BACHELOR OF TECHNOLOGY IN BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Syllabus
2017-2018

DEPARTMENT OF BIOTECHNOLOGY (B. Tech)
ENGINEERING

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established under section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari (Post), Coimbatore- 641021, Tamil Nadu, India
Phone: 0422 – 2980011 – 15  Fax No: 0422 – 298022-23
Email: info@karpagam.com Web: www. kahedu.edu.in
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.

INTENDED OUTCOMES:

Students undergoing this course will be able to

- 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.

Unit I  LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing)  (9)

Listening – Types of listening- Listening to class reading - Video tapes/ Audio tapes. Speaking – Introduction on self. Reading - Reading for comprehension – Reading different kind of passages like descriptive, narrative, objective, conversational and argumentative. Writing – Formal and Informal letters- Letters to the Editor.

Grammar & Vocabulary (Function Grammar & Technical Vocabulary)

Tenses -Articles. Vocabulary - Word Formation – Word expansion (Root word) - Prefix and Suffix.

Unit II  LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing)  (8)


Grammar & Vocabulary (Function Grammar & Technical Vocabulary)

WH questions –Yes/No Question - Subject Verb agreement. Vocabulary – Compound Nouns/Adjectives – Irregular verbs.
Unit - III  LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing)  

**Listening** – Listening for specific task – fill in the gaps. **Speaking** – Phonemes – Syllables – Role play – Conversation Practice. **Reading** – comprehension passages based on general topics or matters of current affairs. **Writing** - Autobiographical writing & Biographical writing.

**Grammar & Vocabulary (Function Grammar & Technical Vocabulary)**

Preposition – Infinitive & Gerund. **Vocabulary** – Foreign words used in English – British and American usage.

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Unit- IV  LSRW SKILLS & GRAMMAR, CAREER ORIENTED

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing)  

**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) & Instruction writing.

**Grammar & Vocabulary (Function Grammar & Technical Vocabulary)**

Parts of Speech , Sentence pattern – Voice (active and passive voice). **Vocabulary** – One word substitution.

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Unit- V  LSRW SKILLS & GRAMMAR, FIELD WORK

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing)  


**Grammar & Vocabulary (Function Grammar & Technical Vocabulary)**

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:**

<table>
<thead>
<tr>
<th>S. NO.</th>
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<tbody>
<tr>
<td>1</td>
<td>Sangeeta Sharma, Meenakshi Raman</td>
<td>Technical Communication: Principles And Practice 2nd Edition</td>
<td>OUP, New Delhi.</td>
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**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
OBJECTIVES:

- To impart analytical ability in solving mathematical problems of Physical or Engineering models.
- To understand the concepts of Matrices, Theory of Equations, Differential Calculus and its application, Integral Calculus and its application, Ordinary differential equations.

INTENDED OUTCOMES:

1. This course equips students to have basic knowledge and understanding in the field of matrices, integral and differential calculus.
2. The students acquire the knowledge of techniques in solving ordinary differential equations that model engineering 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- Euler’s form of Differential equations.

Total: 60
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**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)
OBJECTIVE:

- To enhance the fundamental knowledge in Physics and its applications relevant to various branches of Engineering and Technology

INTENDED OUTCOME:

1. The students will have the knowledge on the basics of physics related to properties of matter, fiber optics, quantum, crystal physics and that knowledge will be used by them in different engineering and technological applications.

UNIT I  PROPERTIES OF MATTER AND THERMODYNAMICS  (9)

Three types of modulus of elasticity – basic definitions, relation connecting the modulii (Derivation), Poisson’s ratio- Torsional pendulum- bending of beams - bending moment – uniform and non uniform bending

UNIT II  LASER AND FIBER OPTICS  (9)

Introduction – emission and absorption process- Einstein’s coefficients derivation. Types of LASER - CO₂, 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 – Black body radiation - dual nature of matter and radiation – de Broglie wavelength, uncertainty principle –Schrödinger’s wave equation – time dependent and time independent equations – particle in one dimensional box- physical significance of wave function, scanning electron microscope

UNIT IV  CRYSTAL PHYSICS  (9)

Lattice – unit cell – Bravais lattice – 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)


Total- 45
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<td>1</td>
<td>Ganesan.S and Baskar.T</td>
<td>Engineering Physics I</td>
<td>GEMS Publisher, Coimbatore-641 001</td>
<td>2015</td>
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<td>Serway and Jewett</td>
<td>Physics for Scientists and Engineers with Modern Physics</td>
<td>Thomson Brooks/Cole, Indian reprint, New Delhi</td>
<td>2010</td>
</tr>
<tr>
<td>5</td>
<td>P. Khare, A. Swarup</td>
<td>Engineering Physics: Fundamentals and Modern Applications</td>
<td>Jones &amp; Bartlett Learning</td>
<td>2009</td>
</tr>
</tbody>
</table>

## WEBSITES:

1. www.nptel.ac.in  
2. www.physicsclassroom.com  
3. www.oyc.yale.edu  
4. www.physics.org
OBJECTIVES:

- To understand about the water technology.
- To get the information on electrochemical cells, batteries, fuels and combustion.
- To study about the corrosion and protective coatings.
- To gain knowledge on adsorption phenomena.

INTENDED OUTCOME:

1. This course will create an impact on the students and make them to realize the modern utility on electrochemical cells, batteries, fuels and combustion process, corrosion and adsorption methods.

UNIT I WATER TECHNOLOGY


UNIT II ELECTROCHEMISTRY AND STORAGE DEVICES


UNIT III FUELS AND COMBUSTION


UNIT IV CORROSION SCIENCE

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings – Organic coatings-Paints - Constituents and functions –Inorganic coatings- Metallic coatings - Electroplating of Cu over Fe and Electro less plating (Ni) - Surface conversion coating - Hot dipping.- Anodizing of Al

UNIT V SURFACE CHEMISTRY AND PHASE RULE

Phase Rule: Definition - Phase diagrams – one component water system, two component Ag-Pb system.

Total: 45

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WEBSITES:

5. http://www.chem.qmul.ac.uk/surfaces/sec
INTRODUCTION TO BIOTECHNOLOGY

OBJECTIVE

- To give a basic knowledge on the various fields of Biotechnology.
- To make them understand the ethical considerations in Biotechnology.

INTENDED OUTCOMES

At the end of the course,

- The students will be exposed to the various techniques and applications involved in Biotechnology.
- The students will get a better understanding on development of bioproducts with social and ethical considerations.

UNIT I  BASICS OF BIOLOGY  (9)
Cell theory, Prokaryotic and eukaryotic cells- Cell structure, Biomolecules: carbohydrates, Proteins, lipids and Nucleic acid-DNA & RNA, Types of bonds involved in biomolecules.

UNIT II  GENERAL BIOTECHNOLOGY  (9)
Biotechnology: An overview – biotechnology – an interdisciplinary pursuit, old and new biotechnology, scope and importance, Isolation and screening of microorganisms, microbe growth curve, basics of rDNA technology – cloning

UNIT III  INDUSTRIAL BIOTECHNOLOGY  (9)
Production of single cell protein (SCP): advantages and nutritional value, Overview of enzymes and its applications in various fields, Production of primary and secondary metabolites from microbial source - citric acid, ethanol fermentation and penicillin.

UNIT IV  BIOTECHNOLOGY IN AGRICULTURE AND HEALTH CARE  (9)
Biotechnology methods of crop improvement – plant tissue culture, Genetically modified crops – golden rice and Bt cotton, Conventional vaccines, concept of recombinant vaccines, recombinant insulin.

UNIT V ENVIRONMENTAL BIOTECHNOLOGY AND ETHICAL CONSIDERATIONS  (9)
Biofuels - Production, bioinsecticides - Production, biofertilizers – types, production and Biosafety- definition- levels - guidelines.

Total hours: 45
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<td>1</td>
<td>R.C. Dubey</td>
<td>A Textbook of Biotechnology</td>
<td>S. Chand &amp; Company LYD.</td>
<td>2014</td>
</tr>
<tr>
<td>2</td>
<td>P.K. Gupta</td>
<td>Elements of Biotechnology</td>
<td>Rastogi Publication</td>
<td>2nd Edition (3rd Reprint) 2015-17</td>
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<tr>
<td>2</td>
<td>H.D. Kumar</td>
<td>Modern Concepts of Biotechnology</td>
<td>Vikas Publication House Pvt LTD</td>
<td>2007</td>
</tr>
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</table>
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.

INTENDED OUTCOMES

- 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.

UNIT I ELECTRIC CIRCUITS & MEASUREMENTS


UNIT II ELECTRICAL MACHINES


UNIT III MEASURING INSTRUMENTS

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


UNIT V DIGITAL ELECTRONICS

Number systems – binary codes - logic gates - Boolean algebra, laws & theorems- simplification of Boolean expression - implementation of Boolean expressions using logic gates - standard forms of Boolean expression.

TOTAL 45

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<tr>
<td>2</td>
<td>Sedha R.S</td>
<td>Applied Electronics</td>
<td>S. Chand &amp; Co</td>
<td>2006</td>
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<tbody>
<tr>
<td>4</td>
<td>Premkumar N</td>
<td>Basic Electrical Engineering</td>
<td>Anuradha Publishers</td>
<td>2003</td>
</tr>
</tbody>
</table>
OBJECTIVE:

- To develop basic laboratory skills and demonstrating the application of physical principles.

INTENDED OUTCOME:

1. The students will have the knowledge on Physics practical experiments and that knowledge will be used by them in different engineering and technological applications.

LIST OF EXPERIMENTS – PHYSICS

1. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of Young’s modulus of the material – Non uniform bending (or) Uniform bending.
5. Spectrometer Dispersive power of a prism.
7. Particle size determination using Diode Laser
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 – Wheatstone Bridge
OBJECTIVE:

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

INTENDED OUTCOME:

1. The students will be outfitted with hands-on knowledge in quantitative chemical analysis of water quality parameters and corrosion measurement.

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 BaCl₂ vs Na₂SO₄.
8. pH Titration (acid & base).
9. Potentiometric Titration (Fe²⁺ / KMnO₄ or K₂Cr₂O₇).
10. Estimation of Ferric ion 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.
OBJECTIVE

- To provide exposure to the students with hands on experience on various basic engineering practices in Mechanical, Electrical and Electronics Engineering.

INTENDED OUTCOMES

- To provide exposure to the students with hands on experience on various basic Engineering practices in Civil and Mechanical Engineering
- To provide exposure to the students with hands on experience on various basic Engineering practices in Electrical and Electronics Engineering.

PART – A (MECHANICAL)

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

ii. **BASIC MACHINING**
   - Simple Turning and Taper turning
   - Drilling and Tapping
   - Sheet Metal Work
   - Model making – Trays, funnels, etc.

iii. **DEMONSTRATION ON**
   - Smithy operations
   - Foundry operations
   - Plumbing Works
   - Carpentry Works

PART – B (ELECTRICAL & ELECTRONICS)

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

v. **ELECTRONICS ENGINEERING**
   - Study of Electronic components– Resistor (color coding), capacitors and inductors.
   - Soldering practice – Components Devices and Circuits – Using general purpose PCB.
   - Study of logic gates AND, OR, NOT, NOR and NAND.
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<tbody>
<tr>
<td></td>
<td>Balasubramanian, S</td>
<td>Laboratory</td>
<td></td>
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OBJECTIVES

1. To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing national standards related to technical drawings.

OUTCOMES:

On Completion of the course the student will be able to
1. perform free hand sketching of basic geometrical constructions and multiple views of objects.
2. do orthographic projection of lines and plane surfaces.
3. draw projections and solids and development of surfaces.
4. prepare isometric and perspective sections of simple solids.
5. demonstrate computer aided drafting.

UNIT I INTRODUCTION

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

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

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

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

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)

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

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<td>VTU</td>
<td>A Primer on Computer Aided Engineering Drawing</td>
<td>Belgaum</td>
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### WEB REFERENCES

OBJECTIVE:

Yoga Education Helps To Develop The Self Discipline, Self Control, Awareness, Concentration And Higher Level Of Consciousness.

AIM : To Enable The Student To Have Physical Health And Mental Health.

UNIT- I
Introduction To Yoga- Meaning Of Yoga – Concept Of Yoga- Aim And Objectives Of Yoga –History Of Yoga - Systems Of Yoga.– Stages (Or) Limbs Of Yoga

UNIT- II

UNIT- III

UNIT- IV

UNIT- V

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<td>1.</td>
<td>Dr.K.Chandrasekaran</td>
<td>Sound Health Through Yoga</td>
<td>PremKalyan</td>
<td>2009</td>
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<td>2.</td>
<td>B.K.S.Iyangar</td>
<td>Light On Pranayama</td>
<td>Crossroad Centuary</td>
<td>2013</td>
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<tr>
<td>3.</td>
<td>Thirumular</td>
<td>Thirumandhiram</td>
<td>Sriramakrishna Math</td>
<td>2016</td>
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Yoga Education Helps To Develop The Self Discipline, Self Control, Awareness, Concentration And Higher Level Of Consciousness.
SEMESTER II

17BTCC201A BUSINESS COMMUNICATION 3 0 0 3

OBJECTIVES:

- To help students comprehend the role of listening skills in effective communication.
- To familiarize students with verbal and non-verbal communication.
- To expose students to neutral accent.
- To develop emotional intelligence skills in them for enhancing their self-esteem.
- To assist them in setting goals and developing positive attitude.
- To enable students to acquire decision making skills, problem solving skills and assertive skills.

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Design and deliver a persuasive presentation that convines the audience of the topic’s relevance and overcomes resistance, using appropriate visual support and adhering to a specified time limit.
- Use a strategic communication model and critical thinking to identify objectives, analyze audiences, and choose the most effective structure and style for delivering strategically sound written and spoken messages.
- Practice principles of effective business writing and document design in all written documents.
- Build an understanding of different organizational cultures, business practices, and social norms to communicate more effectively in domestic and cross-cultural business contexts.
- Develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.

UNIT I


UNIT II


UNIT III

UNIT - IV
Difference between goals and dreams - SMART goal setting - 3 Ds of goal setting- Determination, Discipline and Direction - Developing the right attitude - Motivation - Intrinsic and Extrinsic motivation - Dealing with change - Dedication - Taking responsibilities - Decision making.

UNIT - V
Intrapersonal skills - Self-analysis - Thought process – Interpersonal skills - Confidence building - Resolving conflicts- Analytical skills - Team Building - Leadership skills - Planning/organizing - Ability to work independently - Professional ethics - Communicating via e-mail. Ethical perspectives and their implications for responsible communication - Proposal Presentation

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<td>Meenakshi Raman ; Prakash Singh</td>
<td>Business Communication</td>
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http://tribehr.com/social-hr-software/talent-management/skills-tracking
www.ispeakyouspeak.blogspot.com
https://alison.com/subjects/6/Personal-Development-Soft-Skills
www.learning-development.hr.toolbox.com
http://www.niit.com/solution/soft-skill-training

http://mybcommlab.com to test your understanding of the concepts presented in each chapter and explore additional materials that will bring the ideas to life in videos, activities, and an online multimedia e-book.
OBJECTIVES:

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

INTENDED 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 them 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.
- Enrich the ability to face interviews with confidence.

