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# EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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<th>S. No.</th>
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<th>COURSE TITLE</th>
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OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12


UNIT II GENERAL READING AND FREE WRITING 12

Reading: comprehension - pre-reading - post reading - comprehension questions (multiple choice questions and/or short questions/ open-ended questions). Inductive reading - short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts). Writing: paragraph writing - topic sentence - main ideas - free writing, short narrative descriptions using some suggested vocabulary and structures. Listening: telephonic conversations. Speaking: sharing information of a personal kind - greeting - taking leave.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12


UNIT IV READING AND LANGUAGE DEVELOPMENT 12

UNIT V EXTENDED WRITING

Reading - longer texts- close reading – Writing - brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-

Listening – listening to talks-

Speaking – participating in conversations- short group conversations-

Language development -modal verbs- present/ past perfect tense - Vocabulary development -collocations- fixed and semi-fixed expressions

OUTCOMES:

At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:


REFERENCES


MA8151 ENGINEERING MATHEMATICS – I

OBJECTIVES :

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.
UNIT I DIFFERENTIAL CALCULUS
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES

UNIT III INTEGRAL CALCULUS
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS

UNIT V DIFFERENTIAL EQUATIONS

TOTAL : 60 PERIODS

OUTCOMES :
After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :
PH8151 ENGINEERING PHYSICS

OBJECTIVES:

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

UNIT I PROPERTIES OF MATTER


UNIT II WAVES AND FIBER OPTICS


UNIT III THERMAL PHYSICS


UNIT IV QUANTUM PHYSICS


UNIT V CRYSTAL PHYSICS

- Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of
imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

REFERENCES:

CY8151 ENGINEERING CHEMISTRY

OBJECTIVES:
- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT
UNIT II SURFACE CHEMISTRY AND CATALYSIS  

UNIT III ALLOYS AND PHASE RULE  

UNIT IV FUELS AND COMBUSTION  

UNIT V ENERGY SOURCES AND STORAGE DEVICES  
Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H₂-O₂ fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:
- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures — lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS
Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

OUTCOMES:
Upon completion of the course, students will be able to
- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TOTAL : 45 PERIODS

TEXT BOOKS:

REFERENCES:

GE8152 ENGINEERING GRAPHICS L T P C
2 0 4 4

OBJECTIVES:
- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.
Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.
UNIT II  PROJECTION OF POINTS, LINES AND PLANE SURFACE  6+12
Orthographic projection- principles-Principal planes-First angle projection-projection of points.
Projection of straight lines (only First angle projections) inclined to both the principal planes -
Determination of true lengths and true inclinations by rotating line method and traces
Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object
method.

UNIT III  PROJECTION OF SOLIDS  5+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the
axis is inclined to one of the principal planes by rotating object method.

UNIT IV  PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF
SURFACES  5+12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one
of the principal planes and perpendicular to the other – obtaining true shape of section.
Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and
cones.

UNIT V  ISOMETRIC AND PERSPECTIVE PROJECTIONS  6+12
Principles of isometric projection – isometric scale –Isometric projections of simple solids and
truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple
vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by
visual ray method.

TOTAL: 90 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
• familiarize with the fundamentals and standards of Engineering graphics
• perform freehand sketching of basic geometrical constructions and multiple views of objects.
• project orthographic projections of lines and plane surfaces.
• draw projections and solids and development of surfaces.
• visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:
   2009.

REFERENCES:
   Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores,
   introduction to Interactive Computer Graphics for Design and Production, Eastern
Publication of Bureau of Indian Standards:

Special points applicable to University Examinations on Engineering Graphics:
1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

GE8161 PROBLEM SOLVING AND PYTHON PROGRAMMING LAB L T P C
0 0 4 2

OBJECTIVES:
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton’s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame
PLATFORM NEEDED
Python 3 interpreter for Windows/Linux

OUTCOMES:
Upon completion of the course, students will be able to
- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL: 60 PERIODS

BS8161 PHYSICS AND CHEMISTRY LAB (Common to all branches of B.E. / B.Tech Programmes) 0 0 4 2

OBJECTIVES:
- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)
1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young’s modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to
- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometry.

1. Estimation of HCl using Na₂CO₃ as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler’s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by lodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
12. Pseudo first order kinetics-ester hydrolysis.
14. Determination of CMC.
15. Phase change in a solid.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:
- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

TEXTBOOKS:
in a text- paragraphing- Writing- interpreting charts, graphs- Vocabulary Development- vocabulary used in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 12
Listening- Listening to classroom lectures/ talks on engineering/technology -Speaking – introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading; Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentences

UNIT IV REPORT WRITING 12

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12
Listening- TED/Ink talks; Speaking –participating in a group discussion -Reading– reading and understanding technical articles Writing– Writing reports- minutes of a meeting- accident and survey- Vocabulary Development- verbal analogies Language Development- reported speech.

OUTCOMES: At the end of the course learners will be able to:
- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TOTAL :60 PERIODS

TEXT BOOKS:

REFERENCES
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.
OBJECTIVES:

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES  12

UNIT II VECTOR CALCULUS  12
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green’s, Gauss divergence and Stoke’s theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS  12
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION  12

UNIT V LAPLACE TRANSFORMS  12

TOTAL: 60 PERIODS

OUTCOMES:

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green’s theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
• Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS:

REFERENCES:

PH8254 PHYSICS OF MATERIALS L T P C
(3 0 0 3)

OBJECTIVES:
• To introduce the physics of various materials relevant to different branches of technology

UNIT I PREPARATION OF MATERIALS 9

UNIT II CONDUCTING MATERIALS 9
UNIT III SEMICONDUCTING MATERIALS


UNIT IV DIELECTRIC AND MAGNETIC MATERIALS


UNIT V NEW MATERIALS AND APPLICATIONS


TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the students will able to

- gain knowledge on phase diagrams and various material processing methods,
- acquire knowledge on basics of conducting materials, superconductors and their applications
- get knowledge on the functioning of semiconducting materials and their applications in LED and solar cells,
- understand the functioning of various dielectric and magnetic materials,
- have the necessary understanding on various advanced materials.

