etching (DRIE), and Surface micromachining process- structural and sacrificial material.

**UNIT II-ELECTRICAL AND MECHANICAL CONCEPTS OF MEMS**

Conductivity of semiconductors, crystal plane and orientation, stress and strain - definition - Relationship between tensile stress and strain- mechanical properties of Silicon and thin films, Flexural beam bending analysis under single loading condition- Types of beam- longitudinal strain under pure bending -deflection of beam- Spring constant, torsional deflection, intrinsic stress, resonance and quality factor.

**UNIT III-ELECTROSTATIC AND THERMAL PRINCIPLE SENSING AND ACTUATION**

Electrostatic sensing and actuation-Parallel plate capacitor - Application- Inertial, pressure and tactile sensor parallel plate actuator- comb drive Thermal sensing and Actuators-Thermal sensors-Actuators- Applications Inertial, flow and infrared sensors.

**UNIT IV-PIEZORESISTIVE, PIEZOELECTRIC AND MAGNETIC PRINCIPLE SENSORS AND ACTUATOR**

Piezoresistive sensors- piezoresistive sensor material- stress in flexural cantilever and membrane- Application-Inertial, pressure, flow and tactile sensor. Piezoelectric sensing and actuation- piezoelectric material properties-quartz- PZT-PVDF -ZnO- Application-Inertial, Acoustic, tactile, flow-surface elastic waves Magnetic actuation- Micro magnetic actuation principle- Deposition of magnetic materials-Design and fabrication of magnetic coil.

## **UNIT V-POLYMER AND OPTICAL MEMS**

Polymers in MEMS- polyimide-SU-8 Liquid crystal polymer(LCP )- PDMS – PMMA – Parylene - Fluorocarbon, Application-Acceleration, pressure, flow and tactile sensors. Optical MEMS-passive MEMS optical components-lenses-mirrors-Actuation for active optical MEMS.

**TEXT BOOK:**

<b>S.NO.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of publication</b>
1	Chang Liu	Foundations of MEMS	Pearson Indian Print, 1 <sup>st</sup> Edition	2012

**REFERENCES:**

<b>S.NO.</b>	<b>Author(s) Name</b>	<b>Title of the book</b>	<b>Publisher</b>	<b>Year of publication</b>
1	Gaberiel M. Rebiz	RF MEMS Theory, Design and Technology	John Wiley & Sons	2003
2	Charles P. Poole and Frank J. Owens	Introduction to Nanotechnology	John Wiley & Sons	2003
3	Julian W. Gardner and Vijay K. Varadhan	Microsensors, MEMS and Smart Devices	John Wiley & sons	2001

**Course Objectives**

- To introduce the basic concepts of neural networks and its applications in various domain
- To educate how to use Soft Computing to solve real-world problems
- To have a solid understanding of Basic Neural Network.
- To provide students with a sound and comprehensive understanding of artificial neural networks and machine learning.
- To gain exposure in the field of neural networks and relate the human neural system into the digital world
- To provide knowledge of computation and dynamical systems using neural networks

**Course Outcomes**

At the end of the course the students will be able to

- Understand the basic concepts of neural networks and its applications in various domains
- Gain knowledge about learning process in Neural Networks
- Apply perception concept in design
- Design using ART phenomena
- Gain knowledge on SOM concepts
- Ability to develop the use of Soft Computing to solve real-world problems

**UNIT I: INTRODUCTION TO NEURAL NETWORKS**

Introduction - biological neurons and their artificial models - learning, adaptation and neural network's learning rules - types of neural networks- single layer, multiple layer- feed forward, feedback networks

**UNIT II LEARNING PROCESS**

Error – correction learning – memory based learning - hebbian learning-competitive learning-Boltzmann learning- supervised and unsupervised learning-adaptation-statistical learning theory.

**UNIT III PERCEPTION**

Single layer perception-Adaptive filtering-unconstrained optimization-Least-mean square algorithm-Leaning curve-Annealing Technique-perception convergence theorem-Relationship between perception and Baye's classifier-Back propagation algorithm

**UNIT IV ATTRACTOR NEURAL NETWORK AND ART**

Hopfield model-BAM model-BAM stability-Adaptive BAM -Lyapunov function-effect of gain-Hopfield design-Application to TSP problem-ART- layer 1-layer 2-orienting subsystem- ART algorithm-ARTMAP

**UNIT V SELF ORGANIZATION**

Self organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical vector Quantization. Applications of self-organizing maps: The Neural Phonetic Typewriter Learning Ballistic Arm Movements

**REFERENCES:**

1. Simon Haykin, "Neural Networks and Learning Machines" -3/E - Pearson/ Prentice Hall 2009
2. Satish Kumar- "Neural Networks : A Classroom Approach"-TMH-2008
3. Freeman J.A., Skapura D.M."Neural networks, algorithms, applications, and programming techniques" -Addison Wesley, 2005.
4. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms, and Applications" - Pearson/ Prentice Hall
5. Robert J Schalkoff-"Artificial Neural Networks,McGraw Hill"-1997

**Course Objectives**

- To introduce the basic concepts of Fuzzy logic and its applications in various domain
- To educate how to use Fuzzy computation to solve real-world problems
- To have a solid understanding of Basic fuzzy models.
- Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
- To learn about applications on Fuzzy based systems
- To familiarize with fuzzy inference and defuzzy inference procedures

**Course Outcomes**

At the end of the course the students will be able to

- Understand the basic concepts of Fuzzy logic and its applications in various domain
- Gain knowledge on theory of Reasoning
- Develop fuzzy controllers
- Understand concepts of adaptive fuzzy control
- Ability to develop how to use Fuzzy computation to solve real-world problems
- Design fuzzy based model for any application

**UNIT - I**

Basics Of Fuzzy Logic: Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, the extension principle

**UNIT – II**

Theory Of Approximate Reasoning: Linguistic variables, Fuzzy proportions, Fuzzy if- then statements, inference rules, compositional rule of inference-fuzzy models

**UNIT - III**

Fuzzy Knowledge Based Controllers (Fkbc): Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, fuzzyfication and defuzzyfication procedures – Design of Fuzzy Logic Controller

**UNIT - IV**

Adaptive Fuzzy Control: Process performance monitoring, adaption mechanisms, membership functions, tuning using gradient descent and performance criteria. Self organizing controller model based controller.

**UNIT V****FUZZY BASED SYSTEMS**

Simple applications of FKBC -washing machines- traffic regulations -lift control-fuzzy in medical applications-Introduction to ANFIS.

**TEXT BOOKS:**

1. An Introduction to Fuzzy Control- D. Diankar, H. Hellendoom and M. Reinfrank- Narosa Publishers India, 1996.
2. Fuzzy Sets Uncertainty and Information- G. J. Klir and T. A. Folger- PHI IEEE, 1995.