UNIT-1  LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)


Grammar & Vocabulary (Function Grammar & Technical Vocabulary)
Regular & Irregular verbs - Kinds of sentences - Question tags. Homonyms and Homophones.

UNIT-II  LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)

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
unit. Writing - Writing a review (Film review) - Summary of a story. Grammar & Vocabulary (Function Grammar & Technical Vocabulary) Modal verbs – Conjunction - Expression of cause and effect. Phrasal verbs - Idioms.

UNIT – III  LSRW SKILLS & GRAMMAR

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)


UNIT-IV  LSRW SKILLS & GRAMMAR, CAREER ORIENTED

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)


UNIT- V  LSRW SKILLS & GRAMMAR, FIELD WORK

Receptive Skills (Listening, Reading and Scanning) & Productive Skills (Writing, Speaking and Representing) (9)

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 & Vocabulary (Function Grammar & Technical Vocabulary) Transformation of sentences (Simple, Compound & Complex).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.
### TEXT BOOK:

<table>
<thead>
<tr>
<th>S. NO.</th>
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<tbody>
<tr>
<td>1</td>
<td>Sangeeta Sharma, Meenakshi Raman</td>
<td>Technical Communication: Principles And Practice 2nd Edition</td>
<td>OUP, New Delhi.</td>
<td>2015</td>
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</thead>
</table>

### 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
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 understand the concepts of Boundary value problems and Statistics.

INTENDED OUTCOMES:

1. The students will be able to understand mathematical tools needed in evaluating multiple integrals and their usage.
2. The students will be able to familiarize functions of several variables which is used in many physical engineering problems.

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)


UNIT III  FOURIER SERIES  (12)


UNIT IV  BOUNDARY VALUE PROBLEMS  (12)

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

UNIT V  STATISTICS  (12)


Total: 60
**REFERENCES:**

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<thead>
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<tbody>
<tr>
<td>2</td>
<td>Dr.P.Kandasamy, Dr.K.Thilagavathy, Dr.K.Gunavathy</td>
<td>Engineering Mathematics Volume III</td>
<td>S.Chand &amp;Co., New Delhi.</td>
<td>2013</td>
</tr>
</tbody>
</table>

**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 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.

INTENDED OUTCOME:

1. Students will prepare themselves to go ecofriendly and help preserving the nature and environment.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

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

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

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

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

Total: 45

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<tr>
<td>1.</td>
<td>Dr. Ravikrishnan, A</td>
<td>Environmental Science</td>
<td>Sri Krishna Hi tech Publishing Company Private Ltd., Chennai</td>
<td>2012</td>
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WEBSITES:
OBJECTIVE:

- To understand the importance of chemistry behind every biomolecule and their uses.
- To make the students understand the importance of biomolecules.

INTENDED OUTCOMES:

- To provide strong foundation to biochemistry.
- To learn the structure and properties of important biomolecules.

UNIT-I THE FOUNDATIONS OF BIOCHEMISTRY

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


UNIT-II WATER

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 CARBOHYDRATES AND GLYCIBIOLOGY

Monosaccharides: aldose, ketose, epimers, pyronoses, 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-IV (a) AMINO ACIDS, PEPTIDES, PROTEINS


(b) LIPIDS

Fatty acids, structural lipids in membrane, galactolipids, sphingolipids, and sterols, lipid extraction.
UNIT-V NUCLEOTIDES AND NUCLEIC ACIDS

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 - Double helix, Watson-Crick structure, RNA-three dimensional structure, nucleic acid chemistry: denaturation and annealing, DNA sequences determination, chemical synthesis of DNA.

Total: 45

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OBJECTIVE:
- To familiarize with open source office packages
- To write programs for Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings and Functions.

INTENDED OUTCOME:
- Study, analyze and understand logical structure of a computer program, and different construct to develop a program in ‘C’ language

THEORY:

What is computer- Computer Components- What is C- C Character set- Constants, Variables and Keywords-General form of C Program - Relational and Logical Operators - Selection Structures- If and nested if - Switch Case - Loops-Definition and types- Functions- Arrays- Introduction to Strings-Pointers.

PRACTICALS:

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, implementation of pointers.

REFERENCES:

Total Hours: 45
OBJECTIVE:
- To impart knowledge on qualitative and quantitative techniques.
- To estimate and assay various biomolecules.

INTENDED OUTCOMES:
- The students are taught the different quantitative and qualitative technique
- Estimation of Biomolecules will be done by the students

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 / Spectrophotometric method)
9. Estimation of RNA (Orcinol method / Spectrophotometric method)

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<td>1</td>
<td>Boyer, R.</td>
<td>Experimental Biochemistry</td>
<td>Benjamin Cummings, Redwood City, California, USA</td>
<td>2000</td>
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<tr>
<td>2</td>
<td>Palanivelu, P.</td>
<td>Analytical Biochemistry and Separation Techniques</td>
<td>Kalaimani Printers, Madurai</td>
<td>2001</td>
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<tr>
<td>1</td>
<td>Sadasivam, S. &amp; A. Manickam</td>
<td>Biochemical Methods</td>
<td>New Age International Pvt Ltd Publishers, New Delhi</td>
<td>2002</td>
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</table>
Scope:
Any business has to be developed from scratch. As entrepreneur one should learn various avenues of promoting the given business along with ethics which is other side of the coin. This course is meant to inculcate to develop a business plan connected with ethics.

Objective:
To explain relevance of Ethics while taking business decisions.

Unit I

Unit II
Business Plan Process - Sources of Information – Online Resources - Offline Resources - Sources of Market Research - Benefits of market study - Coverage of market study.

Unit III

Reference books:
2. Rhonda Abrams “The business plan in a day" Prentice Hall.
3. Business plan preparation - Entrepreneurship Development Institute of India
Semester III

17BTBT301 PROBABILITY AND STATISTICS 3 2 0 4

OBJECTIVES:

- To introduce the concept of probability and Sampling techniques.
- To understand the fundamentals of Experimental Designs and Quality Control.

INTENDED OUTCOME:

1. The students would be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

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)

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).

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</table>

**WEBSITES:**

1. www.cut-theknot.org/probability.shtml
2. www.mathcentre.ac.uk
3. www.mathworld. Wolfram.com
OBJECTIVES

- To gain the basic knowledge in understanding the cell structure and its organelles.
- To know how the transport of various nutrients across the cell wall takes place.

INTENDED OUTCOME:

- The students will be able to understand type of cell, its morphology, signaling, cell culture and transport of various nutrients across the cell wall
- To understand the cell cycle phenomena extensively

UNIT-I CELL STRUCTURE AND CELL ORGANELLES (9)
History of cell biology, comparison of eukaryotic and prokaryotic cells, membrane organisation, theories, components; Structure of prokaryotic cells - cilia, flagella, cell wall; Structure of eukaryotic cell organelles: cytoplasm, endoplasmic reticulum, mitochondria, chloroplast, peroxisomes, nucleus, Microscopic techniques for viewing cell organelles.

UNIT-II CYTOSKELETAL PROTEINS & CELL DIVISION (9)
Cytoskeletal proteins - Types, contractile proteins – actin & myosin, cell adhesion proteins; 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, Ca2+ 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 CELL SIGNALLING (9)
Cytosolic, nuclear and membrane bound receptors, examples of receptors, identify cation and purification of cell surface receptors, secondary messangers, autocrine, paracrine and endocrine modes of action

UNIT- V FUNCTION OF MITOCHONDRIA AND CHLOROPLAST (9)

Total Hours: 45
## TEXT BOOKS

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<tbody>
<tr>
<td>1</td>
<td>S. C. Rastogi</td>
<td>Cell Biology</td>
<td>New Age International Pub. Ltd</td>
<td>2004</td>
</tr>
<tr>
<td>3</td>
<td>De Robertis, E. D. P. and De Robertis, E. M. F</td>
<td>Cell and Molecular biology</td>
<td>B. I publications pvt. Ltd.</td>
<td>2005</td>
</tr>
</tbody>
</table>
### OBJECTIVES

- To understand the similarities and differences among the microorganisms.
- To learn the nutritional requirements of bacteria, growth curve and different methods to quantitate bacterial growth.

### INTENDED OUTCOMES

At the end of the course,
- The students will get a clear understanding on the identification of microorganisms.
- The students will be exposed to the various classes of antibiotics, anti-viral and anti-fungal agents.

### UNIT-I INTRODUCTION

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

### UNIT-II MICROBES-STRUCTURE AND MULTIPLICATION

Structural organization and multiplication - bacteria, viruses, algae and fungi, actinomycetes, yeast, mycoplasma, cyanobacteria and bacteriophage.

### UNIT- III MICROBIAL NUTRITION, GROWTH AND METABOLISM

Cultivation, Nutritional requirements and different media – bacterial culture; aerobic and anaerobic; growth curve, preservation methods; bioenergetics, utilization of energy, biosynthesis of important molecules.

### UNIT – IV CONTROL OF MICROORGANISMS

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

### UNIT – V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY

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

Total Hours: 45
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<td>1</td>
<td>TalaronK, Casita, Pelczar And Reid.</td>
<td>Foundations in Microbiology</td>
<td>W.C. Brown Publishers</td>
<td>1993</td>
</tr>
<tr>
<td>4</td>
<td>Kolwzan, B, Adamiak, W, Grabes, K, Pawelczyk, A</td>
<td>Introduction to Environmental Microbiology</td>
<td>ebook</td>
<td>2006</td>
</tr>
</tbody>
</table>
OBJECTIVES

To impart knowledge on
- Basic chemical calculations, first and second laws of thermodynamics, material balances without and with chemical reactions.
- Fluid mechanics, Fluidisation, centrifugal and piston pumps, characteristics, compressors.

INTENDED OUTCOME:

To familiarize
- Units and Basic calculation
- Study of fluids
- Conservation and application
- Mechanism of Fluidization and Transportation of fluids

UNIT- I     BASIC CHEMICAL CALCULATIONS

SI units, stoichiometry, basic chemical calculations: mole, atomic mass and molar mass, equivalent mass, conversion of mass function 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

Entropy, Enthalpy, Free energy, Energy balances, sensible heat, latent heat, vapour pressure, steady and unsteady state calculations.

UNIT- III    MATERIAL BALANCES

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

UNIT- IV    FLUID MECHANICS

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

UNIT- V    TRANSPORTATION OF FLUIDS

Pumps- Types, Working principle, Characteristics, Suction and Cavitation; Measurements of flowing fluids; Fluidization and flow through Packed Bed Column

Total Hours: 45
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<tr>
<td>1</td>
<td>Bhatt B.I., and Vora S.M.</td>
<td>Stoichiometry</td>
<td>Tata McGraw-Hill,</td>
<td>2010</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To enable the students to understand the basic concepts in organic chemistry with the emphasis on stereochemistry and enzyme reactions
- To study the protein folding pathways and energy landscapes.

INTENDED OUTCOME:

- At the end the students will understand various biochemical synthesis, protein kinetics and the mechanism involved in biochemical reactions.
- The students will be exposed to the structure of various enzymes and the kinetics involved in protein folding.

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 SN1 SN2 reactions, E1E2 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, co-operativity - oxygen binding by haemoglobin. Inhibition – reversible and irreversible – competitive, non-competitive, uncompetitive inhibition (characteristics and examples).

UNIT-III STEREOCHEMISTRY OF ENZYMATIC REACTIONS (9)
Sterospecific 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)
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, \(^{1}\text{H}^{2}\text{H}\) exchange methods, folding of peptides, CI2 folding, molecular chaperones.

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<td>Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding</td>
<td>W H Freeman</td>
<td>1999</td>
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<td>2</td>
<td>Morrison, R. T</td>
<td>Organic Chemistry</td>
<td>Prentice Hall of India Pvt Ltd</td>
<td>1999</td>
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<td>Bioorganic Chemistry</td>
<td>Springer Verlag</td>
<td>1999</td>
</tr>
<tr>
<td>4</td>
<td>Palmer,T</td>
<td>Enzymes</td>
<td>Affiliated East West Press Pvt.Ltd</td>
<td>2004</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To develop basic laboratory skills in cell biology.
- To describe, analyze, interpret and explain experimental data based on scientific reasoning and knowledge.

INTENDED OUTCOME:

- The students will be able to use the different kinds of microscope.
- Students will be able to perform the different staining techniques.

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

REFERENCE BOOKS

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<th>S.NO.</th>
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<td>2</td>
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<td>Experimental procedures in Life Sciences</td>
<td>Anjanna Book House, Chennai</td>
<td>2011</td>
</tr>
</tbody>
</table>
OBJECTIVES

To demonstrate technical competence in handling microorganism.

INTENDED OUTCOME:

- The students will learn to work by following the safety and aseptic guidelines
- The students will be able to select the appropriate culture media and culture conditions based on the type of microorganism to be grown

1. Laboratory Safety and Aseptic Techniques
2. Microscopy-Light Microscopy, Phase Contrast & Fluorescent 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/aeration/pH)
10. Water quality analysis – Most Probable Number Test (MPN)

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<td>Arora, B., D.R. Arora</td>
<td>Practical Microbiology</td>
<td>CBS Publishers and Distributors, Bangalore</td>
<td>2007</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To train the students in the synthesis of organic molecules.
- To learn to purify the compounds.

INTENDED OUTCOME:

- Students will be able to synthesize commercially important products in small scale.
- Students will understand the chemical reactions involved in the formation of chemical compounds.

2. Synthesis of p-nitroacetanilide.
3. Preparation of Acetanilide from Aniline.
4. Hydrolysis of Sucrose.
5. Extraction of Lycopene
7. Preparation of 1,2:5,6- dicyclohexylidine- alpha-D glucofruranose.
8. Preparation of Oleic acid.
9. Preparation of casein from milk

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17BTBT313    BIO-ORGANIC CHEMISTRY LAB    0 0 3 2 100

17BTBT314    COURSE ORIENTED PROJECT 1    0 0 2 1 100
OBJECTIVE

1. To elevate the students into productivity powerhouses who can employ life skills to better their performances

UNIT I
Overview to communication, self Introduction, Presentation on their own topic, Extempore, Group Activity

UNIT II
Group Discussion, Do's and Don'ts of Group Discussion, Body language, Grooming and Resume, Resume correction

UNIT III
Introduction to HRM – Questions - Do's and Don’t’s - Interview - Mock GD - Stress Management

UNIT IV
Personality Development - Presentation skills, Interpersonal skills, Critical thinking, Confidence building and Stress management.