TEXT BOOKS:

REFERENCES
OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

UNIT I  SCOPE OF CIVIL AND MECHANICAL ENGINEERING  10
Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering


UNIT II  SURVEYING AND CIVIL ENGINEERING MATERIALS  10


UNIT III  BUILDING COMPONENTS AND STRUCTURES  15


UNIT IV  INTERNAL COMBUSTION ENGINES AND POWER PLANTS  15
Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants — working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps
UNIT V  REFRIGERATION AND AIR CONDITIONING SYSTEM  10

OUTCOMES:
On successful completion of this course, the student will be able to
• appreciate the Civil and Mechanical Engineering components of Projects.
• explain the usage of construction material and proper selection of construction materials.
• measure distances and area by surveying
• identify the components used in power plant cycle.
• demonstrate working principles of petrol and diesel engine.
• elaborate the components of refrigeration and Air conditioning cycle.

TOTAL: 60PERIODS

TEXTBOOKS:

REFERENCES:

BT8291  MICROBIOLOGY  L T P C
3 0 0 3

OBJECTIVES
• To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
• To solve the problems in microbial infection and their control.

UNIT I  INTRODUCTION  6
Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II  MICROBES- STRUCTURE AND MULTIPLICATION  12
Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.
UNIT III  MICROBIAL NUTRITION, GROWTH AND METABOLISM  12
Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV  CONTROL OF MICROORGANISMS  6
Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V  INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY  9
Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

TEXT BOOKS

BT8251  BIOCHEMISTRY  L T P C  3 0 0 3

OBJECTIVE
- To enable students learn the fundamentals of Biochemical Processes and Biomolecules.

UNIT I  INTRODUCTION TO BIOMOLECULES - CARBOHYDRATES  8

UNIT II  STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES  12
Structure and properties of Important Biomolecules.
Lipids: fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins.
Protein: Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary structure.
Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, RNA, DNA-Watson-Crick structure of DNA, reactions, properties, measurement, nucleoprotein complexes

UNIT III METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM

UNIT IV INTERMEDIARY METABOLISM AND REGULATION
Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNIT V PROTEIN TRANSPORT AND DEGRADATION
Protein targeting, signal sequence, secretion; Folding, Chaperone and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

TOTAL: 45 PERIODS

OUTCOMES
- To ensure students have a strong foundation in the structure and reactions of Biomolecules.
- To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
- To correlate Biochemical processes with Biotechnology applications.

TEXT BOOKS

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

GROUP A (CIVIL & MECHANICAL)

I  CIVIL ENGINEERING PRACTICE  13
Buildings:
• (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:
(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
   Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:
(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
   Wood work, joints by sawing, planing and cutting.

II  MECHANICAL ENGINEERING PRACTICE  18
Welding:
(a) Preparation of butt joints, lap joints and T-joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:
(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:
(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:
(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example –
   Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.
GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13
1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
5. Measurement of energy using single phase energy meter.

IV ELECTRONICS ENGINEERING PRACTICE 16
1. Study of Electronic components and equipments – Resistor, colour coding – measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer 2 Nos
   (b) Demolition Hammer 2 Nos
   (c) Circular Saw 2 Nos
   (d) Planer 2 Nos
(e) Hand Drilling Machine
(f) Jigsaw

MECHANICAL
1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
9. Study-purpose items: centrifugal pump, air-conditioner One each.

ELECTRICAL
1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos
   (b) Digital Live-wire detector 2 Nos

ELECTRONICS
1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

BT8261 BIOCHEMISTRY LAB

AIM
- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

EXPERIMENTS
1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer – titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
7. Protein estimation by Biuret and Lowry’s methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).

Equipment Needed for 20 Students

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Autocalve</td>
<td>1</td>
</tr>
<tr>
<td>Hot Air Oven</td>
<td>1</td>
</tr>
<tr>
<td>Incubators</td>
<td>2</td>
</tr>
<tr>
<td>Light Microscopes</td>
<td>4</td>
</tr>
<tr>
<td>Incubator Shaker</td>
<td>1</td>
</tr>
<tr>
<td>Colorimeter</td>
<td>2</td>
</tr>
<tr>
<td>Laminar Flow Chamber</td>
<td>2</td>
</tr>
</tbody>
</table>

Glassware, Chemicals, Media as required

TOTAL: 60 PERIODS

TEXT BOOKS
1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

REFERENCES
OBJECTIVE:
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I  PARTIAL DIFFERENTIAL EQUATIONS  12
Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II  FOURIER SERIES  12

UNIT III  APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS  12
Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV  FOURIER TRANSFORMS  12

UNIT V  Z - TRANSFORMS AND DIFFERENCE EQUATIONS  12

TOTAL:  60 PERIODS

OUTCOMES:
Upon successful completion of the course, students should be able to:
- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
• Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
• Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
• Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

REFERENCES:
UNIT III PHASE EQUILIBRIA
Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.

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

UNIT V THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION
Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course, the student would have the ability
- To explain the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications and biological systems.
- To demonstrate the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.
- To design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data to do the design and operation of bioprocesses.
- To describe the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations microbial growth and product formation.