## **OPEN ELECTIVES OFFERED BY MECHANICAL ENGINEERING**

**Course Objective**

1. To explain to the students about MEMS Technology, Present, Future and Challenges.
2. To gain a knowledge of basic approaches for microsystem design.
3. To gain a knowledge of state-of-the-art lithography techniques for microsystems.
4. To learn new materials, science and technology for microsystem applications.
5. To understand materials science for microsystem applications.
6. To understand state-of-the-art micromachining and packaging technologies.

**Course Outcome**

1. Students will explain MEMS Technology, Present, Future and Challenges.
2. Gain a knowledge of basic approaches for microsystem design
3. Gain a knowledge of state-of-the-art lithography techniques for microsystems
4. Learn new materials, science and technology for microsystem applications
5. Understand materials science for microsystem applications
6. Understand state-of-the-art micromachining and packaging technologies

**UNIT I INTRODUCTION**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

**UNIT II SENSORS AND ACTUATORS-I**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

**UNIT III SENSORS AND ACTUATORS-II**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

**UNIT IV MICROMACHINING**

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

**UNIT V POLYMER AND OPTICAL MEMS**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

**TEXT BOOKS**

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

## REFERENCES

1. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Boca Raton, 2000
3. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD, 2002
4. James J. Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
5. Thomas M. Adams and Richard A. Layton, "Introduction MEMS, Fabrication and Application," Springer 2012.

**Course Objective**

1. To develop the student's knowledge in various robot structures and their workspace.
2. To develop student's skills in performing spatial transformations associated with rigid body motions.
3. To develop student's skills in perform kinematics analysis of robot systems.
4. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
5. To provide the student with some knowledge and analysis skills associated with trajectory planning.
6. To provide the student with some knowledge and skills associated with robot control.

**Course Outcome**

1. Develop the student's knowledge in various robot structures and their workspace.
2. Develop student's skills in performing spatial transformations associated with rigid body motions.
3. Develop student's skills in perform kinematics analysis of robot systems.
4. Provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
5. Provide the student with some knowledge and analysis skills associated with trajectory planning.
6. Provide the student with some knowledge and skills associated with robot control.

**UNIT I            FUNDAMENTALS OF ROBOT**

Robot – Definition, Need for Robots, Robot Anatomy, Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions, grippers types. Forward kinematics, inverse kinematics- Manipulators with two, three degrees of freedom in 2D - Derivations and problems.

**UNIT II            DRIVES AND SENSORS**

Drives- hydraulic, pneumatic and electrical. Force sensing, touch and tactile sensors, proximity sensors, non contact sensors and Machine vision sensors. Safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism.

**UNIT III           PROGRAMMING AND APPLICATIONS**

Robot programming languages – VAL programming – Motion Commands, Sensorscommands. Role of robots in inspection, assembly, material handling, underwater, space, nuclear, defence and medical fields.

**UNIT IV           MACHINE VISION**

Machine Vision - Sensing - Low and higher level vision - Image acquisition and digitization - Cameras, CCD,CID, CPD, etc., - Illumination and types - Image processing and analysis - Feature extraction - Applications.

**UNIT V            IMPLEMENTATION AND ROBOT ECONOMICS**

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

**TEXT BOOKS**

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.

**REFERENCES**

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.
3. Koren Y., “Robotics for Engineers”, Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
5. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
6. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.
7. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

**Course Objective**

1. To recognize and evaluate occupational safety and health hazards in the workplace.
2. To determine appropriate hazard controls following the hierarchy of controls.
3. To analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. To prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. To teach student the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
6. To prevent or mitigate harm or damage to people, property, or the environment.

**Course Outcome**

1. Recognize and evaluate occupational safety and health hazards in the workplace.
2. Determine appropriate hazard controls following the hierarchy of controls.
3. Analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. Understand the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
6. Prevent or mitigate harm or damage to people, property, or the environment.

**UNIT I INTRODUCTION TO LOGISTICS**

Logistics - concepts, definitions and approaches, factors influencing logistics - Supply chain: basic tasks, definitions and approaches, influencing supply chain - a new corporate model.

**UNIT II PHASES OF SUPPLY CHAIN**

The new paradigm shift - The modular company - The network relations - Supply processes - Procurement processes - Distribution management.

**UNIT III EVOLUTION OF SUPPLY CHAIN MODELS**

Strategy and structure - Factors of supply chain - Manufacturing strategy stages - Supply chain progress - Model for competing through supply chain management - PLC grid, supply chain redesign - Linking supply chain with customer.

**UNIT IV SUPPLY CHAIN ACTIVITIES**

Structuring the SC, SC and new products, functional roles in SC - SC design framework - Collaborative product commerce (CPC).

**UNIT V SCM ORGANISATION AND INFORMATION SYSTEM**

The management task - Logistics organization - The logistics information systems - Topology of SC application - Product Data Management - Warehouse management system MRP- I, MRP - II, ERP,. - Case study, ERP Software's

**TEXT BOOKS**

1. Shari.P.B and Lassen.T.S, "Managing the global supply chain", Viva books, New Delhi, 2000.
2. Ayers.J.B, "Hand book of supply chain management", The St. Lencie press, 2000.

**REFERENCES**

1. Nicolas.J.N, "Competitive manufacturing management - continuous improvement", Lean production, customer focused quality, McGrawHill, New York, 1998.
2. Steudel.H.J and Desruelle.P, "Manufacturing in the nineteen - How to become a mean, lean and world class competitor", Van No strand Reinhold, New York, 1992.

**Course Objective**

1. To generalized equations for mass, momentum and heat.
2. To understand the concepts of Reynolds and Gauss theorems.
3. To learn combined diffusive and convective transport.
4. To apply Film- and penetration models for mass and heat transfer.
5. To apply Stefan-Maxwells equations for multi-component diffusion.
6. To Solve the given set of equations either analytically or numerically.

**Course Outcome**

1. Generalized equations for mass, momentum and heat.
2. Understand the concepts of Reynolds and Gauss theorems.
3. Learn combined diffusive and convective transport.
4. Apply Film- and penetration models for mass and heat transfer.
5. Apply Stefan-Maxwells equations for multi-component diffusion.
6. Solve the given set of equations either analytically or numerically.