TOTAL 15

REFERENCES

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<td>Barun K Mitra</td>
<td>Personality Development and Soft Skills</td>
<td>Oxford University Press-New Delhi</td>
<td>2012</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To impart knowledge on mixing, agitation and filtration techniques
- To learn about the modes of heat transfer and the principle, design of various heat exchangers.

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Demonstrate the usage of filtration equipment for filtering the media required for the process.
- Understand the basic concepts of heat transfer operations using Fourier’s law and different modes of heat energy.

UNIT- I MIXING AND AGITATION (8)
Agitation: purpose, equipments, flow pattern, dimensional analysis; power; agitation of liquids; gas-liquid systems; gas-solid suspensions; agitator scale up.

UNIT-II FILTRATION (8)
Filtration-types, 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 and sphere, unsteady state conduction, heat transfer from extended surfaces.

UNIT- IV CONVECTION HEAT TRANSFER (10)
Dimensional analysis, forced and natural convection, convection in flow over surfaces - pipes boiling and condensation.

UNIT- V HEAT EXCHANGERS (9)
Heat exchanger- types, Equipments; overall heat transfer coefficients; design; NTU concept; Evaporators; single and multiple effects; mass and enthalpy balances.

Total Hours: 45
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OBJECTIVES

- To understand the thermodynamic properties of fluids.
- To have knowledge on phase equilibria and chemical reaction equilibrium.

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Relate the partial molar properties of industrial process fluids and their applicability in solution thermodynamics.
- Apply laws of thermodynamic to solve the energy related issues and analyze the various parameters for the efficiency and process modernization in liquefaction.

UNIT-I THERMODYNAMIC PROPERTIES OF FLUIDS (9)
Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties - equations of state; Actual property exchanges - Calculations; 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 - 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 - 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 and refrigeration

Total Hours: 45
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<td>van der Wielen</td>
<td>Thermodynamics in Biochemical Engineering</td>
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</table>
OBJECTIVES

- To have strong foundation in understanding theoretical principles associated with various instruments used in the chemical and biotechnology research.
- To impart knowledge in separation methods including chromatography, electrophoresis

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Understand the properties of electromagnetic radiation and to rectify the noise during measurements.
- Relate the concepts of various spectroscopic techniques and their applications in biotechnology.

UNIT I  INTRODUCTION TO SPECTROMETRY (9)


UNIT II  MOLECULAR SPECTROSCOPY (9)


UNIT III  MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY (9)

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMRspectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation, application.

UNIT IV  SEPARATION METHODS (9)

UNIT V THERMAL METHODS

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

Total Hours: 45

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<td>Instrumental Methods of Chemical Analysis</td>
<td>Krishna prakasan</td>
<td>2004</td>
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</table>
OBJECTIVES

- To have strong understanding of classical genetics,
- To understand the structure of nucleic acids, transcription, translation and gene regulation.

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Understand the structure of DNA and differentiate the process of replication in prokaryotes and eukaryotes.
- Describe the process of regulation of transcription and translation in prokaryotes and eukaryotes.

UNIT-I CLASSICAL GENETICS (7)
Eukaryotic genetics- Mendelian genetics, linkage, crossing over, classical experiments – Hershey and Chase, Avery McLeod & McCarty. Prokaryotic genetics - Bacterial conjugation, transduction and transformation.

UNIT- II STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION (10)
Conformation of DNA, Types of RNA, Replication in prokaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organisation of eukaryotic chromosome – cot value, replication of telomer es in eukaryotes

UNIT-III TRANSCRIPTION (10)
Conformation of RNA- Prokaryotic and Eukaryotic transcription, RNA polymerase, Transcription signals, transcription factors, Features of promoters and enhancers, ribozymes. Post transcriptional modification – 5’ capping, adenylation, splicing, processing of rRNA and tRNA, RNA editing.

UNIT-IV TRANSLATION (9)
Genetic code, Salient features - Wobble hypothesis, basic machinery of translation and its mechanism, codon usage, Post translational modifications, protein targeting.

UNIT-V REGULATION OF GENE EXPRESSION (9)
Regulation of genes – replication, transcription & translation factors, Lac operon, ara operon and trp operon, phage life cycle, Mutation – transition, transversion, artificial & natural mutation, suppressor mutation and repair of DNA.

Total Hours: 45
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<td>Mc Graw Hill</td>
<td>2005</td>
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</table>
OBJECTIVES

- To develop skills of the students in the area of bioprocess technology with emphasis on bioprocess principles.
- To learn about fermentation processes, metabolic stoichiometry, energetics, kinetics of microbial growth etc.

INTENDED OUTCOME:

- At the end of the course, the students would have learnt about fermentation processes, metabolic stoichiometry, energetics, kinetics of microbial growth etc.
- This will serve as an effective course to understand certain specialized electives in Bioprocess related fields.

UNIT-I OVERVIEW OF FERMENTATION PROCESSES

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of Fermentor and ancillaries, monitoring and controlling – fermentation parameters processes.

UNIT-II RAW MATERIALS AND MEDIA DESIGN

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

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

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  


Total Hours: 45

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<td>3</td>
<td>Harvey W. Blanch, Douglas S. Clark</td>
<td>Biochemical Engineering</td>
<td>CRC Press</td>
<td>2014</td>
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</tbody>
</table>
OBJECTIVES

- To study about the structure, composition and function of various biomolecules
- To study the metabolic pathways of various biomolecules

INTENDED OUTCOME:

At the end of the semester
- The students will enable to understand the metabolism of carbohydrates, lipids, proteins and the bioenergetics.
- The students will be exposed to the metabolic and genetic disorders

UNIT-I BIOENERGETICS (8)

Metabolism - 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, genetic disorders affecting carbohydrate metabolism

UNIT III 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. Inborn errors of amino acid metabolism.

UNIT IV METABOLISM OF LIPIDS (9)

Digestion, mobilization, and transport of fats, fatty acid entry into mitochondria via the acyl-carnitine/carnitine transporter. Biosynthesis of fatty acid, Triacylglycerol and cholesterol. The β-oxidation pathway. Oxidation of a monounsaturated and polyunsaturated fatty acid. Genetic defects in fatty Acyl–CoA dehydrogenases causing serious diseases.
UNIT V  METABOLISM OF NUCLEIC ACIDS

Biosynthesis of nucleotides, denovo and salvage pathways for purines and pyrimidines, regulatory mechanisms; catabolism of purine & pyrimidine; Metabolic disorders associated with nucleic acid metabolism.

Total Hours: 45

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<td>Metabolism at a Glance</td>
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</table>
OBJECTIVES

- To understand the basic principle of analytic techniques
- To have hands on experience in instrumental techniques used in chemical and biochemical research labs.

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Use absorption spectroscopy to obtain valid and precise results in qualitative analysis experiments using Lambert’s – Beer law.
- Demonstrate the different spectroscopic and chromatographic techniques.

1. Precision and validity in an experiment using absorption spectroscopy and validating Lambert-Beer's law using kMnO₄
2. Determination of analytical wavelength for KMnO₄
3. Determination of iron concentration using 1,10 phenanthroline.
4. Finding the pKa 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 AL+++ by flourimetry.
9. Determination of Rₜ value using TLC.
OBJECTIVES

- To make the students understand the concept of pressure drop
- To enable the students learn different separation techniques

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Calculate the flow measurements and pressure drop in pipes using fluidized bed and packed column.
- Analyze the process of filtration, distillation and extraction.
- Demonstrate the process involved in adsorption equilibrium and 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
OBJECTIVE:

- To give hands on training on the development of industrially important biotechnology products

INTENDED OUTCOMES:

At the end of the course,

- The students will be able to get exposure on small scale development of biotechnology products

1. Production of ethanol from molasses and grapes
2. Production of Biofertilizers
3. Production of Single cell protein (Spirullina)
4. Mushroom cultivation
5. Production of jam from mixed fruits
OBJECTIVES

- To learn about the scale up of bioreactors
- To help the students to familiarize with various reactors used in bioprocess engineering

INTENDED OUTCOMES

- To get clear understanding of the fermentation processes.
- To get exposure for the commercial production of bioproducts.
- Describe the scale up of bioreactors.

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 STR.

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)

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.

Total Hours: 45
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OBJECTIVES

- To learn the applied aspects of molecular biology
- To have knowledge on modern techniques used in genetic engineering

INTENDED OUTCOMES:

- To develop the skills of the students in the area of genes.
- To design and develop bio based products.
- To get familiarize in PCR, recombinant DNA technology.

UNIT-I  BASICS OF RECOMBINANT DNA TECHNOLOGY  (6)

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

UNIT-II  CREATION OF RECOMBINANT MOLECULES  (9)

Restriction mapping, design of linkers and adaptors, gene editing. 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, factors affecting foreign gene expression, over expression and purification of recombinant proteins.

UNIT-IV  THEORIES OF rDNA TECHNIQUES  (10)

Polymerase chain reaction: Inverse PCR, Nested PCR, Taqman assay, RT - PCR, RACE PCR, RAPD, RFLP, site directed mutagenesis (Kunkel’s Method), nucleic acid sequencing-Sangers method, Maxam Gilbert sequencing and automated sequencing method.

UNIT-V  APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY  (10)

Applications of recombinant DNA Technology: Cloning in plants, Ti plasmid, Methods of producing transgenic animals and their applications, gene silencing, gene therapy.

Total Hours: 45
## TEXT BOOKS

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<tr>
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</thead>
</table>
OBJECTIVES

- To have an idea of overview of industrial bioprocess, how to produce some commercially important organic acids, aminoacids and alcohols
- To study the production processes for secondary metabolites and enzymes
- To have knowledge in the production of recombinant proteins

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Apply the processing techniques for the production of commercial bioproducts.
- Outline the applications of modern biotechnological process.

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, Industrially important organisms, fermentation processes – modes of operation.

UNIT- II  PRODUCTION OF PRIMARY METABOLITES  (10)
Production of commercially important organic acids - citric acid, lactic acid, acetic acid, amino acids - glutamic acid, phenylalanine, aspartic acid, alcohols - ethanol, butanol.

UNIT-III  PRODUCTION OF SECONDARY METABOLITES  (10)
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 - 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 - 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).
# TEXT BOOKS

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<tbody>
<tr>
<td>1</td>
<td>Casida Jr, L.E.</td>
<td>Industrial Microbiology</td>
<td>New Age International (P) Ltd</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>Prescott, S. C. and Dunn, C. G</td>
<td>Industrial Microbiology</td>
<td>Agrobios (India).</td>
<td>2006</td>
</tr>
<tr>
<td>3</td>
<td>R. C. Dubey</td>
<td>A textbook of Biotechnology</td>
<td>S. Chand &amp; Company ltd.,</td>
<td>2003</td>
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# REFERENCE BOOKS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Author(s) Name</th>
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<th>Publisher/journal</th>
<th>Year of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Moo, M and Young</td>
<td>Comprehensive Biotechnology</td>
<td>Pergamon</td>
<td>2007</td>
</tr>
<tr>
<td>3</td>
<td>Barta, A. et al.</td>
<td>The expression of a nopaline Synthase human growth hormone chimaeric gene in transformed tobacco and sunflower callus tissue</td>
<td>Plant Mol. Biol</td>
<td>1986</td>
</tr>
</tbody>
</table>
OBJECTIVES
- To enable the students to get aware of available tools and databases for performing research in bioinformatics.
- To give fundamental ideas in bioinformatics, various bioinformatics databases, sequence analysis methods.

INTENDED OUTCOMES
- To get exposure with the use of database tools.
- To understand in depth about protein structure prediction.

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)
Database technology, Genbank:organisms in Genbank, genomic DNA databases, cDNA databases corresponding to expressed genes, Introduction to phylogenetics- distance based trees, UPGMA, neighbour joining trees, 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, 3DProtein structure file format: PDB, mmCIF, MMDB, Methods of Tertiary structure prediction: Threading and fold recognition methods, Homology modeling, Fold recognition databases.
Total Hours: 45
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<tbody>
<tr>
<td>1</td>
<td>Dan E. Krane, Michael L. Rayme</td>
<td>Fundamental Concepts of Bioinformatics</td>
<td>Pearson education</td>
<td>2004</td>
</tr>
<tr>
<td>3</td>
<td>David W. Mount</td>
<td>Sequence and Genome Analysis</td>
<td>Cold Spring Harbor Laboratory</td>
<td>2004</td>
</tr>
<tr>
<td>4</td>
<td>Jonathan Pevsner</td>
<td>Bioinformatics and Functional Genomics</td>
<td>Wiley-Liss</td>
<td>2003</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To have better understanding about extraction and purification and characterization of enzymes.
- To study immobilization of enzymes and enzyme engineering

INTENDED OUTCOMES

- The students will get familiarized with the application of enzymes in industries.
- To understand in depth of the kinetics parameters of enzymes.
- Describe the purification and production of enzymes

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. 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; Enzyme Biosensor – Classification, Design, Application - industry, healthcare, food and environment.
## TEXTBOOKS

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<td>1</td>
<td>Palmer, T</td>
<td>Enzymes</td>
<td>Affiliated East West Press Pvt. Ltd</td>
<td>2004</td>
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<td>2</td>
<td>Wiseman</td>
<td>Enzyme Biotechnology</td>
<td>Ellis Horwood Publishers</td>
<td>1995</td>
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<td>3</td>
<td>Chaplin and Bucke</td>
<td>Enzyme Technology</td>
<td>Cambridge University Press</td>
<td>1990</td>
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<tr>
<td>1</td>
<td>H. W. Blanch and D. S. Clark</td>
<td>Biochemical Engineering</td>
<td>Marcel Dekker, Inc.</td>
<td>1996</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To learn the basic aspects in plant biotechnology
- To study the application of plant biotechnology

INTENDED OUTCOME

- To have a better understanding on the study of diseases related to plants.
- Demonstrate the basics of genetic materials.
- Analysis of the application of plant biotechnology.

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)

Nitrogen fixation Process - Nitrogenase activity, nod genes, nif genes, bacteroids- Applications.

UNIT- IV  AGROBACTERIUM & VIRAL VECTORS  (9)


UNIT- V  APPLICATION OF PLANT BIOTECHNOLOGY  (9)

Outline of plant tissue culture, transgenic plants, herbicide and pest resistant plants, Drought/salinity/cold tolerant plants, molecular pharming, therapeut ic products.

Total Hours: 45
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<tr>
<td>1</td>
<td>Gamburg OL, Philips GC,</td>
<td>Plant Tissue &amp; Organ Culture fundamental Methods</td>
<td>Narosa Publications</td>
<td>1995</td>
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<td>2</td>
<td>Singh BD.</td>
<td>Text Book of Biotechnology</td>
<td>Kalyani Publishers</td>
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<td>Heldt HW</td>
<td>Plant Biochemistry &amp; Molecular Biology</td>
<td>Oxford University Press</td>
<td>1997</td>
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</tbody>
</table>
OBJECTIVES

- To understand the role of beneficial microorganisms in food processing and preservation
- To analyze methods used to control or destroy microorganism commonly found in food.