TEXT BOOKS:

REFERENCE:
COURSE OBJECTIVES
To enable the students to
- learn the basics mechanics of fluid particles
- learn the properties and handling behaviour of particulate solids
- understand the principle and working of size reduction equipment
- understand the working mechanism of the size separation equipment
- enable the students to learn the basic concepts of fluid particles

UNIT I     BASIC CONCEPTS OF MOMENTUM TRANSFER  9

UNIT II     FLUID FLOW THROUGH PACKED AND FLUIDIZED BED  9
Flow past immersed bodies – Significance of form friction - Concept of Drag, Drag Coefficients and Particle Reynolds number -. Flow of fluids through packed beds – Packing and types of packing - Pressure drop across packed beds –Kozeny Carman equation – Ergun”s equation - Concept of Fluidization – Condition for Solid particles to be in a suspended in a flowing fluid – minimum fluidization velocity

UNIT III     PROPERTIES OF PARTICULATE SOLIDS AND SIZE REDUCTION  9
Characterization of solid particles, properties of masses of particles, storage and handling of solids, mixing of solids, equipment used for mixing of solids, liquid- solid and gas-solid systems. Crushing laws, classification of the size reduction equipment, principles, construction, working and application of the size reduction equipment like crushers, grinders, ultra-fine grinders and cutters.

UNIT IV      MECHANICAL SEPARATIONS  9
Screening and classification, ideal and actual screens, capacity and effectiveness of screen, study of the filtration techniques, types of filters, filter aids, filter media, sedimentation and thickening, centrifugal sedimentation process, principle of other separation methods like flotation, jigging, electrostatic and magnetic separation, tabling

UNIT V      PARTICLE SIZE ENLARGEMENT  9
Inter-particle forces, comparison and interaction between forces, nucleation and growth of particles, granulation equipment, Transport of fluid-solid systems: Hydraulic and pneumatic transport, flow regimes, rheological models, dilute and dense phase, Colloids and nanoparticles: surface forces, suspension rheology and application

TOTAL : 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students would know about:
- CO1: The basic concepts of fluid mechanics and its properties
- CO2: Evaluate the fluid flow phenomena through packed and fluidized bed
CO3: Design agitation vessel based on standard design criterion
CO4: The working principles and mechanism of size reduction and size separation equipments
CO5: The concepts related to fluid particles and its rheology

TEXT BOOKS
2. Martin J Rhodes; Introduction to Particle Technology, 2nd Edn., John Wiley & Sons Ltd. 2013

REFERENCES
3. Introduction to Particle Technology by Rhodes, Martin, John Wiley & Sons, 1999

BT8305  CELL BIOLOGY  L T P C
3 0 0 3

OBJECTIVES:
- To provide knowledge on the fundamentals of cell biology
- To help students understand the signalling mechanisms

UNIT I  CELL STRUCTURE AND FUNCTION OF THE ORGANELLES  9

UNIT II  CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS  9
Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, Cell culture and immortalization of cells and its applications.

UNIT III  TRANSPORT ACROSS CELL MEMBRANE  9

UNIT IV  SIGNAL TRANSDUCTION  9
Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors autocrine / paracrine / endocrine models, Secondary messengers molecules.
UNIT V  TECHNIQUES USED TO STUDY CELLS
Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic 
studies like SEM, TEM and Confocal Microscopy. Localization of proteins in cells – 
Immunostaining.

OUTCOMES: 
Upon completion of this course, the students
- Would have deeper understanding of cell at structural and functional level.
- Would have broad knowledge on the molecular interaction between cells.
- Would demonstrate a clear understanding of the signal transduction, secondary 
messengers.
- Would develop skill on working principles of microscopy and identification of cell types.

TEXT BOOKS:
Francis), 2002.

REFERENCES:
2004.

BT8301  STOICHIOMETRY 
3 2 0 4
OBJECTIVES: 
- The course aims to develop skills of the students in the area of Chemical Engineering with 
emphasis in process calculations and fluid mechanics.
- This will enable the students to perform calculations pertaining to processes and 
operations.

UNIT I  BASIC CHEMICAL CALCULATIONS  (9 + 6) 
Dimension – Systems of units esp. engineering FPS, Engineering MKS & SI systems – Conversion 
from one system to the other – composition of mixtures and solutions – mass fraction, mass %, 
mole fraction, mole %, mass ratios, molarity, molality, normality, ppm, composition by density.
UNIT II  I D E A L A N D A C T U A L G A S E Q U A T I O N S  

UNIT III  M A T E R I A L B A L A N C E  
Material balance concept – overall & component – material balance applications for evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, drying, crystallization, Humidification, Reverse Osmosis separation and Mixing Recycle and Bypass illustration

UNIT IV  E N E R G Y B A L A N C E  
General energy balance equation for open systems, closed system sensible heat calculation, Heat required for phase change thermo chemistry, application of steam tables, Saturated and superheated steam application in bioprocess

UNIT V  C H E M I C A L R E A C T I O N  

TOTAL: 75 PERIODS

OUTCOMES:
Upon success completion of this course, the students will be able to:
- Solve problems related to units and conversions and fit the given data using the methodologies
- Solve problems related to material and energy balance concepts & design reactors for biochemical processes
- Apply their knowledge in the field of biochemical engineering from the principles of thermodynamics

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
To enable the students
- To know in detail about the elements of atom, charges and their bonding rule.
- To understand the various kinetic properties and types of reaction mechanisms.
- To understand the possible bio-organic reactions involved in biosynthesis.