**UNIT I INTRODUCTION AND BASIC CONCEPTS**

General overview of transport phenomena including various applications, Transport of momentum, heat and mass , Transport mechanism, Level of transport, Driving forces, Molecular transport (diffusion), convective transport (microscopic)

**UNIT II PROPERTIES, UNITS AND OTHER PHYSICAL PARAMETERS**

Unit systems, temperature, mole, concentration, pressure, Gas laws, laws of conservation, energy and heat units

**UNIT III MOMENTUM TRANSPORT**

Basic concepts in fluid mechanics, Force, unit and dimensions, pressure in fluid, head of fluid, Molecular transport for momentum, heat and mass transfer, Viscosity of fluids, Newton's law, Momentum transfer, Newtonian and non- Newtonian fluids, Fluid flow and Reynolds number, Overall mass balance, Control volume and Continuity equation, Overall energy balance, Bernoulli's equation, Overall momentum balance, Drag coefficient, Stokes law, Flow in packed beds, Flow in fluidized bed

**UNIT IV ENERGY TRANSPORT**

Basic concepts in heat transfer, Heat transfer mechanisms, Fourier's law of heat conduction, thermal conductivity, convective heat transfer coefficient, Conduction heat transfer - through flat slab/wall and through hollow cylinder, Conduction through solids in series, Forced convection heat transfer inside pipes, Heat transfer outside various geometrics in forced convection, General discussion on natural convection heat transfer, Heat exchangers, General discussion on radiation heat transfer

**UNIT V MASS TRANSPORT**

Basic concepts in mass transport, Some application examples, Modes of mass transfer, Molecular diffusion- Fick's law, Analogy between mass, heat and momentum transfer, Dispersion, Hydraulic or Darcy's flow in porous media, Chemical kinetics and activation energy, Film theory, Convective mass transfer, Liquid-solid mass transfer, Liquid-liquid mass transport, Gas-liquid mass transfer, Aeration and oxygen transport, Air stripping

## REFERENCES

1. Geankoplis, C. J. 2003. Transport Processes and Separation Processes Principles. 4th Edition. Prentice Hall.
2. <https://laulima.hawaii.edu/portal>

**Course Objective**

1. To describe the principles of the study of human movement.
2. To describe the range of factors that influence the initiation, production and control of human movement.
3. To identify the body's lever systems and their relationship to basic joint movement and classification.
4. To distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
5. To explain joint and muscle function and the forces acting upon the human body during various sporting activities.
6. To relate the different body systems necessary for human movement to occur.

**Course Outcome**

1. Describe the principles of the study of human movement.
2. Describe the range of factors that influence the initiation, production and control of human movement.
3. Identify the body's lever systems and their relationship to basic joint movement and classification.
4. Distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
5. Explain joint and muscle function and the forces acting upon the human body during various sporting activities.
6. Relate the different body systems necessary for human movement to occur.

**UNIT I INTRODUCTION**

Biomechanics - Improving Performance – Applications - Preventing And Treating Injury - Qualitative And Quantitative Analysis - Scholarly Societies - Computer Searches – Biomechanical Knowledge versus Information - Kinds of Sources - Evaluating Sources

**UNIT II KEY MECHANICAL CONCEPTS**

Mechanics - Basic Units - Nine Fundamentals of Biomechanics - Principles and Laws - Nine Principles for Application of Biomechanics

**UNIT III HUMAN ANATOMY AND SOME BASIC TERMINOLOGY**

Gross (Whole-Body) Modeling - Position and Direction Terminology - Terminology for Common Movements - Skeletal Anatomy - Major Joints - Major Muscle Groups - Anthropometric Data

**UNIT IV ANATOMICAL DESCRIPTION**

Key Anatomical Concepts - Directional Terms - Joint Motions - Muscle Actions - Active and Passive Tension of Muscle - Limitations of Functional Anatomical Analysis - Mechanical Method of Muscle Action Analysis - The Need for Biomechanics to Understand Muscle Actions - Sports Medicine and Rehabilitation Applications

## **UNIT V            MECHANICS OF THE MUSCULOSKELETAL SYSTEM**

Tissue Loads - Response of Tissues To Forces - Biomechanics of The Passive Muscle–Tendon Unit - Biomechanics of Bone - Biomechanics of Ligaments - Three Mechanical Characteristics of Muscle - Stretch-Shortening Cycle (SSC) - Force–Time Principle - Neuromuscular Control

### **REFERENCES**

1. Duane Knudson, “Fundamentals of Biomechanics”, Springer Science+ Business Media, LLC, 2007
2. C. Ross Ethier Craig A. Simmons, “Introductory Biomechanics”, Cambridge University Press, 2007

**OPEN ELECTIVES OFFERED BY AUTOMOBILE  
ENGINEERING**

**Course Objectives:**

- To impart knowledge on the constructional details and principle of operation of various automobile components.
- To learn the function and working of various components in transmission and drive lines.
- To study the concept and working of steering and suspension systems in an automobile.
- To give knowledge on the wheels, tyres and brakes of automobiles.
- To provide information on the current and future trends in automobiles.
- Identify and explain the types of steering system.

**Course Outcomes:****Upon successful completion of the course, the students should be able to:**

- Demonstrate the operating principles and constructional details of various automobile components.
- Explain the function and working of components in transmission and drive lines.
- Identify and explain the types of steering system.
- Identify and explain the types of suspension system.
- Classify and describe the types of wheels, tyres and brakes of automobiles.
- Discuss the current and future trends in the automobiles.

**UNIT-I ENGINE AND FUEL FEED SYSTEMS**

Classification of Engine , construction and working of four stroke petrol and diesel engine, firing order and its significance. Carburettor working principle, requirements of an automotive carburettor, Petrol injection Systems (MPFI, TBI), Diesel fuel injection systems (CRDI)

**UNIT –II TRANSMISSION SYSTEMS**

Requirements of transmission system. Flywheel. Different types of clutches, principle, Construction, torque capacity and design aspects. Objective of the gearbox - Determination of gear ratios for vehicles. Performance characteristics at different speeds. Different types of gearboxes - operation. Function of Propeller Shaft Construction details of multi drive axle vehicles. Different types of final drive. Differential principles. Constructional details of differential unit. Non-slip differential. Differential lock

**UNIT -III SUSPENSION SYSTEM**

Need of suspension system - Types of suspension - Suspension springs - Constructional details and characteristics of leaf, coil and torsion bar springs - Independent suspension - Rubber suspension – Pneumatic suspension – Hydro Elastic suspension - Shock absorbers. Vibration and driving comfort.

**UNIT-IV BRAKES**

Necessity of brake, stopping distance and time, brake efficiency, weight transfer, shoe brake and disc brake theory Brake actuating systems - Mechanical, Hydraulic and Pneumatic. Parking and engine exhaust brakes. Power and power assisted brakes. Antilock Braking System (ABS).

## **UNIT -V ELECTRICAL SYSTEM**

Principle and construction of lead acid battery. Lighting system: details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator. Starting System and charging system.