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Analyze the properties of food constituents and the spoilage of food caused by microorganisms.
- Demonstrate the different fermented food products and additives available in industries and their mode of processing and preservation.

UNIT I FOOD AND ENERGY

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


UNIT III FERMENTATION PRODUCTS

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

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.
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 microorganisms, 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**

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<td>1</td>
<td>James M. Jay, Martin J. Loessner, David A. Golden</td>
<td>Modern Food Microbiology</td>
<td>Springer Science &amp; Business Media</td>
<td>2005</td>
</tr>
<tr>
<td>2</td>
<td>William C. Frazier</td>
<td>Food Microbiology</td>
<td>Tata MC Graw hill</td>
<td>1987</td>
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<td>1</td>
<td>H.-D. Belitz, Werner Grosch, Peter Schieberle</td>
<td>Food Chemistry</td>
<td>Springer Science &amp; Business Media</td>
<td>2009</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To train in the batch sterilization design, batch cultivation
- To estimate $k_{La}$ by different methods

INTENDED OUTCOMES

- To get expertise in the $k_{La}$ estimation.
- To get hands on experience on enzyme kinetics.

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

- To learn how to ligate DNA into expression vectors
- To understand SDS-PAGE and PCR

INTENDED OUTCOME

- Demonstrate the process involved in the recombinant protein expression.
- The student acquire the knowledge of techniques involved in DNA isolation.

1. Agarosegelectrophoresis
2. Isolation of plasmid & chromosomal DNA from bacterial cell
3. Isolation of plant cell genomic DNA from plant source
4. Isolation of genomic DNA from animal cell
5. Purification of DNA from agarose gel
6. Restriction enzyme digestion and ligation
7. Competent cells preparation (CaCl₂ method)
8. Transformation and screening for recombinants
9. Blue and white selection for recombinants
11. SDS PAGE
12. PCR

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</table>
OBJECTIVES

- To learn about online tools available to perform bioinformatics research
- To develop skills of the students in performing analysis of protein sequences, structural features of protein.

INTENDED OUTCOME

- The students will gain confidence in the usage of databases.
- Demonstrate the need of protein structural databases.
- The students can learn in detail about BLAST and FASTA algorithms.

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. Protein sequence analysis tools
10. Multiple Sequence alignment & phylogenetic tree construction.
OBJECTIVE

- To learn about the types of chromatography.
- To learn about the partial purification of enzymes.

INTENDED OUTCOMES

- To get hands on experience with advanced techniques such as ultrafiltration, gel filtration and affinity chromatography.
- To get hands on experience on the partial purification of enzymes.

1. Ammonium Sulphate /TCA/ Organic solvent precipitation
2. Ultrafiltration using tangential-flow membrane separation
3. Ion Exchange Column Chromatography
4. Gel Filtration chromatography
5. Affinity chromatography

Mini project
UNIT- I GENERAL CONCEPT OF NATURAL PRODUCT ISOLATION

Natural Product Isolation, Extraction of Plant Secondary Metabolites, Biochemical analysis of 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-I I 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

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<tr>
<td>1</td>
<td>Satyajit D. Sarker, Zahid Latif, Alexander I. Gray</td>
<td>Methods in biotechnology: Natural products isolation</td>
<td>Springer</td>
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<td>2</td>
<td>Corrado Tringali</td>
<td>Bioactive Compounds from Natural Sources</td>
<td>CRC press</td>
<td>2011</td>
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<tr>
<td>3</td>
<td>Mayo, D. W.; Pike, R. M.; Butcher, S. S.</td>
<td>Microscale Organic Laboratory;</td>
<td>John Wiley &amp; Sons</td>
<td>1986</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To learn about mass transfer, gas-liquid, vapour-liquid and solid-third operations
- To know about extraction operations.

INTENDED OUTCOMES

At the end of the course the student will be able to
- Describe the mechanism of diffusion in mass transfer operations
- Design and solve the operational and control issues in distillation process by McCabe – thiele principles which has its application in industries
- Develop the design equation and model the process operation for absorption and extraction equipment applicable to industrial process

UNIT- I DIFFUSION AND MASS TRANSFER

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

UNIT- II GAS LIQUID OPERATIONS

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

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

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

UNIT- V SOLID FLUID OPERATIONS

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

Total Hours: 45+15 = 60
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<tr>
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<td>Geankoplis C.J.</td>
<td>Transport Processes and Unit Operations</td>
<td>Prentice Hall</td>
<td>2002</td>
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<td>3</td>
<td>Coulson and Richardson</td>
<td>Chemical Engineering Vol. I &amp; II</td>
<td>Asian Books Pvt Ltd</td>
<td>1998</td>
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</table>
OBJECTIVES

- To demonstrate the knowledge of general principles of immunology, immune responses to infections, genetics of transplantation and autoimmune disorders.
- To have understanding on the pathogenesis of diseases like AIDS, Cancer, TB

INTENDED OUTCOMES

At the end of the course the student will be able to
- Be familiar with the immune organs and its function
- Understand the mechanism of immune responses with respect to transplantation and graft rejection
- Be aware of autoimmune disorders and its treatment

UNIT-I INTRODUCTION (7)
Cells of immune system, innate and acquired immunity, primary and secondary lymphoid organs, Components of immune system: antibodies, 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 AND TUMOR 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, tumor immunology-immune therapy
UNIT-V AUTOIMMUNITY

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

Total Hours: 45

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<td>Roitt I, Male, Brost</td>
<td>Immunology</td>
<td>Mosby Publ</td>
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<td>2</td>
<td>Kuby J,</td>
<td>Immunology</td>
<td>WH Freeman &amp; Co</td>
<td>2000</td>
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<td>3</td>
<td>David W Mount</td>
<td>Bioinformatics: Sequence And Genome Analysis</td>
<td>cold Spring Harbor Press</td>
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<tr>
<td>1</td>
<td>Ashim K. Chakravarthy</td>
<td>Immunology</td>
<td>Tata McGraw-Hill</td>
<td>1998</td>
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</table>
OBJECTIVES

- To equip the students to know the basic of formulations and to apply them in clinical trials. Students understand drug principles, biotechnology oriented pharmaceutical products: its preparations, testing and quality assurance.

INTENDED OUTCOMES

At the end of the course the student will be able to

- Be familiar with the different forms of drugs and its pharmacokinetics
- Understand the manufacturing process of drugs and its applications
- Motivate themselves to become an entrepreneur in pharmaceutical field

UNIT- I INTRODUCTION

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

UNIT- II BASICS OF PHARMACOKINETICS

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

UNIT- III MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS

Drug development process- Types of reaction process – Fermentation, organic synthesis, extraction, special requirements for bulk drug manufacture- QC intrumentsation, Analysis.

UNIT- IV MANUFACTURE OF SOILD DOSAGE FORMSS

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

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
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<tr>
<td>1</td>
<td>David B. Troy, Paul Beringer</td>
<td>Remington: The science and practice of pharmacy</td>
<td>Lippincott Williams &amp; Wilkins</td>
<td>2006</td>
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<tr>
<td>3</td>
<td>Katzung B.G.</td>
<td>Basic and Clinical Pharmacology</td>
<td>Prentice Hall of Intl</td>
<td>1995</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To learn various forcefields, simulation methods in molecular modeling
- To have better understanding on molecular docking and ligand based drug design methods

INTENDED OUTCOMES

At the end of the course the student will be able to
- Recognize the benefits of simulation model studies
- Have knowledge of quantum mechanics and molecular mechanics & dynamics
- Understand the docking and ligand based drug design methods

UNIT-I MOLECULAR MODELLING

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

Introduction to the computational quantum mechanics; one electron atom, ply electronic atoms and molecules, Hartree Fock equations; calculating molecular properties using ab initio and semi empirical methods.

UNIT-III MOLECULAR MECHANICS

Molecular mechanics; general features of molecular mechanics force field, bond stretching, angle bending, torsional terms, non – bonded interactions; force field parameterization and transferability; effective pair potential, energy minimization; derivative and non – derivative methods, applications of energy minimization.

UNIT-IV MOLECULAR DYNAMICS

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

Introduction to cheminformatics,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.

Total hours : 45
### TEXTBOOKS

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<tr>
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<tr>
<td>1</td>
<td>Andrew Leach</td>
<td>Molecular Modelling: Principles and Applications</td>
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<tr>
<td>1</td>
<td>Yvonne C. Martin, editor, Peter Willett</td>
<td>Designing bioactive molecules: three-dimensional techniques and applications</td>
<td>Washington, DC: American Chemical Society</td>
<td>1998</td>
</tr>
<tr>
<td>2</td>
<td>Matthew F. Schlecht</td>
<td>Molecular Modeling on the PC</td>
<td>Wiley-Blackwell; Har</td>
<td>1998</td>
</tr>
</tbody>
</table>
OBJECTIVES

- The principles in chemical reactions kinetics, ideal reactors, non ideal flow.
- The concepts of RTD

INTENDED OUTCOMES

The students will be exposed to the design of various reactors
The students will be able to provide solutions for the design and rate equations

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)


UNIT-IV DESIGN FOR HETEROGENOUS SYSTEMS (9)

Rate equations – contacting patterns for two phase systems; fluid particle reactions – unreacted 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


Total Hours: 45

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<tr>
<td>1</td>
<td>Levenspiel O</td>
<td>Chemical Reaction Engineering.</td>
<td>JohnWiley</td>
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<td>2</td>
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<td>Elements of Chemical Reaction Engineering</td>
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</thead>
</table>
## OBJECTIVES

- To understand the basic principles of nanobiotechnology in detail
- To know the various applications of nanomaterials in Biotechnology

## INTENDED OUTCOMES:

- Students will be able to understand the properties of biological building blocks
- Students will be able to appreciate the various cutting edge technology for creating materials for human health care

## 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 of Nanotechnology in biotechnology.

## UNIT-II STRUCTURAL AND FUNCTIONAL PRINCIPLES OF BIONANOTECHNOLOGY (9)


## UNIT-III MICROFLUIDICS (9)


## UNIT-IV PROTEIN AND DNA BASED NANOSTRUCTURES (9)

UNIT-V NANOPARTICLES IN CANCER THERAPY

Magnetic nano and microparticles for embolotherapy - hyperthermic therapy - delivery of chemotherapeutic drugs-brachytherapy, Thermoresponsive liposomes for hyperthermic chemotherapy assemblies and ultrasound activation.

Total Hours: 45

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<tr>
<td>1</td>
<td>Niemeyer, C.M. and Mirkin, C.A</td>
<td>Nanobiotechnology: Concepts, Applications and Perspectives</td>
<td>Wiley-VCH</td>
<td>2004</td>
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<td>2</td>
<td>Goodsell, D.S.</td>
<td>Bionanotechnology</td>
<td>John Wiley and Sons, Inc</td>
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<td>Springer Handbook of Nanotechnology</td>
<td>Springer-Verlag Berlin Heidelberg</td>
<td>2004</td>
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<td>3</td>
<td>Freitas Jr R.A</td>
<td>Nanomedicine</td>
<td>Landes Biosciences</td>
<td>2004</td>
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<td>4</td>
<td>Kohler, M. and Fritzsche, W.</td>
<td>Nanotechnology – An Introduction to Nanostructuring Techniques</td>
<td>Wiley-VCH</td>
<td>2004</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To learn ELISA technique
- To learn and get exposure to perform immunology lab experiments

At the end of the course,
- Students will be able clear in the basic techniques required for performing animal studies.
- Students will have a basic idea on the technique to be used for diagnosing the diseases.

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.
10. Western blotting
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<tr>
<td>1</td>
<td>Hay, F.C. and M.R. Westwood</td>
<td>Practical Immunology</td>
<td>Blackwell Science, Publishers</td>
<td>2004</td>
</tr>
<tr>
<td>5</td>
<td>Weir, D.M</td>
<td>Immunological Techniques</td>
<td>Blackwell Scientific Publications</td>
<td>1992</td>
</tr>
</tbody>
</table>
OBJECTIVES
- To practice the preparation of a solid dosage form.
- To learn to prepare liquid oral and topical preparations.

INTENDED OUTCOMES
At the end of the course,
- The students will be able to prepare the various dosage forms.
- The students will get to know how to check the quality of the preparation at industrial scale.

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
OBJECTIVES
- To know how to visualize and understand macromolecule-ligand interactions
- To perform molecular docking
- To have experience with various computational tools used for drug design

INTENDED OUTCOMES
- The students will have a better understanding of the visualization tools
- The students will be able to select the targets and ligands and can study the effect by docking

1. Explore Visualization tools
2. Learn to calculate properties of small molecules
3. Perform a QSAR study
4. Homology modeling of proteins
5. Virtual screening using Zinc database
6. Pharmacophore mapping
7. Active site prediction
8. Protein ligand docking
9. Protein-Protein docking
The students will be directed to do a project work during VI semester and their projects will be evaluated for, forty percentages in Continuous Internal Assessment and sixty percentages in End Semester Examination.

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

**OBJECTIVES**

- To provide exposure in practical aspects
- To equip the students to meet the industry standards.
OBJECTIVES

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

INTENDED OUTCOMES:

- To get familiarize in the teaching presentation skills.
- To gain confidence in the teaching process.

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 presentation skills and facing the interviews.
OBJECTIVE

1. To enable the students to create an awareness on Engineering Ethics, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I  ENGINEERING ETHICS

UNIT II  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 III  HISTORICAL DEVELOPMENT, PLANNING, ORGANISING

UNIT IV  DIRECTING AND CONTROLLING

UNIT V  ENTREPRENEURSHIP AND MOTIVATION

TOTAL 45

TEXT BOOKS

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<tr>
<td>2</td>
<td>Khanka S.S</td>
<td>Entrepreneurial Development</td>
<td>S.Chand and Co. Ltd., New Delhi</td>
<td>2006</td>
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<td>Rabindra N Kanungo</td>
<td>Entrepreneurship and innovation</td>
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<td>1998</td>
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<tr>
<td>3</td>
<td>Charles E Harris, and Michael J Rabins</td>
<td>Engineering Ethics – Concepts and Cases</td>
<td>Wadsworth Thompson Learning, New Delhi</td>
<td>2013</td>
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WEB REFERENCES
1. [http://www.managementstudyguide.com/taylor_fayol.htm](http://www.managementstudyguide.com/taylor_fayol.htm)
2. [http://tutor2u.net/business/gcse/people_motivation_theories.htm](http://tutor2u.net/business/gcse/people_motivation_theories.htm)
OBJECTIVES

- To impart knowledge on downstream processing principles
- To understand the methods of separation/isolation and purification of bio-products.

INTENDED OUTCOMES

At the end of the course,
- The students will be able to choose the appropriate purification technique based on the nature of the product.
- The students will have the idea to increase the yield of the final product without much loss in purification stage.