UNIT I  BONDING AND STEREOCHEMISTRY  9
Atoms Electrons and orbitals - Covalent Bonds - Octet rule - Polar covalant Bonds - Electronegativity- formal charge - Resonance Acids and Bases - Arrhenius and Bronsted Lowry Theories - Acid Base equilibria - SP3 hybridization - Conformations analysis ethane, butane and cyclohexane - Cis- trans isomerism. Stereochem activity around the tetrahedral carbon – optical activity - Conformation of the peptide bond.

UNIT II  MECHANISMS OF SUBSTITUTION AND ADDITION REACTIONS  9
SN1 and SN2 reactions on tetrahedral carbon- nucleophiles- mechanism steric effects – nucleophilic addition on Acetals and ketals -Aldehyde and ketone groups – reactions of carbonyl group with amines- acid catalyzed ester hydrolysis – Saponification of an ester- hydrolysis of amides. Ester enolates - claisen .condensation – Michael condensation.

UNIT III  KINETICS AND MECHANISM  9

UNIT IV  CATALYSIS  9
Reactivity – Coenzymes – Proton transfer – metal ions – Intra molecular reactions – Covalent catalysis – Catalysis by organized aggregates and phases. Inclusion complexation

UNIT V  BIOORGANIC REACTIONS  9
Timing of Bond formation and fission – Acyl group transfer – C-C bond formation and fission – Catalysis of proton transfer reactions – Transfer of hydride ion – Alkyl group. Transfer – Terpene biosynthesis – Merrifield state peptide synthesis – Sanger method for peptide and DNA sequencing

OUTCOME:
- On completion of this course, the students will learn the basics principles of chemical Bonding, Stereochemistry of Bio-organic molecules and their kinetics, mechanisms of reactions and catalysis.

TEXT BOOKS:

REFERENCE:
BI8311          BIOORGANIC CHEMISTRY LAB                L T P C
0 0 4 2

COURSE OBJECTIVES
To enable the students to
- gain knowledge on the various kinetic properties and types of reaction mechanisms
- understand the possible bio-organic reactions involved in biosynthesis

LIST OF EXPERIMENTS
1. Synthesis of aspirin
2. Hydrolysis of sucrose
3. Preparation of pyruvic acid from tartaric acid
4. Preparation of oleic acid from tartaric acid
5. Preparation of alpha D-glucopyranose pentaacetate
6. Preparation of 1,2,5,6 dicyclohexylnoine alpha d glucofuranose
7. Isolation of lycopene from tomato paste
8. Preparation of L-proline
9. Preparation of L-cysteine from hair
10. Preparation of S-ethyl hydroxybutonate from ethyl acetoacetate using yeast

TOTAL : 60 PERIODS

COURSE OUTCOMES
On successful completion of the course, the students will be able to
CO1 : Identify various kinetic properties and the types of reaction mechanisms in bio-organic molecules
CO2 : Understand their kinetics and mechanisms of the reactions.

BI8312                    CELL BIOLOGY AND MICROBIOLOGY LAB                         L T P C
0 0 4 2

COURSE OBJECTIVES
- To establish an understanding about the basic techniques (concept of aseptic work, cultivation and identification) in microbiology.
- To describe the different aspects of microbial nutrition and growth
- To describe the microbial interactions and their significance in environment
- To describe the microbial interactions and their significance in agriculture, food and pharmaceuticals
LIST OF EXPERIMENTS
1. Microscopy principle & identification of given plant, animal and bacterial cells
2. Gram’s Staining, Leishman Staining & Giemsa Staining
3. Thin Layer Chromatography
4. Separation of Peripheral Blood Mononuclear Cells
5. Osmosis and Tonicity
6. Trypan Blue Assay
7. Staining for different stages of cell division
8. Preparation of culture media using nutrient broth and nutrient agar
9. Isolation of microorganisms from different sources (Soil and water) using Serial Dilution Technique
10. Culturing of microorganisms – Broth and Plates (Pour plates, Streak plates, Spread plate)
11. Growth curve observation on bacteria
12. Acid Fast Staining, Capsular Staining and Endospore Staining
14. Biochemical Analysis 2 - IMVIC Test
16. Antibiotic sensitivity assay

TOTAL : 60 PERIODS

COURSE OUTCOMES
On successful completion of the course, the students will be able to
CO1 Identify the microbiological techniques, the defining characteristics of the major group of microorganisms and apply the concepts to study microbial phylogeny.
CO2 Classify the methods to measure microbial growth
CO3 Evaluate the interaction of the microorganisms with the environment in beneficial or detrimental ways
CO4 Identify the industrially important microbes
CO5 Apply the scientific method by stating a question; researching the topic; determining appropriate tests; performing tests; collecting, analysing, and presenting data.
OBJECTIVES: The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- Improve general and academic listening skills
- Make effective presentations.

UNIT I
Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II
Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III
Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

UNIT IV
Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

UNIT V
Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL : 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

TEXT BOOKS:

REFERENCES:

MA8391          PROBABILITY AND STATISTICS         L T P C
                          4 0 0 4

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

UNIT I   PROBABILITY AND RANDOM VARIABLES 12

UNIT II   TWO - DIMENSIONAL RANDOM VARIABLES 12
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 12
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV   DESIGN OF EXPERIMENTS 12
One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - $2^2$ factorial design.
UNIT V  STATISTICAL QUALITY CONTROL

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

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

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

TEXT BOOKS:

REFERENCES:

GE8291  ENVIRONMENTAL SCIENCE AND ENGINEERING  L T P C
3 0 0 3

OBJECTIVES:
- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth’s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
UNIT I  ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY  14
Definition, scope and importance of environment—need for public awareness—concept of an ecosystem—structure and function of an ecosystem—producers, consumers and decomposers—energy flow in the ecosystem—ecological succession—food chains, food webs and ecological pyramids—Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)—Introduction to biodiversity definition: genetic, species and ecosystem diversity—biogeographical classification of India—value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values—Biodiversity at global, national and local levels—India as a mega-diversity nation—hotspots of biodiversity—threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts—endangered and endemic species of India—conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems—pond, river, hill slopes, etc.