### **TEXT BOOKS**

<b>SL.NO.</b>	<b>AUTHOR(S)</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1.	Young U.P and Griffiths L	Automotive Electrical Equipment	ELBS & New Press	1999
2.	Ganesan.V	Internal Combustion Engines	Tata McGraw-Hill Publishing Co., New Delhi	2003
3.	Dr.Kirpal Singh	Automobile Engineering	Standard Publishes	2011

### **REFERENCES**

<b>SL.NO.</b>	<b>AUTHOR(S)</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1.	Heldt .P.M	The Automotive Chassis	Literary Licensing,LLC	2012
2.	Crouse.W.H	Automobile Electrical Equipment”, 3 <sup>rd</sup> Edition	McGraw-Hill Book Co., Inc., New York.	1986
3.	N.Newton, W. Steeds and T.K.Garrett	The Motor vehicle, 13th edition	SAE Inc	2001

**Course Objectives**

- The objective of this course is to make the students to know and understand the constructional details, operating characteristics and design aspects of Two and Three wheelers.
- Construct the frames of two and three wheelers of different layouts.
- Demonstrate the constructional details and principle of operation of various engine components.
- Identify and explain the types of transmission systems.
- Identify and explain the types of steering and suspension systems.
- Classify and describe the types of wheels, tyres and brakes for two and three wheelers.

**Course Outcomes**

Upon successful completion of the course, the students should be able to:

- Construct the frames of two and three wheelers of different layouts.
- Demonstrate the constructional details and principle of operation of various engine components.
- Identify and explain the types of transmission systems.
- Identify and explain the types of steering and suspension systems.
- Classify and describe the types of wheels, tyres and brakes for two and three wheelers.
- Explain the servicing of two and three wheelers.

**UNIT I INTRODUCTION**

Classifications- design considerations –weight and dimension limitations – requirements stability problems, gyroscopic effect- pendulum effect of two and three wheelers.

**UNIT II POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS**

2 stoke and 4 stoke SI engines and CI engines design criteria– design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburettor types and design. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical system.

**UNIT III CLUTCHES AND TRANSMISSION**

Types of clutches for 2 and 3 wheelers. Design of clutch system. Gears for two and three wheelers. Design of gear box and gear change mechanism. Belt, chain and shaft drive. Freewheeling devices, starting systems.

#### **UNIT IV        FRAMES, SUSPENSION, WHEELS AND TYRES**

Types of frames used for two wheelers and three wheelers. Wheel frames- construction design of frames for fatigue strength torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres.

#### **UNIT V        THREE WHEELERS**

Auto rickshaws, different types, Pick-Ups and delivery type vehicle, frames and transmission for 3 wheelers wheel types, wheel attachment tyre types. Brakes and their operating mechanism.

#### **TEXT BOOKS:**

<b>SL.NO.</b>	<b>AUTHOR(S)</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1.	Irving P.E.	Motor Cycle Engineering.	Temple Press Book, London.	1992.
2.	Srinivasan.S.	Motor cycle, Scooter, Mobeds.	New century book house.	1988.

#### **REFERENCES:**

<b>SL.NO.</b>	<b>AUTHOR(S)</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1.	M.M.Griffin.	Motor cycles from inside and outside.	Prentice Hall Inc, New Jersey.	1978.
2.	Bruce A. Johns, David D.Edmundson and Robert Scharff	Motorcycles: Fundamentals, Service, Repair	Goodheart-Willcox	1999

**Course Objectives**

- The objective of this course is to make the students to know and understand the maintenance and fault diagnosis of basic systems inAutomobile.
- Describe and differentiate the types of maintenance.
- List the procedure for dismantling, servicing and assembling of engine components.
- Demonstrate the servicing of transmission and driveline components.
- Discuss the procedure for steering and suspension
- Discuss the procedure for wheel and brake maintenance.

**Course Outcomes**

Upon successful completion of the course, the students should be able to:

- Describe and differentiate the types of maintenance.
- List the procedure for dismantling, servicing and assembling of engine components.
- Demonstrate the servicing of transmission and driveline components.
- Discuss the procedure for steering and suspension
- Discuss the procedure for wheel and brake maintenance.
- Explain the fault diagnosis in the electrical and air conditioner systems.

**UNIT I MAINTENANCE OF RECORDS AND SCHEDULES**

Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists, Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance.

**UNIT II ENGINE MAINTENANCE**

Dismantling of engine components and cleaning, cleaning methods, visual anddimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.

**UNIT III CHASSIS MAINTENANCE**

Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system, Maintenance servicing of suspension systems. Brake systems, types and servicing techniques, Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.

#### **UNIT IV ELECTRICAL SYSTEM MAINTENANCE**

Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems, Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.

#### **UNIT V MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VEHICLE BODY**

Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply, Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives, Lubrication maintenance, lubricating oil changing, greasing of parts, Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance.

#### **TEXT BOOKS**

<b>SL.NO.</b>	<b>AUTHOR(S)</b>	<b>TITLE OF THE BOOK</b>	<b>PUBLISHER</b>	<b>YEAR OF PUBLICATION</b>
1.	John Doke	Fleet Manag ement	McGraw Hill Co	1984
2.	James D Halderman	Advanced Engine Performance Diagnosis	Prentice Hall Publications	2011
3.	Service Manuals from Different Vehicle Manufacturers			

**Course Objectives:**

- To impart knowledge on trends in the vehicle power plants.
- To learn the various advanced driver assistance systems.
- To study the working of advanced suspension and braking systems in an automobile.
- To give information about motor vehicle emission and noise pollution control.
- To provide knowledge of the vehicle telematics.
- To give information about the noise control techniques

**Course Outcomes:**

Upon successful completion of the course, the students should be able to:

- Distinguish and describe the various modern vehicle power plant systems.
- List and explain the various driver assistant mechanisms.
- Identify and describe the working of advanced suspension and braking systems.
- Apply the knowledge of motor vehicle emission and noise pollution control.
- Describe the noise control techniques
- Describe the vehicle telematics and its applications.

**UNIT I TRENDS IN POWER PLANTS**

Hybrid vehicles - Stratified charged / lean burn engines - Hydrogen engines - battery vehicles – Electric propulsion with cables - Magnetic track vehicles.

**UNIT II DRIVER ASSISTANCE SYSTEMS**

Collision Avoidance Systems, Adaptive cruise control, adaptive noise control, anti spin regulation, traction control systems, cylinder cut- off technology, ABS, Driver Drowsiness Detection system

**UNIT III SUSPENSION BRAKES AND SAFETY**

Air suspension - Closed loop suspension - antiskid braking system, Retarders, Regenerative braking safety cage - air bags - crash resistance - passenger comfort.