UNIT-I DOWNSTREAM PROCESSING (9)

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
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<td>P.A. Belter, E.L. Cussler And Wei-Houhu</td>
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<td>Wiley Interscience Pub</td>
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<td>2</td>
<td>R.K. Scopes</td>
<td>Protein Purification – Principles And Practice</td>
<td>Narosa Pub</td>
<td>1994</td>
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<tr>
<td>3</td>
<td>Roger G. Harrison , Paul Todd , Scott R.Rudge and Demetri P.Petrides</td>
<td>Bioseparation Science and Engineering</td>
<td>Oxford University Press</td>
<td>2003</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To perform cell disruption techniques
- To have experience with various chromatography techniques

INTENDED OUTCOMES

At the end of the course,

- The students will learn to perform the various purification techniques.
- The students will gain knowledge on selecting the purification technique by analyzing the nature of the product and its commercial value.

1. Cell fractionation using centrifuge.
2. Ammonium sulphate precipitation.
3. Liquid–Liquid extraction.
4. Solid–Liquid extraction.
5. Drying of solid by heat source.
6. Dialysis
7. Protein Purification by isoelectric point precipitation.
8. Crystallization.
9. Purification of α–Amylase from *Bacillus*.
10. Adsorption Studies.
The students will be directed to do a project work which will be the Phase I if their main project work that will be performed in the eighth semester during. Their projects will be evaluated for forty percentages in Continuous Internal Assessment and sixty percentage in End Semester Examination.

End Semester Examination evaluation will be based on the report submitted by the student after the completion of the project work.
The students will be performing their main project work as a continuation of the Phase I project completed in the seventh semester. Their projects will be evaluated for a total of three hundred marks, out of which one twenty marks will be for Continuous Internal Assessment and one hundred and eighty marks for End Semester Examination.

End Semester Examination evaluation will be based on the report submitted and presentation of his/her work by the student to a panel of evaluators after the completion of the project work.
PROFESSIONAL ELECTIVES
OBJECTIVES
• To impart knowledge on techniques involved in animal cell culture and to learn about strategies and methodologies, molecular diagnostics, cloning, xenotransplantation, transgenic animals and their applications.
• This subject will help the students to know about the latest techniques in animal biotechnology and the useful products produced from cell culture using reactors.

INTENDED OUTCOMES:

Students undergoing this course will be able to
• Describe the basic animal cell culture techniques and role of various types of culture and their preservation.
• Discuss the various bacterial and viral diseases and their diagnostic techniques.
• Define and compare the various techniques of cloning and artificial breeding of animals.

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   MICROMANIPULATION OF EMBRYOS (9)

Breeding of farm animals to biopharming - 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 III   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.

UNIT IV   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 V  THERAPY OF ANIMAL DISEASES

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

Total Hours: 45

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<tr>
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<td>Ranga M.M.</td>
<td>Animal Biotechnology</td>
<td>Agrobios India Limited</td>
<td>2002</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To create awareness on the demands of products and the mindset to start Biotech companies.
- Learn about bioethics issues in developing and marketing biotech products to the public.

INTENDED OUTCOME

- To recognize the need for ability to engage in lifelong learning
- Will understand the project management and finance
- To understand the impact of engineering solutions in global and societal context

UNIT I  OVERVIEW OF BIOTECHNOLOGY INDUSTRIES  (9)

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

UNIT II  NEW VENTURE CREATION – ENTREPRENEURSHIP  (9)


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  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.

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


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<td>2</td>
<td>Ruth Ellen Bulger</td>
<td>The ethical dimensions of the Biological sciences</td>
<td>Cambridge University Press</td>
<td>1993</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To provide comprehensive knowledge of safety and hazards aspects in industries and the management of hazards.
- To make the students understand the practical safety challenges

INTENDED OUTCOME

- To design an integrated system with due considerations to public health, safety, society and environment
- To understand the impact of engineering solutions in global and societal context

UNIT I FIRE AND EXPLOSION


UNIT II RELIEF SYSTEMS

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

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

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 toxins and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases.
UNIT V CASE STUDIES

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

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<td>Lee’s Loss Prevention in the Process Industries</td>
<td>Butterworth-Heinemann</td>
<td>2005</td>
</tr>
</tbody>
</table>
OBJECTIVES

- The student will understand the primary germ layer formation and the derivation of various organs from these layers.
- To enable the student to relate the final structure in its perfection or defects to the early development.

INTENDED OUTCOME

- To apply the skills obtained in basic life science courses to identify the mechanism of threats to human health.
- To get involved in teams aspiring to solve societal problems
- The students will be able to function as a member of multidisciplinary team

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

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

TEXTBOOKS

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<td>Developmental Biology</td>
<td>Saras Publications</td>
<td>1995</td>
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Total Hours: 45
OBJECTIVES

- To make the students aware of the importance of phyto medicine.
- To enable the students analyze phytochemicals.

INTENDED OUTCOMES

At the end of the course,
- The students will get to know the importance of medicinal and aromatic plants
- The students will be exposed to the various methods of analyzing the phytochemicals and their therapeutic applications

UNIT I  CRUDE DRUGS

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

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

Plant Tissue Culture as source of medicines, Secondary metabolite production in plants; Plant Tissue Culture for enhancing secondary metabolite production (Withaniasomnifera, Rauwolfiaserpentina, Catheranthusroseus, Andrographispaniculata, Dioscorea sp.); Anticancer, Antiinflammatory, Antidiabetic, Analgesicdrugs, Biogenesis of Phytopharmaceuticals.

UNIT IV  ANALYSIS OF PHYTOCHEMICALS

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

Application of phytochemicals in industry and healthcare; Biocides, Biofungicides, Biopesticides. Nutraceuticals and their significance.

Total Hours: 45

TEXT BOOKS

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<tr>
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<td>1</td>
<td>Hornok, L.</td>
<td>Cultivation &amp; Processing of Medicinal Plants</td>
<td>Wiley &amp; Sons</td>
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<td>2</td>
<td>Trease &amp; Evans</td>
<td>Pharmacognosy</td>
<td>Harcourt Brace &amp; Company</td>
<td>1989</td>
</tr>
</tbody>
</table>
OBJECTIVES

☐ To learn molecular techniques in order to enhance the product yield.

☐ Methods to improve production strains to meet industrial demands.

INTENDED OUTCOMES

Students undergoing this course will be able to

- Understand the regulations involved in metabolisms and enzyme production
- Be familiarize with the synthesis methods of metabolites
- Be aware of concepts of bioconversion

UNIT I INTRODUCTION

(9)


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
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<td>Principles of Fermentation Technology</td>
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OBJECTIVES

- To understand the basics of genomics and proteomics
- To learn about protein profiling

INTENDED OUTCOMES

Students undergoing this course will

- Apply the scientific knowledge through Bioinformatics for genetic related works
- Understand the higher end techniques for protein estimation and profiling

UNIT I    OVERVIEW OF GENOMES OF BACTERIA, ARCHAEA AND EUKARYOTA (9)


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    TECHNIQUES IN PROTEOMICS (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.

Total Hours: 45
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<td>1</td>
<td>Cantor and Smith</td>
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<td>John Wiley &amp; Sons</td>
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<td>2</td>
<td>Pennington and Dunn</td>
<td>Proteomics</td>
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<td>Introduction to Proteomics</td>
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<td>2</td>
<td>Primrose and Twyman</td>
<td>Principles of genome analysis and genomics</td>
<td>Blackwell Publishing Co</td>
<td>2003</td>
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</table>
OBJECTIVES

- To evaluate the process plant design for regulatory compliance
- To design a plant layout for processing of biological materials

INTENDED OUTCOMES

At the end of this course,

- The students will be able to select the parameters for designing an equipment
- The students will be able to solve the issues regarding scale up and scale down

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

Process economics - Case studies. Commodity chemicals and production of pharmaceutical products.

Total Hours: 45

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<td>2</td>
<td>Joshi M. V. and V.V.Mahajani</td>
<td>Process Equipment Design</td>
<td>Macmillan India Ltd</td>
<td>2000</td>
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</table>
OBJECTIVES

- To learn about host parasite interactions
- To understand the host defense mechanisms and molecular mechanisms involved in pathogenesis of disease caused by E. Coli and Vibrio Cholerae

INTENDED OUTCOME

- Students will have a better understanding on the methods that are used for the control of pathogens.
- To study in depth of the molecular pathogenesis.

UNIT- I HOST-MICROBE INTERACTIONS (7)


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.

UNIT- III MOLECULAR PATHOGENESIS (10)


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
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<td>3</td>
<td>Peter Williams, Julian Ketley &amp; George Salmond,</td>
<td>Methods in Microbiology: Bacterial Pathogenesis,</td>
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OBJECTIVES

- Understanding the basics of drug action in various systems
- Basic understanding about various natural sources as medicine

INTENDED OUTCOMES

At the end of the course,

- The students will be able to apply their knowledge for the discovery of drugs.
- The students will be able to identify the lead compounds from plants for drug development

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)

UNIT IV PHARMACOGNOSY (9)

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
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<td>2002</td>
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<tr>
<td>3</td>
<td>T.E. Wallis</td>
<td>Text Book of Pharmacognosy</td>
<td>CBS Pub</td>
<td>1985</td>
</tr>
</tbody>
</table>
OBJECTIVES
- To gain deeper understanding of important marine organisms and also aware about the marine pollution
- To understand various medicinal compounds that are from marine flora and fauna that will help them to design novel therapeutics.

INTENDED OUTCOMES
- Upon the completion of the course, students can describe different microbes present in the marine environment.
- Students would have an understanding of marine ecosystem and microbes in that niche.

UNIT I  INTRODUCTION TO MARINE ENVIRONMENT  (9)

UNIT II  MARINE ORGANISMS AND THEIR INDUSTRIAL APPLICATIONS  (9)

UNIT III  MARINE ENVIRONMENTAL BIOTECHNOLOGY  (9)

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
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<td>E. W. Becker</td>
<td>Microalgae: Biotechnology and Microbiology</td>
<td>Cambridge University Press</td>
<td>1994</td>
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</tbody>
</table>
OBJECTIVES

- To enable the students to get depth knowledge in the structural principles of proteins, techniques of mutagenesis
- To give fundamental ideas on engineering enzymes, metageonomics

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Describe the properties of amino acids and proteins and the biosynthesis and chemical synthesis of peptides.
- Exemplify the process of mutagenesis and their effect on protein conformation and bioimprinting.
- Elucidate the stability and purification process in Engineering of proteins.
- Usage of metagenomics library for the study of microbial communities.
- Understand the process involved in the development of biosensors, gene engineered proteins and vaccine developed from proteins.

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)


UNIT- III ENGINEERING ENZYMES (9)

Engineering stability (Bacillus subtilis)netural 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

Metagenomics and ecosystems Biology- conceptual framework, tools and methods- Analyses of metagenomics, Single gene approach, Targeted partial metagenome sequencing, Analyses of metatranscriptome- Limitation in anlaysing the metatranscriptome- 17s rRNA sequencing and metatranscriptomepyrosequencing, 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

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

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<td>2</td>
<td>C. Branden and J. Tooze</td>
<td>Introduction to Protein Structure</td>
<td>Garland Publications</td>
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</tbody>
</table>
OBJECTIVES

- To gain more insight into antigens and antibodies and its types, raising techniques.
- Assessing cell mediated immunity and learning the techniques in immunocytology.

INTENDED OUTCOMES:

- This course equips students to have in depth knowledge of antigens and antibody mechanisms.
- The students will be able to apply the knowledge of genetic engineering in immunotheranostics.

UNIT I   ANTIGENS  (7)
Types of antigens, their structure, factors affecting antigenicity, 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, Immunelectrophoresis, SDS-PAGE - purification and synthesis of antigens, ELISA – principle and applications, adioimmunoassay (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  IMMUNO PATHOLOGY  (9)
Preparation of 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 – immuno fluorescence, immune enzymatic and immuno ferritin techniques, immuno electron 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
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OBJECTIVES

- To develop skills in students with bioreactors and biotreatment methods of industrial wastewater.
- Study the natural and engineered bio-treatment methods to remediate the pollutants.

INTENDED OUTCOMES

Students undergoing this course will be able to
- Understand the ways to protect environment from pollution by using biotechnology
- Be familiarize with industrial waste management systems
- Be aware of opportunities in waste treatment industries

UNIT I  INTRODUCTION

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

Aromatics - benzene, pentachlorophenol, Polyaromatic hydrocarbons (PAHs) – naphthalene, Polychlorinated biphenyls (PCBs) hexachloro biphenyl, Pesticides-DDT and Surfactants–LAS

UNIT III  INDUSTRIAL WASTE WATER MANAGEMENT

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


UNIT V  DEVELOPMENTS PERTAINING TO ENVIRONMENTAL BIOTECHNOLOGY

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.

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<td>Environmental Biotechnology</td>
<td>Oxford University press</td>
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<td>Prescott, Harley, Klein</td>
<td>Microbiology</td>
<td>WCB publishers</td>
<td>1996</td>
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</table>
OBJECTIVES

- To make the students understand the basic tools in genetic engineering
- To learn the construction of genomic and cDNA libraries

INTENDED OUTCOMES

At the end of the course,

- The students will be exposed to the use of various vectors for creating the recombinant organisms.
- The students will get to know the various applications of gene cloning

UNIT I CLONING VECTORS

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

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


UNIT IV GENOMIC AND cDNA LIBRARY

UNIT V APPLICATION OF GENE CLONING


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</thead>
<tbody>
<tr>
<td>1</td>
<td>T. A. Brown</td>
<td>Gene Cloning and DNA Analysis: An Introduction</td>
<td>Blackwell</td>
<td>2010</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To learn the principles of carcinogenesis
- To have exposure to cancer targets, available therapy

INTENDED OUTCOME

The students will gain knowledge on
- basic concepts of cancer biology
- various stages in carcinogenesis,
- molecular cell biology of cancer, cancer metastasis, and cancer therapy.

UNIT I  FUNDAMENTALS OF CANCER BIOLOGY (8)


UNIT II  PRINCIPLES OF CARCINOGENESIS (9)


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


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.

**TEXT BOOKS**

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Ian F. Tannock</td>
<td>The Basic Science of Oncology&quot;</td>
<td>McGraw Hill Professional</td>
<td>2005</td>
</tr>
<tr>
<td>5</td>
<td>Rudden, R. W.</td>
<td>Cancer Biology</td>
<td>Oxford University Press</td>
<td>1995</td>
</tr>
</tbody>
</table>

**Total Hours: 45**
OBJECTIVES

- To study about the various cell types and their advances in tissue engineering.
- To learn the principles of genetherapy and their practical application.

INTENDED OUTCOMES:

- At the end of this course, the students will gain knowledge about tissue engineering.
- The course will be useful to the student for opting higher studies.