UNIT II  ENVIRONMENTAL POLLUTION  8
Definition—causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards—solid waste management: causes, effects and control measures of municipal solid wastes—role of an individual in prevention of pollution—pollution case studies—disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site—Urban / Rural / Industrial / Agricultural.

UNIT III  NATURAL RESOURCES  10
Forest resources: Use and over-exploitation, deforestation, case studies—timber extraction, mining, dams and their effects on forests and tribal people—Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams—benefits and problems—Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies—Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies—Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies—Land resources: Land as a resource, land degradation, man induced and slides, soil erosion and desertification—role of an individual in conservation of natural resources—Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets—river/forest/grassland/hill/mountain.

UNIT IV  SOCIAL ISSUES AND THE ENVIRONMENT  7
UNIT V HUMAN POPULATION AND THE ENVIRONMENT


TOTAL: 45 PERIODS

OUTCOMES:
- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

REFERENCES:

BT8404 BIOPROCESS PRINCIPLES

OBJECTIVES:
- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- To endow the students with the basics of microbial kinetics, metabolic stoichiometry and energetics.

UNIT I OVERVIEW OF FERMENTATION PROCESSES

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor (CSTR) and ancillaries, main parameters to be monitored and controlled in fermentation processes.
UNIT II  RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS  
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  

OUTCOMES:  
Upon completion of the course in Bioprocess Principles graduates will be able to

- Apply engineering principles to systems containing biological catalysts to meet the needs of the society.
- Convert the promises of molecular biology and genetic engineering into new processes to make bio-products in economically feasible way.

TEXT BOOKS:  

REFERENCES:  
4. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
COURSE OBJECTIVES
To enable the students to
• understand the fundamental concepts of conduction and its evaluation in different criterias
• understand the fundamental concepts of convection.
• understand the basic concepts of radiation and the laws governing it.
• understand the phenomenon of boiling and condensation.
• have knowledge on the concepts of heat transfer in different heat exchangers

UNIT I  CONDUCTION
Basic Concepts: Modes of heat transfer, conduction, convection and radiation, analogy between heat flow and electrical flow. Conduction: One dimensional steady state heat conduction, the Fourier heat conduction equation, conduction through plane wall, conduction through cylindrical wall, spherical wall, conduction through composite slab, cylinder and sphere, critical radius of insulation, Extended surfaces: heat transfer from a fin, fin effectiveness and efficiency, Introduction to unsteady state heat conduction.

UNIT II  CONVECTION
Natural and forced convection, the convective heat transfer coefficient. Forced Convection: Correlation equations for heat transfer in laminar and turbulent flows in a Circular tube and duct, Reynolds and Colburn analogies between momentum and heat transfer, heat transfer to liquid metals and heat transfer to tubes in cross flow. Natural Convection: Natural convection from vertical and horizontal surfaces.

UNIT III  RADIATION
Basic Concepts of radiation from surface: black body radiation, Planks law, Wien's displacement law, Stefan Boltzmann's law, Kirchhoff's law, grey body, Radiation intensity of black body, View factor, emissivity, radiation between black surfaces and grey surfaces. Solar radiations, combined heat transfer coefficients by convection and radiation.

UNIT IV  BOILING AND CONDENSATION
Pool boiling, pool boiling curve for water, maximum and minimum heat fluxes, correlations for nucleate and film pool boiling, drop wise and film wise condensation, Nusselt analysis for laminar film wise condensation on a vertical plate, film wise condensation on a horizontal tube, effect of non-condensable gases on rate of condensation. Evaporation: Types of evaporators, boiling point elevation and Duhring's rule, material and energy balances for single effect evaporator, multiple effect evaporators: forward, mixed and backward feeds, capacity and economy of evaporators.

UNIT V  HEAT EXCHANGERS

TOTAL : 45 PERIODS
COURSE OUTCOMES
On successful completion of the course, the students would
CO1: Understand the concept and solve problems related to heat transfer by conduction in solids for steady state and transient conditions.
CO2: Understand the concept and solve heat transfer problems in forced and natural convection.
CO3: Have the ability to discuss and solve heat transfer problems related to radiation.
CO4: Understand the mechanism of heat transfer in boiling, condensation and apply the concepts in evaporators.
CO5: Be able to apply the concepts of heat transfer in heat exchangers.

TEXT BOOKS

REFERENCES

BT8502 ANALYTICAL METHODS AND INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:
To enable the students
- To have a fundamental knowledge about the Light spectrum, Absorption, Fluorescence, NMR, Mass spectroscopy.
- To acquire knowledge on the different chromo to graphic methods for separation of biological products.

UNIT I INTRODUCTION TO SPECTROMETRY

UNIT II MOLECULAR SPECTROSCOPY
UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY


UNIT IV SEPARATION METHODS


UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY


TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, students will have a better understanding of spectroscopy and the separation techniques used for biological products.

TEXT BOOKS:


REFERENCES:

OBJECTIVES:
- To define the principles of adsorption, absorption, leaching and drying extraction, distillation crystallization operations.
- To begin the concept of membrane separation process and develop skills of the students in the area of mass transfer operations with emphasis on separation and purification of products.

UNIT I DIFFUSION AND MASS TRANSFER 9
Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon.

UNIT II GAS LIQUID OPERATIONS 9
Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

UNIT III VAPOUR LIQUID OPERATIONS 9
V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCabe-Thiele & Onchon-Savarit Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

UNIT IV EXTRACTION OPERATIONS 9
L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles.