**UNIT IV NOISE & POLLUTION**

Reduction of noise - Internal & external pollution control through alternate fuels/power plants – Catalytic converters and filters for particulate emission.

**UNIT V TELEMATICS**

Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition

**TEXT BOOKS**

SL. NO	AUTHOR(S)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Ljubo Vlacic, Michael Saren and Fumio Harashima	Intelligent Vehicle Technologies	Butterworth-Heinemann publications, Oxford	2001
2.	Ronald K.Jurgen	Navigation and Intelligent Transportation Systems	Automotive Electronics Series,SAE, USA.	1998
		–Progress in Technology		

**REFERENCES**

SL. NO	AUTHOR(S)	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	William B Riddens	“Understanding Automotive Electronics”, 5 <sup>th</sup> Edition	Butterworth Heinemann Woburn.	1998
2.	Bechhold,	“Understanding Automotive Electronics”	SAE	1998
3.	Robert Bosch,	“Automotive HandBook”, 5 <sup>th</sup> Edition	SAE	2000

## **OPEN ELECTIVES OFFERED BY CIVIL ENGINEERING**

**COURSE OBJECTIVES**

1. To examine the role and tasks of basic housing policies and building bye laws
2. Understand the process of integrated service delivery in the context of economic, social, environmental and institutional factors
3. Analyze the Innovative construction methods and Materials
4. Analyze city management strategies and strengthen the urban governance through a problem solving approach
5. To know the Importance of basic housing policies and building bye laws
6. To use Housing Programmes and Schemes

**COURSE OUTCOME**

The students will be able to

1. Know the Importance of basic housing policies and building bye laws
2. Use Housing Programmes and Schemes
3. Plan and Design of Housing projects
4. Examine Innovative construction methods and Materials
5. Know Housing finance and loan approval procedures
6. Understand Construction as well as managing techniques

**UNIT I INTRODUCTION TO HOUSING 9**

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

**UNIT II HOUSING PROGRAMMES 9**

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organisations.

**UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS 9**

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

**UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS 9**

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

**UNIT V HOUSING FINANCE AND PROJECT APPRAISAL 9**

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing of Housing Units, Rents, Recovery Pattern (Problems).

**TOTAL HRS : 45**

**TEXT BOOKS**

1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd., New Delhi, 2002.
2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House, Bombay, 2001.

**REFERENCES**

1. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002.
2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000.

**COURSE OBJECTIVES**

1. Defining and identifying of eng. services systems in buildings.
2. The role of eng. services systems in providing comfort and facilitating life of users of the building.
3. The basic principles of asset management in a building & facilities maintenance environment
4. Importance of Fire safety and its installation techniques
5. To Know the principle of Refrigeration and application
6. To Understand Electrical system and its selection criteria

**COURSE OUTCOME**

The students will be able to

1. Machineries involved in building construction
2. Understand Electrical system and its selection criteria
3. Use the Principles of illumination & design
4. Know the principle of Refrigeration and application
5. Importance of Fire safety and its installation techniques
6. Know the principle behind the installation of building services and to ensure safety in buildings

**UNIT I MACHINERIES****9**

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

**UNIT II ELECTRICAL SYSTEMS IN BUILDINGS****9**

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

**UNIT III PRINCIPLES OF ILLUMINATION & DESIGN****9**

Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angle illumination – Utilisation factor – Depreciation factor – MSCP – MHCP – Laws of illumination – Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.

#### **UNIT IV REFRIGERATION PRINCIPLES & APPLICATIONS**

**9**

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Subcooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilled water plant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

#### **UNIT V FIRE SAFETY INSTALLATION**

**9**

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

**TOTAL HRS : 45**

#### **TEXT BOOKS**

1. E.R.Ambrose, “Heat Pumps and Electric Heating”, John and Wiley and Sons, Inc., New York, 2002.
2. Handbook for Building Engineers in Metric systems, NBC, New Delhi, 2005.

#### **REFERENCES**

1. Philips Lighting in Architectural Design, McGraw-Hill, New York, 2000.
2. A.F.C. Sherratt, “Air-conditioning and Energy Conservation”, The Architectural Press, London, 2005.
3. National Building Code.

**OBJECTIVES:**

1. To understand the coastal processes, coastal dynamics, impacts of structures like docks, harbours and quays leading to simple management perspectives along the coastal zone.
2. To describe the Coastal zone regulations, coastal processes and wave dynamics.
3. To forecast waves and tides and plan coastal structures including harbours.
4. To explain which scientific background values that are necessary for a successful planning,
5. To apply knowledge about ecosystem values and management in the planning process,
6. To plan and carry out a simplified consultation process for activities in the coastal zone

**OUTCOMES:**

1. Understand the coastal processes, coastal dynamics, impacts of structures like docks, harbours and quays leading to simple management perspectives along the coastal zone.
2. The Coastal zone regulations, coastal processes and wave dynamics.
3. Forecast waves and tides and plan coastal structures including harbours.
4. To explain which scientific background values that are necessary for a successful planning,
5. To apply knowledge about ecosystem values and management in the planning process,
6. To plan and carry out a simplified consultation process for activities in the coastal zone

**UNIT I. COASTAL ZONE 9**

Coastal zone – Coastal zone regulations – Beach profile – Surf zone – Off shore – Coastal waters – Estuaries – Wet lands and Lagoons – Living resources – Non living resources.

**UNIT II . WAVE DYNAMICS 9**

Wave classification – Airy's Linear Wave theory – Deep water waves – Shallow water waves – Wave pressure – Wave energy – Wave Decay – Reflection, Refraction and Diffraction of waves – Breaking of waves – Wave force on structures – Vertical – Sloping and stepped barriers – Force on piles.

**UNIT III. WAVE FORECASTING AND TIDES 9**

Need for forecasting - SMB and PNJ methods of wave forecasting – Classification of tides – Darwin's equilibrium theory of tides – Effects on structures – seiches, Surges and Tsunamis.

**UNIT IV. COASTAL PROCESSES 9**

Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.

**UNIT V. HARBOURS 9**

Types of classification of harbours – Requirements of a modern port – Selection of site – Types and selection of break waters – Need and mode of dredging – Selection of dredgers.