UNIT I 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 II BIOMATERIALS FOR TISSUE ENGINEERING (9)

UNIT III TISSUE ENGINEERING AND CONCEPTS OF TISSUE CREATION (9)
Concepts of Tissue Creation: Sources, Stem Cells, Cells from Tissues, Culture Methods for Tissue Engineering, Maturation of Tissue Construct - Tissue Constructs, Cell therapies, Organ Modules, Cosmetic Measures.

UNIT IV PRINCIPLES AND PRACTICE OF GENE THERAPY (9)
Introduction to gene therapy, Requirements of gene therapy, Genetic defects, Target cells for gene therapy, processes 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
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<tr>
<td>2</td>
<td>Ranga, M. M</td>
<td>Animal Biotechnology</td>
<td>Agrobios</td>
<td>2010</td>
</tr>
<tr>
<td>3</td>
<td>Watson, J. D. and Gilman, M.</td>
<td>Recombinant DNA</td>
<td>Scientific American Books</td>
<td>1992</td>
</tr>
</tbody>
</table>
OBJECTIVES

- Understand the clinical research methodology and management.
- To aid students in learning database management.

INTENDED OUTCOMES

At the end of the course,

- The students will have an idea on the methodology of performing a clinical research
- The students will get to know the ethics in performing the 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)


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 EURegulatory 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

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

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<tr>
<td>2</td>
<td>Machin, D. and Fayers, P</td>
<td>Randomized Clinical Trials: Design, Practice and Reporting</td>
<td>Wiley-Blackwell</td>
<td>2010</td>
</tr>
<tr>
<td>3</td>
<td>Piantadosi, S.</td>
<td>Clinical Trials: A Methodologic Perspective</td>
<td>John Wiley &amp; Sons</td>
<td>2005</td>
</tr>
</tbody>
</table>
OBJECTIVES

- The students will gain knowledge in Stem cell basics and application of stem cells.
- The students will understand recent advancements in the biotechnological applications using both adult and embryonic stem cells.

INTENDED OUTCOMES

At the end of the course,

- The students would have gained an insight on the various methods of culturing stem cells
- The students will be able to identify the various sectors where stem cell technology can be applied.

UNIT I STEM CELLS AND CELLULAR PEDIGREES (9)


UNIT II EMBRYONIC STEMCELLS (9)


UNIT III ADULT STEM CELLS (9)


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, stem cell markers

UNIT V POTENTIAL USES OF STEM CELLS (9)


Total Hours: 45
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<td>1</td>
<td>CS Potten</td>
<td>Stem cells</td>
<td>Elsevier</td>
<td>1997</td>
</tr>
<tr>
<td>2</td>
<td>Kursad and Turksen</td>
<td>Embryonic Stem cells</td>
<td>Humana Press.</td>
<td>2002</td>
</tr>
<tr>
<td>3</td>
<td>Robert Paul Lanza</td>
<td>Essentials of stem cell biology,</td>
<td>O'Reilly</td>
<td>2006</td>
</tr>
</tbody>
</table>
OBJECTIVES

- Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
- Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Outline the overview of energy use as fossil fuels and renewable energy.
- Analyze the different sources available for biomass production and their conversion to biofuel.
- Assess the different methods available for the release of products from cell using downstream processing principles.

UNIT I  OVERVIEW OF ENERGY USE  
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  
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  

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

Total Hours: 45
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<tr>
<td>1</td>
<td>Stout. B.A.</td>
<td>Biomass energy</td>
<td>Texas University Press, College Station</td>
<td>1985</td>
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<tr>
<td>3</td>
<td>Chavla, O.P</td>
<td>Advances in Biogas Technology</td>
<td>ICAR Pub</td>
<td>1986</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To develop skills of the students in cell disruption techniques.
- Purification by various chromatography and physic-chemical separation techniques.

UNIT I CELL DISRUPTION

Mechanical and enzymatic methods of cell disruption, importance of cell disruption in product release, homogenization, ultrasonication, extraction, absorption, adsorption.

UNIT II CHROMATOGRAPHIC METHODS

Chromatographic methods, paper chromatography, thin layer chromatography, gas chromatography, GLC, HPLC, affinity chromatography, ion exchange chromatography, reverse phase chromatography

UNIT III SEPARATION TECHNIQUES

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

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 DOWN STREAM PROCESSES

Leaching, crystallization, lyophilization, drying. Chemistry of extraction, selection of solvent, use of solvent extraction in antibiotic separation, affinity extraction/chromatography. Industrial applications with examples.

Total Hours: 45
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<td>1</td>
<td>P.A. Belter, E.L. Cussler And Wei-Houhu</td>
<td>Bioseparations – Downstream Processing For Biotechnology</td>
<td>Wiley Interscience Pub</td>
<td>1988</td>
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<td>1</td>
<td>R.K. Scopes</td>
<td>Protein Purification – Principles And Practice</td>
<td>Narosa Pub</td>
<td>1994</td>
</tr>
</tbody>
</table>
OBJECTIVES

- The course provides an in depth knowledge in bioconjugate technology.
- To aid students in knowing the chemistry of active groups and bioconjugate reagents.

INTENDED OUTCOMES

At the end of the course,
- The students will know the various conjugates and the conjugation technique
- The students will be exposed to the recent advances in bioconjugate technology

UNIT I FUNCTIONAL TARGETS (9)

Modification of AminoAcids, Peptides and Proteins Modification of sugars, polysaccharides and glycoconjugates – modification of nucleicacids 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 reactivehemical reactions – Photoreactivechemicalreactions.

UNIT III BIOCONJUGATE REAGENTS (9)


UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION (9)

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes– chemical modification of nucleicacids – biotin labeling of DNA – enzyme conjugation to DNA – Fluorescence of DNA.

UNIT V BIOCONJUGATE APLICATIONS (9)


Total Hours: 45
## TEXT BOOKS

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<tbody>
<tr>
<td>1</td>
<td>G.T.Hermanson</td>
<td>Bioconjugate Techniques</td>
<td>AcademicPress</td>
<td>2013</td>
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<tr>
<td>1</td>
<td>RavinNarain</td>
<td>Chemistry of Bioconjugates: Synthesis, Characterization, and Biomedical Applications</td>
<td>Wiley</td>
<td>2013</td>
</tr>
</tbody>
</table>
OBJECTIVES
At the end of the course, the students would have learnt about
- Engineering Ethics and Human Values.
- Moral and Social Values and Loyalty

INTENDED OUTCOMES:

Students undergoing this course will be able to

- Understand the concepts of biosafety regarding the biotechnological products.
- Describe the techniques involved in IPR policies and ethics followed in biotechnology industries.

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)

UNIT III  IPR – POLICIES (9)

UNIT IV  CASE STUDIES (9)
Case Studies on - Patents (Basumati rice, curcumin, Neem, etc.) - Copyright and related rights - Trade Marks - Industrial design and Integrated circuits - Geographic indications - Protection against unfair competition.

UNIT V  IPR ISSUES & BIOETHICS (9)
Trade Secrets, Copy Rights, Farmer's Rights, Plant Breeder's rights; Traditional knowledge and their commercial exploitation and protection. 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

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<tr>
<td>3</td>
<td>Joshi. R</td>
<td>Biosafety and Bioethics</td>
<td>Isha Books, New Delhi</td>
<td>2006</td>
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<tr>
<td>3</td>
<td>Singh K</td>
<td>Intellectual property rights on Biotechnology</td>
<td>BCIL</td>
<td>2015</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To understand the importance of waste water treatment
- At the end of this course, the students will be familiar with principles of operation of various reactors used in waste water treatment.

INTENDED OUTCOMES:

- The students will develop knowledge on the waste water treatment.
- The students will get expertise on the usage of bioreactors.

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)


UNIT III PROCESSES IN WASTE WATER TREATMENT (9)


UNIT IV MODELING OF REACTORS (9)


UNIT V APPLICATIONS OF BIOREACTORS (9)

Attached Growth Reactors, Trickling Filter, Rotating Biological Contactor, Submerged Attached Growth Bioreactors, Future Challenges, Fate and Effects of Xenobiotic Organic Chemicals.

Total Hours: 45
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<td>1</td>
<td>M. Henze</td>
<td>Biological Wastewater Treatment: Principles, Modelling and Design</td>
<td>IWA Publishing</td>
<td>2008</td>
</tr>
<tr>
<td>2</td>
<td>Graty. C.P.L.Daigger, G and Lim, H.C</td>
<td>Biological Wastewater Treatment</td>
<td>Marcel Dekker</td>
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<td>Mizahi A</td>
<td>Biological Waste Treatment</td>
<td>John Wiley Sons Inc</td>
<td>1989</td>
</tr>
</tbody>
</table>
OPEN ELECTIVES OFFERED BY
DEPARTMENT OF SCIENCE AND HUMANITIES
OBJECTIVES:

- To gain knowledge in measures of central tendency.
- To provide necessary basic concepts in probability and random processes.

INTENDED OUTCOMES:

1. Learners acquire skills in handling situations involving more than one random variable and functions of random variables.
2. The students will have an exposure of various distribution functions, correlation and spectral densities.

UNIT- I MEASURES OF CENTRAL TENDENCY AND PROBABILITY

(9)

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

(9)

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

(9)

Joint distributions - Marginal and conditional distributions - Probability mass function - Probability density functions – Covariance - Correlation and regression

UNIT- IV CLASSIFICATION OF RANDOM PROCESS

(9)

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

(9)


Total : 45
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<tbody>
<tr>
<td>1</td>
<td>Ross, S</td>
<td>A first Course in Probability</td>
<td>Pearson Education, New Delhi (Chap 2 to 8)</td>
<td>2012</td>
</tr>
</tbody>
</table>

# WEBSITES:

2. [www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)
3. [www.mathworld](http://www.mathworld). Wolfram.com
OBJECTIVES:

- To know the fundamentals of fuzzy Algebra.
- To know the basic definitions of fuzzy theory
- To know the applications of fuzzy Technology.

INTENDED OUTCOME:

1. The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.

UNIT I
FUZZY SETS

UNIT II
OPERATIONS ON FUZZY SETS
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 Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

UNIT IV
FUZZY MEASURES

UNIT V
FUZZY INFERENCE
Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

Total : 45

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<tr>
<td>2</td>
<td>Michal Baczynski and Balasubramaniam Jayaram</td>
<td>Fuzzy Implications</td>
<td>Springer-Verlag publishers, Heidelberg</td>
<td>2008</td>
</tr>
<tr>
<td>3</td>
<td>Kevin M Passino and Stephen Yurkovich</td>
<td>Fuzzy Control</td>
<td>Addison Wesley Longman publishers, USA</td>
<td>1998</td>
</tr>
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</table>

WEBSITES:

1. www.mathcentre.ac.uk
2. www.mathworld. Wolfram.com
3. www.calvin.edu/~pribeiro/othrlinks/Fuzzy/fuzzysets.htm
OBJECTIVES:

1. To know the fundamentals of linear Algebra.
2. To study about the linear transformations
3. To introduce the concepts of inner product spaces

INTENDED OUTCOMES:

The student will be able to
1. Recognize the underlying theory of vector spaces over a field and inner product spaces over real or complex numbers
2. Visualize linear transformations as matrix form
3. Articulate the importance of Linear Algebra and its applications in branches of Mathematics

UNIT I VECTOR SPACES (9)
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 (9)
Eigen values and Eigen vectors - Diagonalization - Power method - QR decomposition

UNIT III SYSTEM OF LINEAR EQUATIONS (9)

UNIT IV LINEAR TRANSFORMATIONS (9)
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 (9)
The Dot Product on R^n and Inner Product Spaces - Orthonormal Bases - Orthogonal Complements - Application : Least Squares Approximation - Diagonalization of Symmetric M - Application: Quadratic Forms

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<td>3</td>
<td>Jim Defranza, Daniel Gagliardi</td>
<td>Introduction to Linear Algebra with Application</td>
<td>Tata McGraw-Hill, New Delhi.</td>
<td>2008</td>
</tr>
</tbody>
</table>

WEBSITES:

1. www.sosmath.com
2. www.nptel.ac.in
3. www.mathworld.wolfram.com
OBJECTIVES:

1. To provide mathematical basis for acoustics waves and the characteristic behaviour of sound in pipes, resonators and filters.
2. To introduce the properties of hearing and speech

INTENDED OUTCOME:

1. The students will have the knowledge on acoustics waves, the characteristic behaviour of sound in pipes, resonators and filters and that knowledge will be used by them in different engineering and technology applications

UNIT I  INTRODUCTION  (9)

UNIT II  RADIATION AND RECEPTION OF ACOUSTIC WAVES  (9)
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  (9)

UNIT IV  ARCHITECTURAL ACOUSTICS  (9)

UNIT V  TRANSDUCTION  (9)
Transducer as an electives network – canonical equation for the two simple transducers transmitters – moving coil loud speaker– horn loud speaker, receivers – condenser – microphone – moving coil electrodynamics microphone piezoelectric microphone – calibration of receivers

Total: 45
**TEXT BOOK:**

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</thead>
</table>

**WEBSITES:**

1. www.acousticalsociety.org  
2. www.acoustics-engineering.com  
3. www.nptel.ac.in  
4. www.ocw.mit.edu
OBJECTIVES:

1. To understand about the solid waste
2. To study about the waste treatment
3. To gain knowledge on the disposal of waste and waste management.
4. To get the information on energy conservation.

INTENDED OUTCOME:

1. The students will know solid waste and energy conservation. They will understand the methodologies to disposal of solid waste and its management.

UNIT I SOLID WASTE (9)

UNIT II WASTE TREATMENT (9)
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 (9)

UNIT IV HAZARDOUS WASTE MANAGEMENT (9)

UNIT V ENERGY GENERATION FROM WASTE (9)

Total: 45
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</table>

WEBSITES:

2. [http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/](http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/)
OBJECTIVES:

1. To understand about the green chemistry
2. To study the atom efficient process and synthesis elaborately.
3. To gain knowledge on the green technology and renewable energy resources.
4. To get the information on catalysis

INTENDED OUTCOME:

1. Students will know the chemistry and application of green technology for energy sources. They will understand the role of green catalyst in industries.

UNIT I  INTRODUCTION TO GREEN CHEMICAL PRINCIPLES  (9)
Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, 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  (9)
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  (9)
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  (9)
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  (9)
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.

Total: 45
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</table>

**WEBSITES:**

1. [http://www.organic-chemistry.org/topics/green-chemistry.shtm](http://www.organic-chemistry.org/topics/green-chemistry.shtm)
2. [http://www.essentialchemicalindustry.org/processes/green-chemistry.html](http://www.essentialchemicalindustry.org/processes/green-chemistry.html)
4. [http://www.epa.gov/research/greenchemistry/](http://www.epa.gov/research/greenchemistry/)
OBJECTIVES:

1. To get the information on electrochemical material.
2. To study about the conducting polymers
3. To understand about the fuel
4. To gain knowledge on the batteries and power sources.