UNIT V SOLID FLUID OPERATIONS 9
Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves- Time of Drying; Batch and continuous dryers.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course the students will be able
- To demonstrate about gas-liquid, vapour-liquid and solid-liquid and liquid–liquid equilibrium.
- To classify and use the accurate engineering correlations of diffusion and mass transfer coefficients to model a separation process.
- To investigate a multi-stage equilibrium separation processes, simultaneous phase equilibrium and mass balances in continuous separation processes (absorbers, strippers, and distillation columns) and sizing continuous separation units.
- To design and construction with operating principles of process economics of separating equipments

TEXT BOOKS:

REFERENCE:
OBJECTIVES:
To train the students
- To have a practical hands on experience on Absorptiion Spectroscopic methods
- To acquire experience in the purification by performing chromatography
- To validate and analysis using spectrometric and microscopic techniques

LIST OF EXPERIMENTS
1. Precision and validity in an experiment using absorption spectroscopy.
2. Validating Lambert-Beer’s law using KMnO4
3. Finding the molar absorptivity and stoichiometry of the Fe (1,10 phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. Chemical actinometry using potassium ferrioxalate.
7. Estimation of SO4-- by nephelometry.
8. Estimation of Al3+ by Flourimetry.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

TOTAL: 60 PERIODS

OUTCOME:
- The students would visualize and interpret the theory of spectroscopic methods by hands on experiments.

REFERENCES:

Equipment Needed for 20 Students
Colorimeter 2
Glassware, Chemicals, Media as required
BI8411 CHEMICAL ENGINEERING LAB I  

COURSE OBJECTIVES

To provide practical experience on operating the equipments,
- calibration of flow meters,
- determining pressure loss in fluid flow

LIST OF EXPERIMENTS

1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter
2. Determination of separation efficiency of centrifugal separator
3. Determination of energy requirement in size reduction and reduction ratio using the ball mill and hammer mill.
4. Determination of particle size of granular foods by sieve analysis.
5. Stokes law: To study $C_d$ vs $N_{Re}$ graph of the steel ball in different fluids
6. Determination of efficiency of liquid solid separation by filtration
7. Batch filtration studies using a Plate and Frame Filter press
8. Characteristics of batch Sedimentation
9. Reduction ratio in Jaw Crusher
10. Sampling methods: To study different sampling method to determine the average diameter of the particle.
11. Reduction ratio of Roll Crusher
12. Reduction ratio of Drop weight crusher
13. Size separation using Sub-Sieving

TOTAL 60 PERIODS

COURSE OUTCOMES

On successful completion of the course, the student will be able to operate the equipments and determine the parameter related to flow measurements

HS8461 ADVANCED READING AND WRITING  

OBJECTIVES:
- Strengthen the reading skills of students of engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students' critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT I

Reading - Strategies for effective reading- Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title Writing-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence –Write a descriptive paragraph
UNIT II
Reading-Read for details-Use of graphic organizers to review and aid comprehension Writing-
State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples- Write an opinion paragraph

UNIT III
Reading- Understanding pronoun reference and use of connectors in a passage- speed reading techniques-Writing- Elements of a good essay-Types of essays- descriptive-narrative-issue-based-argumentative-analytical.

UNIT IV
Reading- Genre and Organization of Ideas- Writing- Elements of a good essay- Types of essays- descriptive-narrative-issue-based-argumentative-analytical.

UNIT V
Reading- Critical reading and thinking- understanding how the text positions the reader- identify Writing- Statement of Purpose- letter of recommendation- Vision statement

TOTAL : 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

TEXT BOOKS:


REFERENCES:

COURSE OBJECTIVES

- Introduce the knowledge about the basic concepts of molecular biology techniques
- Exemplify the different types of polymerase chain reactions and their applications
- Implement, organize and design different vectors for gene cloning and expression
- Generate the contextual and conditional knowledge of gene function for various applications
- To understand DNA damage and repair systems

UNIT I       GENETICS
Classical Genetics Mendelian genetics, linkage, crossing over, classical experiments – Hershey and chase; Avery McLeod & McCarty. Bacterial conjugation, transduction and transformation.

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

UNIT III       TRANSCRIPTION
Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteomics of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription

UNIT IV      TRANSLATION
Translation Elucidation of genetic code, process of translation in prokaryotes and eukaryotes, suppressor mutation, post-translational modifications, inhibitors of protein synthesis.

UNIT V      GENETIC ENGINEERING
Restriction and Modification enzymes, Design of linkers and adaptors. Maxam Gilbert’s and Sanger’s methods of DNA sequencing. Polymerase Chain Reaction: Thermostable DNA Polymerases, PCR technique and its variants, Applications of PCR. Site directed mutagenesis. Methods of transformation, transgenic plants and animals Safety guidelines of recombinant DNA research.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- CO 1: Apply the principles of molecular biology techniques.
- CO 2: Analyze the experimental data to select a suitable PCR for a particular application.
- CO 3: Evaluate selectivity and specificity of vectors for cloning genes and their expressions.
- CO 4: Examine gene function, gene modulation and their effects on improvement of crops and animals
- CO 5: Comprehend the role of operons and cis/trans elements in gene regulation

TEXT BOOKS
REFERENCES
4. Michael Wink, An Introduction to Molecular Biotechnology Fundamentals, Methods and Applications
5. Wiley, 2013

MA8491      NUMERICAL METHODS     L T P C
4 0 0 4

OBJECTIVE:
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I   SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS    12

UNIT II   INTERPOLATION AND APPROXIMATION     12
Interpolation with unequal intervals - Lagrange's interpolation – Newton’s divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton’s forward and backward difference formulae.