TEXT BOOKS

**TOTAL HRS :**

**45**

1. Richard Sylvester, "Coastal Engineering, Volume I and II", Elseiner Scientific Publishing Co., 2006
2. Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw-Hill Book Co., 2007

**REFERENCES**

1. Ed. A.T. Ippen, "Coastline Hydrodynamics", McGraw-Hill Inc., New York, 2002
2. Dwivedi, S.N., Natarajan, R and Ramachandran, S., "Coastal Zone Management in Tamilnadu"

## **15BECEOE04 EXPERIMENTAL METHODS AND MODEL ANALYSIS 3 0 0 3 100**

### **OBJECTIVE:**

1. To Describe some of the factors affecting reproducibility and external validity.
2. To List the different types of formal experimental designs (e.g. completely randomised, randomised block, repeated measures, Latin square and factorial experimental designs).
3. To explain the concept of variability, its causes and methods of reducing it
4. To describe possible causes of bias and ways of alleviating it
5. To identify the experimental unit and recognise issues of non-independence (pseudo-replication).
6. To describe the six factors affecting significance, including the meaning of statistical power and “p-values”.

### **OUTCOMES:**

1. Describe some of the factors affecting reproducibility and external validity.
2. List the different types of formal experimental designs (e.g. completely randomised, randomised block, repeated measures, Latin square and factorial experimental designs).
3. Explain the concept of variability, its causes and methods of reducing it
4. Describe possible causes of bias and ways of alleviating it
5. Identify the experimental unit and recognise issues of non-independence (pseudo-replication).
6. Describe the six factors affecting significance, including the meaning of statistical power and “p-values”.

### **UNIT I MEASUREMENTS 9**

Basic Concept in Measurements, Measurement of displacement, strain pressure, force, torque etc, Type of strain gauges (Mechanical, Electrical resistance, Acoustical etc..).

### **UNIT II GAUGING 9**

Strain gauge circuits – The potentiometer and Wheatstone bridge – use of lead wires switches etc. Use of electrical resistance strain gauges in transducer applications.

### **UNIT III RECORDING DEVICES 9**

Indicating and recording devices - Static and dynamic data recording –Data (Digital and Analogue) acquisition and processing systems. Strain analysis methods – Rosette analysis. Static and dynamic testing techniques. Equipment for loading-Moire’s techniques.

### **UNIT IV NON DESTRUCTIVE TESTING TECHNIQUES 9**

Non destructive testing techniques. Photoelasticity – optics of photoelasticity – Polariscope – Isoclinics and Isochromatics - methods of stress separation.

## **UNIT V        LAWS OF SIMILITUDE**

**9**

Laws of similitude - model materials – model testing – testing large scale structures – holographic techniques

**TOTAL HRS : 45**

### **TEXT BOOKS**

1. Dally J W and Riley W.F, Experimental stress Analysis, McGraw-Hill, Inc. New York, 2005.
2. Srinath L S et al, Experimental Stress Analysis, Tata McGraw-Hill Publishing co., Ltd., New Delhi, 2006.

### **REFERENCE BOOKS**

1. Rangan C S et al., Instrumentation – Devices and Systems, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 2002.
2. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2006.

**OBJECTIVES**

1. To enable the students for a successful career as water management professionals.
2. To create a potential among students in the area of irrigation management with specific enrichment to synthesis of data and their analysis.
3. To expose the students the need for an interdisciplinary approach in irrigation water management
4. To providing a platform to work in an interdisciplinary team.
5. To provide students an ability to understand the applications of mathematical and scientific concepts to analyse intricate technical, social and environmental problems in irrigation water management and finding solutions for them.
6. To promote student awareness for a life-long learning process and inculcate professional ethics and codes of professional practice in water management.

**OUTCOME**

At the end of this the students will be in a capacity to

1. Understand the concepts of soil-water-plant relationship as well as to expose them to the principles and practices of crop production.
2. Exposure to ground water, hydraulics of ground water related to drainage, drainage concepts, planning, design and management of drainage related irrigation system management
3. Understand the various principles of irrigation management and to analyse the different types of irrigation systems and their performances based on service oriented approach.
4. Gain insight on local and global perceptions and approaches to participatory water resource management
5. Learn from successes and failures in the context of both rural and urban communities of water management.
6. Exposure on the use of economic concepts in irrigation development and to impart knowledge on economic planning so as to enable viable allocation of resources in the irrigation sector.

**UNIT I. IRRIGATION SYSTEM REQUIREMENTS****9**

Irrigation systems – Supply and demand of water – Cropping pattern – Crop rotation – Crop diversification – Estimation of total and peak crop water requirements – Effective and dependable rainfall – Irrigation efficiencies.

**UNIT II. IRRIGATION SCHEDULING****9**

Time of irrigation – Critical stages of water need of crops – Criteria for scheduling irrigation – Frequency and interval of irrigation

### **UNIT III. MANAGEMENT 9**

Structural and non-structural strategies in water use and management – Conjunctive use of surface and ground waters – Quality of irrigation water.

### **UNIT IV. OPERATION 9**

Operational plans – Main canals, laterals and field channels – Water control and regulating structures – Performance indicators – Case study

### **UNIT V. INVOLVEMENT OF STAKE HOLDERS 9**

Farmer's participation in System operation – Water user's associations – Farmer councils – Changing paradigms on irrigation management – Participatory irrigation management

**TOTAL HRS : 45**

#### **TEXT BOOKS**

1. Dilip Kumar Majumdar, "Irrigation Water Management – Principles and Practice", Prentice Hall of India Pvt. Ltd., New Delhi, 2000
2. Hand book on Irrigation Water Requirement, R.T. Gandhi, et. al., Water Management Division, Department of Agriculture, Ministry of Agriculture, New Delhi

#### **REFERENCES**

1. Hand Book on Irrigation System Operation Practices, Water Resources Management and Training Project, Technical report No. 33, CWC, New Delhi, 2000
2. Maloney, C. and Raju, K.V., "Managing Irrigation Together", Practice and Policy in India, Stage Publication, New Delhi, India, 2000

## **COURSE OBJECTIVES**

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings
5. to produce designs using a combination of 2D and 3D software.
6. Get a Detailed study of an engineering artifact

## **COURSE OUTCOME**

The students will be able to

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact
6. Planning and designing of structures

### **UNIT I      INTRODUCTION      9**

Fundamentals of CAD - Hardware and software requirements -Design process - Applications and benefits.

### **UNIT II      COMPUTER GRAPHICS      9**

Graphic primitives - Transformations -Wire frame modeling and solid modeling -Graphic standards –Drafting packages

### **UNIT III      STRUCTURAL ANALYSIS      9**

Fundamentals of finite element analysis - Principles of structural analysis -Analysis packages and applications.

### **UNIT IV      DESIGN AND OPTIMISATION      9**

Principles of design of steel and RC Structures -Applications to simple design problems – Optimisation techniques - Algorithms - Linear Programming – Simplex method

### **UNIT V      EXPERT SYSTEMS      9**

Introduction to artificial intelligence - Knowledge based expert systems -Rules and decision tables –Inference mechanisms - Simple applications.