INTENDED OUTCOME:

1. Students will understand about the fuel. They will get knowledge on the batteries and power sources.

UNIT I METAL FINISHING (9)

UNIT II CONDUCTING POLYMERS AND ELECTROCHEMICALS (9)
lectropolymerisation- 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 (9)
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 (9)
Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries, Lithium ion 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 (9)
Solar cells- Preparation of CdS/Cu2S 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.

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</thead>
</table>

WEBSITES:

2. http://hyperphysics.phy-astr.gsu.edu/hbase/electric/battery.html
OBJECTIVES:

1. To understand about the fuel
2. To study about the abrasives and lubricants.
3. To gain knowledge on inorganic chemicals and explosive materials.
4. To get the information on agriculture chemicals.

INTENDED OUTCOME:

1. The student will acquire basic knowledge on cement. The student will understand the interaction of engineering materials and their utilization in industries.

UNIT I CEMENT AND LIME (9)

UNIT II ABRASIVES AND REFRACTORIES (9)

UNIT III INORGANIC CHEMICALS (9)

UNIT IV EXPLOSIVES (9)

UNIT V AGRICULTURE CHEMICALS (9)

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WEBSITES:

PURPOSE:
It provides techniques of writing and also trains the students to write without their influence of mother tongue. In addition to honing their skills as professional writers, students will develop technical vocabularies that will aid writing research articles and discussing articles produces by their peers.

OBJECTIVE:
1. Develop abilities to write technically and expressively,
2. Recognize writing as a constructive, meaningful process,

INTENDED OUTCOMES:
Students undergoing this course are able to
1. Construct simple sentences, correct common grammatical errors in written English.
2. Build confidence in English language by imbibing lexical and syntax rules.
3. Enrich their reading ability for effective writing.

UNIT – 1 BASIC 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

UNIT – 3 LETTERS, MEMOS AND EMAIL

UNIT – 4 THE ART OF CONDENSATION AND TECHNICAL PROPOSALS
UNIT – 5  REPORTS AND RESEARCH ARTICLES


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<tr>
<td>1</td>
<td>V.N. Arora &amp; Lakshmi Chandra</td>
<td>Improve Your Writing: Revised First Edition</td>
<td>OUP</td>
<td>2014</td>
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<tr>
<td>1</td>
<td>Crème, P. and M. Lea.</td>
<td>Writing at University: A guide for students.</td>
<td>OUP</td>
<td>2003</td>
</tr>
<tr>
<td>2</td>
<td>Graham King</td>
<td>Collins Improve Your Writing</td>
<td>Collins; First edition</td>
<td>2009</td>
</tr>
<tr>
<td>3</td>
<td>David Morley</td>
<td>The Cambridge Intro. To Creative Writing</td>
<td>Cambridge</td>
<td>2008</td>
</tr>
</tbody>
</table>

WEBSITES:

http://www.stevepavlina.com/blog/2006/08/10-ways-to-improve-your-technical-skills/
http://www.nyu.edu/classes/keefer/brain/net2.html
https://www.udemy.com/technical-writing-and-editing/
http://techwhirl.com/what-is-technical-writing/
OPEN ELECTIVES OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
COURSE OBJECTIVES:

- To introduce the Java programming language and explore its current strengths and weaknesses.
- To study the way that object-oriented concepts are implemented in the Java programming language.
- To write working Java code to demonstrate the use of applets for client side programming.

LEARNING OUTCOMES:

- The way that exceptions are detected and handled in the Java programming language.
- Working of Java code that demonstrates multiple threads of execution.

UNIT I Introduction (9)


UNIT II HTML (9)


UNIT III PERL (9)


UNIT IV Client-Server programming (9)

UNIT V  Internet Telephony


TEXT BOOKS:

REFERENCES:
MULTIMEDIA AND ANIMATION

COURSE OBJECTIVES:

- To study the graphics techniques and algorithms.
- To study the multimedia concepts and various I/O technologies.

LEARNING OUTCOMES:

- To enable the students to develop their creativity
- To impart the fundamental concepts of Computer Animation and Multimedia.

UNIT I  Introduction  (9)


UNIT II  Creating Animation in Flash  (9)


UNIT III  3D Animation & its Concepts  (9)


UNIT IV  Motion Caption  (9)


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

TEXT BOOK:

REFERENCES:
1. Principles of Multimedia – Ranjan Parekh, 2007, TMH. (Unit I, Unit V)
COURSE OBJECTIVES:
- Assemble/setup and upgrade personal computer systems
- Perform installation, configuration, and upgrading of microcomputer hardware and software
- Install/connect associated peripherals

LEARNING OUTCOME:
- Diagnose and troubleshoot microcomputer systems hardware and software, and other
  Peripheral equipment.

UNIT I  Introduction

Introduction - Computer Organization – Number Systems and Codes – Memory – ALU – CU –
Instruction prefetch – Interrupts – I/O Techniques – Device Controllers – Error Detection
Microcomputer Concepts – OS – Multitasking and Multiprogramming – Virtual Memory – Cache
Memory – Modern PC and User.

UNIT II  Peripheral Devices

HDD – Special Types of Disk Drives – Mouse and Trackball – Modem – Fax-Modem – CD ROM

UNIT III  PC Hardware Overview

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

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

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
TEXT BOOK:


REFERENCES:

COURSE OBJECTIVES:
- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.

INTENDED OUTCOMES:
- Be aware of the important topics and principles of software development.
- Have the ability to write a computer program to solve specified problems.
- Be able to use the Java SDK environment to create, debug and run simple Java programs.

UNIT I INTRODUCTION TO JAVA (9)

UNIT II PACKAGES (9)

UNIT III I/O STREAMS (9)

UNIT IV EXCEPTION HANDLING (9)

UNIT V MOTIVATION FOR GENERIC PROGRAMMING (9)
TEXT BOOK:


REFERENCES:


WEBSITES:

LIST OF OPEN ELECTIVES OFFERED BY

ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT
OBJECTIVES

• To understand the basic concepts of electric hybrid vehicle.
• To gain the knowledge about electric propulsion unit.
• To understand and gain the knowledge about various energy storage devices.

INTENDED OUTCOMES

• At the end of the course the student will be understand the concept of electric hybrid vehicle and its energy storage schemes.

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.

TOTAL: 45 HOURS

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<tbody>
<tr>
<td>1</td>
<td>Iqbal Hussein</td>
<td>Electric and Hybrid Vehicles: Design Fundamentals</td>
<td>CRC Press – 2nd edition</td>
<td>2010</td>
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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.

INTENDED OUTCOMES

- At the end of the course the student will be able to understand the concept of energy efficient motors, economic crisis and energy management.

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-


UNIT V POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS


TOTAL: 45 HOURS
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<td>1</td>
<td>John C. Andreas</td>
<td>Energy Efficient Electric Motors</td>
<td>Marcel Dekker Inc Ltd – 3rd edition</td>
<td>2005</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To understand the basic principles of PLC systems.
- To gain the knowledge about data handling functions.
- To understand the principles of PID.

INTENDED OUTCOMES

- 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.

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

TOTAL: 45 HOURS

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<tr>
<td>2</td>
<td>John Webb and Ronald A Reiss</td>
<td>Programmable Logic Controllers – Principle and Applications</td>
<td>Fifth edition, PHI</td>
<td>2004</td>
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</table>

**REFERENCES**

**WEBSITE**

http://www.mikroe.com/old/books/plcbook/chapter1/chapter1.htm - Introduction to programmable Logic controller
17BEEEOE04 RENEWABLE ENERGY RESOURCES L T P C 3 0 0 3

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 understand the basic principles fuel cell, Geo thermal power plants.
- To gain the knowledge about hydro energy.

INTENDED OUTCOMES

- At the end of the course student understands about all types of energy sources and utilization.

UNIT I INTRODUCTION


UNIT II SOLAR ENERGY


UNIT III WIND ENERGY


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.

TOTAL: 45 HOURS
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<tr>
<td>1</td>
<td>Rai.G.D</td>
<td>Non-conventional sources of energy</td>
<td>Khanna publishers</td>
<td>2011</td>
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<td>Rao.S. &amp; Parulekar</td>
<td>Energy Technology</td>
<td>Khanna publishers, Eleventh Reprint</td>
<td>2013</td>
</tr>
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</table>

## WEBSITES
1. [www.energycentral.com](http://www.energycentral.com)
2. [www.catelectricpowerinfo.com](http://www.catelectricpowerinfo.com)
OPEN ELECTIVES OFFERED BY
ELECTRONICS AND COMMUNICATION ENGINEERING TO OTHER DEPARTMENTS
OBJECTIVES:

- introduce students to the embedded systems, its hardware and software.
- introduce devices and buses used for embedded networking.
- study about task management
- learn about semaphore management and message passing
- study about memory management

INTENDED OUTCOMES:

- Ability to understand embedded systems, its hardware and software.
- Gain knowledge about devices and buses used for embedded networking.
- Gain knowledge 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– ARM7.

UNIT-II OPERATING SYSTEM OVERVIEW
Introduction– Advantage and Disadvantages 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– Inter task
Communication– Message Mailboxes– Message Queues- Interrupts- Task Management– Memory
Management– Time Management– Clock Ticks.

UNIT-III TASK MANAGEMENT
Introduction– μ C/OS-II- Features- Goals of μ C/OS-II- Hardware and Software Architecture– Kernel
μ C/OS-II– Clock Tick– μ C/OS-II Initialization. Task Management: Creating Tasks– Task Stacks–
Stack Checking– Task’s Priority– Suspending Task– Resuming Task. Time Management: Delaying a

UNIT-IV SEMAPHORE MANAGEMENT AND MESSAGE PASSING

UNIT-V MEMORY MANAGEMENT
Memory Management: Memory Control Blocks–Creating Partition-Obtaining a Memory Block–Returning a Memory Block. Getting Started withµ C/OS-II–Installingµ C/OS-II–Portingµ C/OS-II: Development Tools–Directories and Files– Testing a Port -IAR Workbench withµ C/OS-II-µ C/OS- II Porting on a 8051CPU– Implementation of Multitasking- Implementation of Scheduling andRescheduling –Analyze the Multichannel ADC with help ofµ C/OS-II.

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<td>1</td>
<td>JeanJ. Labrosse</td>
<td>Micro C/OS–II The Real Time Kernel</td>
<td>CMPBOOKS</td>
<td>2009</td>
</tr>
<tr>
<td>3</td>
<td>Steve Furbe,</td>
<td>ARM System-on-Chip Architecture,</td>
<td>Addison-Wesley</td>
<td>2000</td>
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<tr>
<td></td>
<td>Pankaj Gupta</td>
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</table>
OBJECTIVES:

- study about various speakers and microphone  
- learn the fundamental of television systems and standards
- learn the process of audio recording and reproduction
- study the various telephone networks

INTENDED OUTCOMES:

- knowledge about various speakers and microphone
- knowledge about the fundamental of television systems and standards
- knowledge about the process of audio recording and reproduction
- knowledge about the various telephone networks

UNIT I  LOUDSPEAKERS AND MICROPHONES

UNIT II  TELEVISION STANDARDS AND SYSTEMS

UNIT III  OPTICAL RECORDING AND REPRODUCTION
Audio Disc– Processing of the Audio signal–readout from the Disc –Reconstruction of the audio

UNITIV TELECOMMUNICATION SYSTEMS

UNITV HOME APPLIANCES
Basic principle and block diagram of microwave oven; washing machine hardware and software; Components of air conditioning and refrigeration systems.

TEXT BOOKS:

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</thead>
<tbody>
<tr>
<td>1</td>
<td>S.P. Bali</td>
<td>Consumer Electronics</td>
<td>PearsonEducation</td>
<td>2007</td>
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<td>2</td>
<td>J.S.Chitode</td>
<td>Consumer Electronics</td>
<td>Technical Publications</td>
<td>2007</td>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Philip Hoff, Philip Herbert Hoff.</td>
<td>Consumer Electronics for Engineers.</td>
<td>Cambridge University Press</td>
<td>1998</td>
</tr>
</tbody>
</table>
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.

INTENDED OUTCOMES:

- Understand the basic concepts of neural networks and its applications in various domain
- Ability to develop the use of Soft Computing to solve real-world problems
- Understand the Basic Neural Network.

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

UNIT III PERCEPTION

UNIT IV ATTRACT OR NEURAL NETWORK AND ART

UNIT V SELF ORGANIZATION

TEXT BOOKS:

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simon Haykin</td>
<td>Neural Networks and Learning Machines</td>
<td>Pearson/Prentice Hall 3rd Edition</td>
<td>2009</td>
</tr>
<tr>
<td>S.NO.</td>
<td>Author(s) Name</td>
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<tr>
<td>3</td>
<td>Wasserman P.D</td>
<td>Neural Computing Theory &amp; Practice</td>
<td>Van Nortrand Reinhold</td>
<td>1989</td>
</tr>
<tr>
<td>4</td>
<td>Freeman J.A., S kapura D.M</td>
<td>Neural networks, algorithms, applications, and programming techniques.</td>
<td>AdditionWesley</td>
<td>2005</td>
</tr>
</tbody>
</table>
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.

INTENDED OUTCOMES:

- Understand the basic concepts of Fuzzy logic and its applications in various domain
- Ability to develop how to use Fuzzy computation to solve real-world problems
- Understand basic fuzzy models.

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, fuzzy fiction and defuzzy fiction procedures—Design of Fuzzy Logic Controller

UNIT-IV

UNIT V
Fuzzy based systems: Simple applications of FKBC-washing machines-traffic regulations-lift control-fuzzy in medical Applications-Introduction to ANFIS.

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</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>G.J. Klir and T.A. Folger</td>
<td>Fuzzy Sets Uncertainty and Information</td>
<td>PHI IEEE</td>
<td>1995</td>
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<tr>
<td>1</td>
<td>Timothy J. Ross</td>
<td>Fuzzy Logic with Engineering Applications</td>
<td>McGraw Hill</td>
<td>1997</td>
</tr>
<tr>
<td>2</td>
<td>George. J Klir and Bo Yuan</td>
<td>Fuzzy Sets and Fuzzy Logic</td>
<td>Prentice Hall, USA</td>
<td>1995</td>
</tr>
</tbody>
</table>
LIST OF OPEN ELECTIVES
OFFERED BY AEROSPACE ENGINEERING
OBJECTIVES:

To provide in-depth knowledge on various techniques of non-destructive testing.

UNIT I: INTRODUCTION

Properties of Materials – Characteristics of Ferrous, Non-ferrous and Alloys. Destructive testing and Non-destructive testing – Classification – Uses and applications. Codes, Standards and Specifications (ASME, ASTM, AWS etc.).