UNIT III   NUMERICAL DIFFERENTIATION AND INTEGRATION    12
UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS  

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS  
Finite difference methods for solving second order two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

OUTCOMES:
Upon successful completion of the course, students should be able to:
- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To provide the students with the basics of bioreactor engineering.
- To develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

UNIT I  CONFIGURATION OF BIOREACTORS
Ideal reactors and its characteristics: Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation. Packed bed reactor, airlift reactor, introduction to fluidized bed reactor bubble column reactors.

UNIT II  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 III  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.

UNIT IV  MODELLING AND SIMULATION OF BIOPROCESSES
Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT V  RECOMBINANT CELL CULTIVATION
Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast Pichia pastoris / Saccharomyces cerevisae, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of Bioprocess Engineering course graduates will be able to:
- Select appropriate bioreactor configurations and operation modes based upon the nature of bioproducts and cell lines and other process criteria.
- Apply modeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.
- Plan a research career or to work in the biotechnology industry with strong foundation about bioreactor design and scale-up.
- Integrate research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology.
TEXT BOOKS:
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications

REFERENCES
3. James M. Lee, Biochemical Engineering, PHI, USA.
5. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

BI8511 CHEMICAL ENGINEERING LAB II L T P C

COURSE OBJECTIVES:
- To learn chemical engineering principles
- To enable the students to develop a sound working knowledge on the different types of heat transfer equipments
- To provide extensive knowledge on various unit operations involved in bioprocess industries
- To provide knowledge on practical applications in the areas of mass transfer
- To provide knowledge on reaction engineering and particle mechanics.

LIST OF EXPERIMENTS
1. Performance studies on Cooling Tower
2. Batch drying kinetics using Tray Dryer
3. Boiling Heat Transfer
4. Heat Transfer in a Double Pipe Heat Exchanger
5. Heat Transfer in a Condenser
6. Heat Transfer in Helical Coils
7. Heat Transfer in Agitated Vessels
8. Separation of binary mixture using Simple distillation
9. Liquid-liquid extraction
10. Drying characteristics of Rotary dryer
11. Mass transfer characteristics of Rotating disc contactor
12. Estimation of mass/heat transfer coefficient for cooling tower
13. Demonstration of Gas – Liquid absorption

TOTAL 60 PERIODS
COURSE OUTCOMES
CO1 : Design machine elements and Piping system/presentation of PFD and PID
CO2 : Apply the skill in thermal design of heat transfer equipments like shell and tube and double pipe heat exchangers
CO3 : Perform the process design of evaporators.
CO4 : Determine diffusivity and mass transfer co-efficient of a given system
CO5 : Generate vapour liquid equilibrium data and liquid equilibrium data for different systems

BT8511 BIOPROCESS LAB I L T P C
0 0 4 2

OBJECTIVES:
- To train the students on enzyme characterization, immobilization and medium optimization methods.
- To train on methods to investigate the growth of microorganisms in different systems under different conditions.

LIST OF EXPERIMENTS:
1. Enzyme kinetics – Determination of Michaelis - Menten parameters
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics
3. Enzyme activity – Effect of pH
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment
6. Enzyme immobilization – Cross-linking
7. Enzymatic conversion in Packed bed Column
8. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
9. Optimization by Plackett Burman Design
10. Optimization by Response Surface Methodology

OUTCOMES:
At the end of this course, students will be able to:
- Explain about Enzyme kinetics and characterization and how to use them for practical applications.
- Evaluate the growth kinetics of microorganisms and become adept with medium optimization techniques.
- Determine an experimental objective, understand the theory behind the experiment, and operate the relevant equipment safely.
- Demonstrate good lab citizenry and the ability to work in team.
Equipment Needed for 20 Students

Autoclave 1
Hot Air Oven 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Colorimeter 2
Laminar Flow Chamber 2

Chemicals

Invertase enzyme
Phosphate mono basic salt
Phosphate di basic salt
Sucrose
Sodium alginate
Calcium chloride
GOD/POD reagent
Nutrient broth
Glucose
Yeast extract
Cas aminoacid
Ammonium chloride
Glycine
Magnesium sulphate
Sodium chloride

REFERENCES:

4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology,
OBJECTIVES:
The course aims to:
• Enhance the Employability and Career Skills of students
• Orient the students towards grooming as a professional
• Make them Employable Graduates
• Develop their confidence and help them attend interviews successfully

UNIT I
Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II
Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic — questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV
Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V
Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

OUTCOMES:
At the end of the course Learners will be able to:
• Make effective presentations
• Participate confidently in Group Discussions.
• Attend job interviews and be successful in them.
• Develop adequate Soft Skills required for the workplace

Recommended Software
1. Open Source Software
2. Win English

REFERENCES:
OBJECTIVES:

- To provide a quantitative basis, based on thermodynamics, enzyme kinetics, for the understanding of metabolic networks in single cells and at the organ level.
- To enable the students to use organisms to produce valuable substances on an industrial scale in a cost-effective manner.

UNIT I INTRODUCTION TO EXAMPLES OF PATHWAY MANIPULATION - QUALITATIVE TREATMENT


UNIT II MATERIAL BALANCES AND DATA CONSISTENCY

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations, analysis of over determined systems - identification of gross measurement errors. Introduction to MATLAB®

UNIT III METABOLIC FLUX ANALYSIS

Theory, overdetermined systems, underdetermined systems - linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling, applications of metabolic flux analysis.

UNIT IV METABOLIC CONTROL ANALYSIS


UNIT V ANALYSIS OF METABOLIC NETWORKS

Control of flux distribution at a single branch point, Grouping of reactions, case studies, extension of control analysis to intermetabolite, optimization of flux amplifications, consistency tests and experimental validation.