**TOTAL HRS : 45**

## **TEXT BOOKS**

1. Groover M.P. and Zimmers E.W. Jr., “CAD/CAM, Computer Aided Design and Manufacturing”, Prentice Hall of India Ltd, New Delhi, 2005.
2. Krishnamoorthy C.S.Rajeev S., “Computer Aided Design”, Narosa Publishing House, New Delhi, 2000

## **REFERENCES**

1. Harrison H.B., “Structural Analysis and Design”, Part I and II Pergamon Press, Oxford, 2002.
2. Rao S.S., “Optimisation Theory and Applications”, Wiley Eastern Limited, New Delhi, 2002.
3. Richard Forsyth (Ed), “Expert System Principles and Case Studies”, Chapman and Hall, London, 2000.

**OBJECTIVES:**

1. To understand the importance of transportation and characteristics of road transport
2. To know about the history of highway development, surveys and classification of roads
3. To study about the geometric design of highways
4. To study about traffic characteristics and design of intersections
5. To know about the pavement materials and design
6. To design flexible and rigid pavements as per IRC.

**COURSE OUTCOMES**

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

1. Carry out surveys involved in planning and highway alignment.
2. Design cross section elements, sight distance, horizontal and vertical alignment.
3. Implement traffic studies, traffic regulations and control, and intersection design.
4. Determine the characteristics of pavement materials.
5. Design flexible and rigid pavements as per IRC.
6. Will gain the knowledge of horizontal and vertical curves.

**UNIT I. TYPE OF PAVEMENT AND STRESS DISTRIBUTION ON LAYERED SYSTEM****9**

Introduction - Pavement as layered structure - Pavement types - rigid and flexible -Stress and deflections in pavements under repeated loading

**UNIT II. DESIGN OF FLEXIBLE PAVEMENTS****9**

Flexible pavement design - Empirical - Semi empirical and theoretical Methods - Design procedure as per latest IRC guidelines – Design and specification of rural roads

**UNIT III. DESIGN OF RIGID PAVEMENTS****9**

Cement concrete pavements - Modified Westergard approach - Design procedure as per latest IRC guidelines - Concrete roads and their scope in India.

**UNIT IV. PERFORMANCE EVALUATION AND MAINTENANCE****9**

Pavement Evaluation [Condition and evaluation surveys (Surface Appearance, Cracks, Patches And Pot Holes, Undulations, Ravelling, Roughness, Skid Resistance), Structural Evaluation By Deflection Measurements, Present Serviceability Index] Pavement maintenance. [IRC Recommendations Only]

**UNIT V. STABILISATION OF PAVEMENTS****9**

Stabilisation with special reference to highway pavements - Choice of stabilisers -Testing and field control –Stabilisation for rural roads in India -use of Geosynthetics (geotextiles & geogrids) in roads.

**TOTAL HRS : 45**

## **TEXT BOOKS**

1. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khanna tech. Publications, New Delhi, 2007.
2. Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 2005.
3. Wright, P.H., “Highway Engineers”, John Wiley & Sons, Inc., New York, 2001
4. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001

## **REFERENCES**

1. Yoder R.J and Witczak M.W., “Principles of Pavement Design”, John Wiley, 2003.
2. Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.
3. Guideline for the Design of Rigid Pavements for Highways, IRC:58-2001, The Indian Roads Congress, New Delhi.

**OBJECTIVES:**

1. To understand the role of geology in the design and construction process of underground openings in rock.
2. To apply geologic concepts and approaches on rock engineering projects
3. To identify and classify rock using basic geologic classification systems.
4. To use the geologic literature to establish the geotechnical framework needed to properly design and construct heavy civil works rock projects.
5. To sequential design process used in geotechnical engineering practice.
6. To Require civil engineering students to read and summarize geologic literature for site specific projects.

**OUTCOMES:**

1. Understand the role of geology in the design and construction process of underground openings in rock.
2. Geologic concepts and approaches on rock engineering projects
3. Identify and classify rock using basic geologic classification systems.
4. Use the geologic literature to establish the geotechnical framework needed to properly design and construct heavy civil works rock projects.
5. Sequential design process used in geotechnical engineering practice.
6. Require civil engineering students to read and summarize geologic literature for site specific projects.

**UNIT I. CLASSIFICATION AND INDEX PROPERTIES OF ROCKS 9**

Geological classification – Index properties of rock systems – Classification of rock masses for engineering purpose.

**UNIT II. ROCK STRENGTH AND FAILURE CRITERIA 9**

Modes of rock failure – Strength of rock – Laboratory and field measurement of shear, tensile and compressive strength – Stress strain behaviour in compression – Mohr-coulomb failure criteria and empirical criteria for failure – Deformability of rock.

**UNIT III. INITIAL STRESSES AND THEIR MEASUREMENTS 9**

Estimation of initial stresses in rocks – influence of joints and their orientation in distribution of stresses – technique for measurements of insitu stresses.

**UNIT IV. APPLICATION OF ROCK MECHANICS IN ENGINEERING 9**

Simple engineering application – Underground openings – Rock slopes – Foundations and mining subsidence.

**UNIT V. ROCK BOLTING 9**

Introduction – Rock bolt systems – rock bolt installation techniques – Testing of rock bolts – Choice of rock bolt based on rock mass condition.

**TOTAL HRS : 45**

## **TEXT BOOKS**

1. Goodman P.E., “Introduction to Rock Mechanics”, John Wiley and Sons, 2005.
2. Stillborg B., “Professional User Handbook for rock Bolting”, Tran Tech Publications, 2006.

## **REFERENCES**

1. Brow E.T., “Rock Characterisation Testing and Monitoring”, Pergaman Press, 2002.
2. Arogyaswamy R.N.P., “Geotechnical Application in Civil Engineering”, Oxford and IBH, 2000.
3. Hock E. and Bray J., “Rock Slope Engineering, Institute of Mining and Metallurgy”, 1991.

**OBJECTIVE:**

1. To learnt the design of various steel water tanks, concrete water tanks, steel bunkers and silos, concrete bunkers and silos and prestressed concrete water tanks
2. To design the storage structures.
3. To gain knowledge of steel water tanks and their design.
4. To get a brief idea about concrete water tanks.
5. To design steel bunkers and silos
6. To design prestressed concrete water tanks

**OUTCOMES:**

1. The design of various steel water tanks, concrete water tanks, steel bunkers and silos, concrete bunkers and silos and prestressed concrete water tanks
2. Design the storage structures.
3. Gain knowledge of steel water tanks and their design.
4. Get a brief idea about concrete water tanks.
5. Design steel bunkers and silos
6. Design prestressed concrete water tanks

**UNIT I. STEEL WATER TANKS****9**

Design of rectangular riveted steel water tank – Tee covers – Plates – Stays –Longitudinal and transverse beams – Design of staging – Base plates – Foundation and anchor bolts – Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder – Design of staging and foundation

**UNIT II. CONCRETE WATER TANKS****9**

Design of Circular tanks – Hinged and fixed at the base – IS method of calculating shear forces and moments – Hoop tension – Design of intze tank – Dome – Ring girders – Conical dome – Staging – Bracings – Raft foundation – Design of rectangular tanks – Approximate methods and IS methods – Design of under ground tanks – Design of base slab and side wall – Check for uplift.