UNIT II PENETRANT TESTING AND MAGNETIC PARTICLE INSPECTION

Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - An Illustration of Penetrant Testing, Advantages of Penetrant Testing, Disadvantages of Penetrant Testing. Introduction to Magnetic Particle Inspection - An Illustration of Magnetic Particle Inspection, Advantages of Magnetic Particle Crack Detection, Disadvantages of Magnetic Particle Crack Detection

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION


UNIT IV EDDY CURRENT AND ELECTRO-MAGNETIC METHODS


UNIT V NON-DESTRUCTIVE INSPECTION (NDI) AND ITS APPLICATIONS

Inspection of Raw Products, Inspection For In-Service Damage, Power Plant Inspection, Storage Tank Inspection,
Aircraft Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.

**TEXT BOOKS:**

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</table>

**WEB REFERENCE:**

https://www.asnt.org/MinorSiteSections/AboutASNT/Intro-to-NDT

https://www.asnt.org/

www.bindt.org/

www.ndt.net/

OBJECTIVES:

- Ability to design UAV system
- Ability to identify different hardware for UAV

UNIT I INTRODUCTION TO UAV

History of UAV – classification – Introduction to Unmanned Aircraft Systems– models and prototypes – System Composition-applications

UNIT II THE DESIGN OF UAV SYSTEMS


UNIT III AVIONICS HARDWARE

Autopilot – AGL-pressure sensors-servos-accelerometer– gyros- actuators- power supply- processor, integration, installation, configuration, and testing

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS

Payloads- Telemetry-tracking- Aerial photography- controls- PID feedback- radio control frequency range – modems-memory system- simulation- ground test- analysis- trouble shooting

UNIT V THE DEVELOPMENT OF UAV SYSTEMS

Waypoints navigation- ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges- Case Studies – Mini and Micro UAVs.
### TEXT BOOKS:

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<tbody>
<tr>
<td>1.</td>
<td>Reg Austin</td>
<td>Unmanned Aircraft Systems UAV design, development and deployment</td>
<td>John Wiley &amp; Sons New York</td>
<td>2011</td>
</tr>
<tr>
<td>2.</td>
<td>Jay Gundlach</td>
<td>Designing Unmanned Aircraft Systems</td>
<td>American Institute of Aeronautics and Astronautics, Reston</td>
<td>2014</td>
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### WEB REFERENCE:

- [rahauav.com/Library/.../Unmanned-Air-Systems](http://rahauav.com/Library/.../Unmanned-Air-Systems)
- [http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-83x](http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-83x)
- [spaceflight.nasa.gov/shuttle/reference/shutref/orbiter/.../plcomm.html](http://spaceflight.nasa.gov/shuttle/reference/shutref/orbiter/.../plcomm.html)
- [www.theuav.com/](http://www.theuav.com/)
OBJECTIVES:
To study the procedure of the formation of aerodrome, its design and the concepts of air transportation.

UNIT - I INTRODUCTION
Development of air transportation, comparison with other modes of transport – Role of IATA, ICAO – The general aviation industry airline – Factors affecting general aviation, use of aircraft, airport: airline management and organization – levels of management, functions of management, Principles of organization planning the organization – chart, staff departments & line departments.

UNIT - II AIRLINE ECONOMICS
Forecasting – Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. – Passenger fare and tariffs – Influence of geographical, economic & political factors on routes and route selection.

UNIT - III PRINCIPLES OF AIRLINES SCHEDULING
Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, equipments and types of schedule – hub & spoke scheduling, advantages / disadvantages & preparing flight plans – Aircraft scheduling in line with aircraft maintenance practices.

UNIT - IV AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION

UNIT - V VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES
Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.
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## WEB REFERENCE:

- [www.grc.nasa.gov/WWW/k-12/airplane/](http://www.grc.nasa.gov/WWW/k-12/airplane/)
- [www.history.navy.mil/branches/car-toc.html](http://www.history.navy.mil/branches/car-toc.html)
- [www.britannica.com/EBchecked/topic/.../Aircraft-configurations](http://www.britannica.com/EBchecked/topic/.../Aircraft-configurations)
- [www.brown.edu/Departments/EEB/EML/.../principles_flight.html](http://www.brown.edu/Departments/EEB/EML/.../principles_flight.html)
OBJECTIVES:
To introduce the basic concepts of various avionicssystems of aircraft.

UNIT I INTRODUCTION TO AVIONICS

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE


UNIT III FLIGHT DECKS AND COCKPITS

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS


UNIT V AIR DATA SYSTEMS AND AUTO PILOT

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.
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<td>Leesburg,USA</td>
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<td>Systems</td>
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<td>1.</td>
<td>Ian Moir, Allan</td>
<td>Civil Avionics Systems</td>
<td>John Wiley &amp; Sons, New Jersey, USA.</td>
<td>2013</td>
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<td></td>
<td>Seabridge, Malcolm</td>
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<td>Jukes</td>
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WEB REFERENCES:

www.ntps.edu/courses/116-introduction-to-avionics-systems-course
www.ece.ucsb.edu/courses/ECE152/152A_Su11Shynk/Lec1.pdf
www.pbase.com/bruceleibowitz/cockpit
www.cranfield.ac.uk/soe/shortcourses/.../avionics-introduction.html
OPEN ELECTIVES OFFERED BY DEPARTMENT OF AUTOMOBILE ENGINEERING
INTENDED OBJECTIVES:

- This course enables the students to know about all the main and auxiliary systems of automobile with its base construction and working.

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

UNIT -III SUSPENSION SYSTEM

UNIT-IV BRAKES

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

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INTENDED 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.

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.

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</table>
INTENDED OBJECTIVES:

- The objective of this course is to make the students to know and understand the maintenance and fault diagnosis of basic systems in Automobile.

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 and dimensional 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.

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<tr>
<td>3.</td>
<td>Service Manuals from Different Vehicle Manufacturers</td>
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</table>
INTENDED OBJECTIVES:

- This course enables the students to have a knowledge about the recent technologies that is in use in automobile.

UNIT I  TRENDS IN POWER PLANTS

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

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</table>
LIST OF OPEN ELECTIVES
OFFERED BY CIVIL ENGINEERING
OBJECTIVE:
At the end of this course, the students should have learnt the basic terms of housing programmes, planning and designing of housing projects, construction techniques and cost effective materials and housing finance and project appraisal techniques.

UNIT I  INTRODUCTION TO HOUSING
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
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
Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV  CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS
New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V  HOUSING FINANCE AND PROJECT APPRAISAL

TOTAL HRS : 45

TEXT BOOKS

REFERENCES
2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000.
OBJECTIVE:

At the end of this course the students should have learnt various machineries of construction, electrical systems in building, design and principle of illumination, refrigeration principle and application and various fire safety installations.

UNIT I  MACHINERIES

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


UNIT III  PRINCIPLES OF ILLUMINATION & DESIGN


UNIT IV  REFRIGERATION PRINCIPLES & APPLICATIONS


UNIT V  FIRE SAFETY INSTALLATION


TOTAL HRS : 45
TEXT BOOKS

REFERENCES
OBJECTIVE:
At the end of this course the students should have learnt the irrigation system requirements, irrigation scheduling, strategies in water use management, canal operation places and involvement of stake holder

UNIT I.  IRRIGATION SYSTEM REQUIREMENTS  9

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

REFERENCES
OBJECTIVE:

At the end of this course, the students should have learnt the modern construction methods, methods for special structures, modern equipments used for excavation, conveyance etc and principles and practices of temporary structures.

UNIT - I MODERN CONSTRUCTION METHODS

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


UNIT - III MODERN CONSTRUCTION EQUIPMENTS -I

Construction Equipment used for Earth Moving, Excavating, Drilling, Blasting, Tunneling and hoisting

UNIT - IV MODERN CONSTRUCTION EQUIPMENTS -II

Construction Equipment used for Conveying, Hoisting, Dredging, Dewatering Systems, Paving and concreting Plant

UNIT - V PRINCIPLES AND PRACTICES OF TEMPORARY STRUCTURES

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


REFERENCES

2. Nunnaly, S.W., Construction Methods and Management, Prentice – Hall, 2000
LIST OF OPEN ELECTIVES OFFERED BY MECHANICAL ENGINEERING
OBJECTIVE

1. To provide an overview of how computers are being used in mechanical component design

UNIT I OVERVIEW OF CAD SYSTEMS 9
Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

UNIT II INTERACTIVE COMPUTER GRAPHICS AND GRAPHICS TRANSFORMATIONS 9

UNIT III GEOMETRIC MODELING 9

UNIT IV PARAMETRIC DESIGN AND OBJECT REPRESENTATION 9

UNIT V PRODUCT DESIGN AND DEVELOPMENT 9

TOTAL 45

TEXT BOOKS

<table>
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<tbody>
<tr>
<td>2</td>
<td>Radhakrishnan P and Subramanyan S</td>
<td>CAD/CAM/CIM</td>
<td>New Age International Pvt. Ltd</td>
<td>2004</td>
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OBJECTIVE

1. Upon completion of this course, the students can understand the role of logistics and understand the phases of supply chain

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

UNIT IV SUPPLY CHAIN ACTIVITIES
Structuring the SC, SC and new products, functional roles in SC - SC design frame - work - 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

TOTAL 45

TEXT BOOKS

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<tr>
<td>2</td>
<td>Steudel.HJ and Desruelle.P</td>
<td>Manufacturing in the nineteen - How to become a mean, lean and world class competitor</td>
<td>Van Nostrand Reinhold, New York</td>
<td>1992</td>
</tr>
</tbody>
</table>
OBJECTIVE

1. Upon completion of this course, the students can able to understand the relationship between free energy, entropy, internal energy, and enthalpy

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

TOTAL 45

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<tbody>
<tr>
<td>1</td>
<td>Geankoplis, C. J</td>
<td>Transport Processes and Separation Processes Principles</td>
<td>Prentice Hall</td>
<td>2003</td>
</tr>
</tbody>
</table>

WEB REFERENCE

1. https://laulima.hawaii.edu/portal
OBJECTIVE

1. Biomechanics provides key information on the most effective and safest movement patterns, equipment, and relevant exercises to improve human movement.

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

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

TOTAL 45

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<tbody>
<tr>
<td>1</td>
<td>Duane Knudson</td>
<td>Fundamentals of Biomechanics</td>
<td>Springer Science+ Business Media, LLC</td>
<td>2007</td>
</tr>
<tr>
<td>2</td>
<td>C. Ross Ethier Craig A. Simmons</td>
<td>Introductory Biomechanics</td>
<td>Cambridge University Press</td>
<td>2007</td>
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</table>
COURSES OFFERED TO OTHER DEPARTMENT
OPEN ELECTIVES OFFERED BY
DEPARTMENT OF BIOTECHNOLOGY
OBJECTIVE

- To understand the basic design of bioreactors
- To understand the principle of heat transfer inside a bioreactor

INTENDED OUTCOME

- To design bioreactors for various operations
- To select the appropriate separation equipment based on the nature of the product

UNIT I  ENGINEERING PROPERTIES AND STORAGE TANK  
Introduction to various mechanical properties of material to be used material of construction, design of cylindrical storage tank.

UNIT II  REACTOR DESIGN  
Design of Airlift fermentor, Bubble column reactor and Continuous stirred tank reactor.

UNIT III  HEAT TRANSFER EQUIPMENTs  
Design of Shell and tube Heat exchanger, Double pipe heat exchanger, long tube vertical evaporator and forced circulation evaporator.

UNIT IV  MASS TRANSFER EQUIPMENTs  
Design of Bollmann extractor, fractionating column, packed tower and spray tray absorber

UNIT V  SEPARATION EQUIPMENTs  
Design of plate and frame filter press, leaf filter, rotary drum filter, disc bowl centrifuge, rotary drum drier and Swenson –walker crystallizer.

TEXT BOOKS:

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<tr>
<td>2</td>
<td>Don W. Green, Robert H. Perry</td>
<td>Chemical Engineer Hand book</td>
<td>The McGraw- Hill Companies, Inc.</td>
<td>2008</td>
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OBJECTIVE

- To understand the importance of food processing
- To make the students learn the various processing and preservation techniques.

INTENDED OUTCOMES

The students are exposed to

- Properties of food material
- Various methods used for preserving fruits and 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)


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

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<tr>
<td>3</td>
<td>Mircea Enachescu Dauthy</td>
<td>Fruit and Vegetable Processing</td>
<td>FAO agricultural services bulletin</td>
<td>1995</td>
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<td>1</td>
<td>M.A. Rao, Syed S.H. Rizvi, Ashim K. Datta</td>
<td>Engineering properties of foods</td>
<td>CRC Press</td>
<td>2005</td>
</tr>
<tr>
<td>2</td>
<td>B. Sivasankar</td>
<td>Food processing and preservation</td>
<td>PHI Learning Pvt. Ltd</td>
<td>2002</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To enable the students to get aware of available tools and databases for performing research in bioinformatics.
- To provide the thorough understanding of protein structure in detail.

INTENDED OUTCOMES

At the end of the course,

- The students will understand the importance of Bioinformatics in various sectors.
- The students will be exposed to biological database management and microarray technology.

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  
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.

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<tr>
<td>1</td>
<td>Dan E. Krane, Michael L. Rayme</td>
<td>Fundamental Concepts of Bioinformatics</td>
<td>Pearson education</td>
<td>2004</td>
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<tr>
<td>3</td>
<td>David W. Mount</td>
<td>Sequence and Genome Analysis</td>
<td>Cold Spring Harbor Laboratory</td>
<td>2004</td>
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<td>4</td>
<td>Jonathan Pevsner</td>
<td>Bioinformatics and Functional Genomics</td>
<td>Wiley-Liss</td>
<td>2003</td>
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<tr>
<td>1</td>
<td>Michael J. Korenberg</td>
<td>Microarray Data Analysis: Methods and Applications</td>
<td>Springer Science &amp; Business Media</td>
<td>2007</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To develop skills of the students in the field of nano biotechnology and its applications in various fields.
- The course will serve as an effective course to understand Socio-economic issues of nanobiotechnology.

INTENDED OUTCOMES

At the end of the course,
- The students will be able to identify the potential areas where nanoparticles can be utilized.
- The students will be exposed to the ethical issues regarding the use of nanoparticles.

UNIT I INTRODUCTION


UNIT II NANO PARTICLES


UNIT III APPLICATIONS


UNIT IV NANOBIOTECHNOLOGY

UNIT V ETHICAL ISSUES IN NANOTECHNOLOGY


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<td>1</td>
<td>Niemeyer, C.M. and Mirkin, C.A</td>
<td>Nanobiotechnology: Concepts, Applications and Perspectives</td>
<td>Wiley-VCH</td>
<td>2004</td>
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<tr>
<td>2</td>
<td>Goodsell, D.S.</td>
<td>Bionanotechnology</td>
<td>John Wiley and Sons, Inc</td>
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<td>Springer Handbook of Nanotechnology</td>
<td>Springer-Verlag Berlin Heidelberg</td>
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<td>FreitasJr R.A</td>
<td>Nanomedicine</td>
<td>Landes Biosciences</td>
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<td>4</td>
<td>Kohler, M. and Fritzsche, W.</td>
<td>Nanotechnology – An Introduction to Nanostructuring Techniques</td>
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