**UNIT III. STEEL BUNKERS AND SILOS****9**

Design of square bunker – Jansen’s and Airy’s theories – IS Codal provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams – Design of cylindrical silo – Side plates – Ring girder – stiffeners.

**UNIT IV. CONCRETE BUNKERS AND SILOS****9**

Design of square bunker – Side Walls – Hopper bottom – Top and bottom edge beams – Design of cylindrical silo – Wall portion – Design of conical hopper – Ring beam at junction.

**UNIT V. PRESTRESSED CONCRETE WATER TANKS****9**

Principles of circular prestressing – Design of prestressed concrete circular water tanks.

**TOTAL HRS : 45**

**TEXT BOOKS**

1. Rajagopalan K., Storage Structures, Tata McGraw-Hill, New Delhi, 2002.
2. Krishna Raju N., Advanced Reinforced Concrete Design, CBS Publishers and Distributors, New Delhi, 2000

**REFERENCES**

- 1.R.G.Hopkinson and J.D.Kay, "The Lighting of buildings", Faber and Faber, London, 2000
- 2.William H.Seaverns and Julian R.Fellows, "Air-conditioning and Refrigeration", John Wiley and Sons, London, 2000.

**OBJECTIVES:**

1. To understand the need of energy conversion and the various methods of energy storage
2. To explain the field applications of solar energy
3. To identify Winds energy as alternate form of energy and to know how it can be tapped
4. To explain bio gas generation and its impact on environment
5. To understand the Geothermal & Tidal energy, its mechanism of production and its applications
6. To illustrate the concepts of Direct Energy Conversion systems & their applications.

**OUTCOMES:**

1. Understand the need of energy conversion and the various methods of energy storage
2. Explain the field applications of solar energy
3. Identify Winds energy as alternate form of energy and to know how it can be tapped
4. Explain bio gas generation and its impact on environment
5. Understand the Geothermal & Tidal energy, its mechanism of production and its applications
6. Illustrate the concepts of Direct Energy Conversion systems & their applications.

**UNIT I. INTRODUCTION 9**

Terminology – Wind Data – Gust factor and its determination - Wind speed variation with height – Shape factor – Aspect ratio – Drag and lift.

**UNIT II. EFFECT OF WIND ON STRUCTURES 9**

Static effect – Dynamic effect – Interference effects (concept only) – Rigid structure – Aeroelastic structure (concept only).

**UNIT III. EFFECT ON TYPICAL STRUCTURES 9**

Tall buildings – Low rise buildings – Roof and cladding – Chimneys, towers and bridges.

**UNIT IV. APPLICATION TO DESIGN 9**

Design forces on multistorey building, towers and roof trusses.

**UNIT V. INTRODUCTION TO WIND TUNNEL 9**

Types of models (Principles only) – Basic considerations – Examples of tests and their use.

**TOTAL HRS : 45**

**TEXT BOOKS**

1. Peter Sachs, “Wind Forces in Engineering, Pergamon Press, New York, 2002.
2. Lawson T.V., Wind Effects on Buildings, Vols. I and II, Applied Science and Publishers, London, 2005

**REFERENCES**

1. Devenport A.G., “Wind Loads on Structures”, Division of Building Research, Ottawa, 2003
2. Wind Force on Structures – Course Notes, Building Technology Centre, Anna University, 2002.

**OBJECTIVE:**

1. To give an experience in the implementation of new technology concepts which are applied in field of Advanced construction.
2. To study different methods of construction to successfully achieve the structural design with recommended specifications.
3. To involve the application of scientific and technological principles of planning, analysis, design and management to construction technology.
4. To study of construction equipment's, and temporary works required to facilitate the construction process
5. To provide a coherent development to the students for the courses in sector of Advanced construction technology.
6. To present the new technology of civil Engineering and concepts related Advanced construction technology.

**OUTCOMES:**

1. Implementation of new technology concepts which are applied in field of Advanced construction.
2. Different methods of construction to successfully achieve the structural design with recommended specifications.
3. Application of scientific and technological principles of planning, analysis, design and management to construction technology.
4. Will gain the Knowledge of construction equipment's, and temporary works required to facilitate the construction process
5. Development to the students for the courses in sector of Advanced construction technology.
6. The new technology of civil Engineering and concepts related Advanced construction technology.
- 7.

**UNIT - I      MODERN CONSTRUCTION METHODS      9**

Open Excavation, Shafts and Tunnels- Preparation of foundation, Cofferdams, Caisson, Piled Foundation, Prestressed Concrete Construction, Pre-cast Concrete Construction.

**UNIT - II      CONSTRUCTION METHODS FOR SPECIAL STRUCTURES      9**

Construction Methods For Bridges, Construction Methods for Roads, Construction Methods For Special Structures for Railways, Construction Methods for Dams, Construction Methods for Harbour, Construction Methods for River Works Pipelines

**UNIT - III      MODERN CONSTRUCTION EQUIPEMENTS -I      9**

Construction Equipment used for Earth Moving, Excavating, Drilling, Blasting, Tunneling and Hoisting

**UNIT - IV    MODERN CONSTRUCTION EQUIPEMENTS -II****9**

Construction Equipment used for Conveying, Hoisting, Dredging, Dewatering Systems, Paving and concreting Plant

**UNIT - V    PRINCIPLES AND PRACTICES OF TEMPORARY STRUCTURES****9**

Principles and Practices of Temporary structures, Shoring, and Strutting, Underpinning, Principles and Design of Formwork, Scaffolding, Operation and maintenance of construction equipments

**TOTAL HRS : 45****TEXT BOOKS**

1. Peurifoyu , R. L., , Ledbette, W.B., Construction Planning , Equipment and Methods, Mc Graw Hill Co., 2000.
2. Antill J.M., PWD, Civil Engineering Construction, Mc Graw Hill Book Co., 2005

**REFERENCE**

- 1.Varma, M Construction Equipment and its Planning & Applications, Metropoltian Book Co., 2000
- 2.Nunnaly, S.W., Construction Methods and Management , Prentice – Hall, 2000
- 3.Ataev, S.S., Construction Technology, MIR , Pub. 2000