TOTAL: 45 PERIODS

OUTCOMES:

After completion of metabolic engineering, students will be able

- To learn stoichiometry and energetics of metabolism.
- To apply practical applications of metabolic engineering in chemical, energy, medical and environmental fields.
• To integrate modern biology with engineering principles.
• To design a system, component, or process to meet desired needs.

TEXT BOOKS:
2. Sang Yup Lee E. Terry Papoutsakis Marcel Dekker, Metabolic Engineering, inc 1998

REFERENCES:

GE8077 TOTAL QUALITY MANAGEMENT

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OBJECTIVE:
• To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.
UNIT V QUALITY MANAGEMENT SYSTEM


TOTAL: 45 PERIODS

OUTCOME:
- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

REFERENCES:
4. ISO9001-2015 standards

BI8601 BIOLOGICAL REACTION ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES
- Design of chemical and biochemical reaction systems, in the backdrop of the knowledge of existing fundamental theory of reaction kinetics.
- Applications of reaction engineering using a variety of process engineering situations.
- To provide knowledge on estimation of kinetic parameter
- To derive design equations for various reactors.
- To make the students aware of Non-ideal reactors

UNIT I BASIC CONCEPTS OF CHEMICAL KINETICS
Rate equations, rate constant, temperature dependency-Arrhenius law, collision theory, transition state theory, Integral method; irreversible first order, second order and third order type reactions, zero order reactions, reversible first and second order reactions, autocatalytic reactions, variable volume batch reactor, Differential method of rate analysis, method of half-life.

UNIT II TYPES OF REACTORS
Design equations for batch, tubular and stirred tank reactors. Space time and space velocity, steady state mixed flow, plug flow and laminar flow reactors. Multiple reactor systems, Plug flow reactor in series and parallel, equal sized mixed reactors in series, mixed flow reactors of different
sizes in series. Residence time distribution for chemical reactors: General characteristics -RTD functions. Measurement of the RTD -pulse input, step tracer input, integral relationships, mean residence time.

UNIT III PROCESS ENGINEERING
Kinetics of microbial growth and product formation-Phases of growth in a microbial culture, Microbial growth kinetics-Monod Kinetics, Inhibition kinetics, Maintenance energy and endogeneous metabolism, Influence of pH, Temperature and other factors on microbial growth kinetics; Product formation-Classification schemes for microbial products, kinetics of product formation-Leudeking-Piret equation.

UNIT IV MICROBIAL GROWTH PROCESSES
Model structure and complexity-different perspectives for kinetic representations using models-prediction of specific growth rate using unstructured, un-segregated models-logistic equation-growth models for filamentous organisms-structured kinetic models, metabolic models, cybernetic models.

UNIT V REACTION KINETICS
Kinetic analysis of Batch growth of micro-organisms, Kinetics of growth in continuous culture-Monod Chemostat model, cell productivity, optimal dilution rate, productivity ratio, wash out; Stirred tank bioreactor with recycle of biomass, Continuous stirred tank fermenters in series, plug flow fermenters. Estimation of kinetic parameters-use of batch and continuous culture experiments. Bioreactor dynamics -stability analysis in bioreactors-nontrivial and wash out steady states.

COURSE OUTCOMES
CO 1 : Aware of the basic concepts in reaction kinetics and their applications in process engineering context.
CO 2 : Develop a flare for developing feasible designs for chemical and biochemical reaction systems in an engineer’s perspective.
CO 3 : Determine reaction kinetics of various reactors
CO 4 : Analyze the performance of reactor equipment
CO 5 : Create design of various fermentor / bioreactors

TEXT BOOKS

REFERENCES
OBJECTIVES:
- The course applies earlier learned knowledge about mass transfer in bio reactors and sterilization kinetics.
- Skills and knowledge gained is useful by analogy when solving problems typical for the bio industry or for research

LIST OF EXPERIMENTS:
1. Batch Sterilization kinetics
2. Batch cultivation with exhaust gas analysis.
3. Estimation of KLa – Dynamic Gassing-out method,
4. Estimation of KLa – Sulphite Oxidation Method
5. Estimation of KLa – Power Correlation Method
6. Fed batch cultivation and Total cell retention cultivation
7. Photobioreactor
8. Residence time distribution
9. Estimation of Overall Heat Transfer Coefficient
10. Estimation of Mixing Time in reactor

TOTAL: 60 PERIODS

OUTCOMES:
At the end of this course,
- Graduates gain ability to investigate, design and conduct experiments, analyze and interpret data, and apply the laboratory skills to solve complex bioprocess engineering problems.
- Graduates become creative, innovative and adaptable engineers as leaders or team members in their organizations and society.
- Graduates perform competently in chemical and bioprocess industries and become important contributors to national development.
- Graduates will demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.

Equipment Needed for 30 Students
Electrophoresis Kit 1
Reactors 6
Incubators 2
Light Microscopes 1
Incubator Shaker 1
Spectrophotometer 2
Laminar Flow Chamber 1
chemicals
Sodium sulfite
Starch
Disodium disulfate
Copper sulphate
Potassium iodide
Glucose
GOD kit
Nutrient medium
Ammonium chloride
Magnesium sulphate
Sodium chloride
sodium mono basic salt
sodium di basic salt

REFERENCES:
3. James M. Lee, Biochemical Engineering, PHI, USA.

BT8612 GENETIC ENGINEERING LAB
L T P C
0 0 4 2

OBJECTIVES:
• Provide hands-on experience in performing basic recombinant DNA techniques.
• Introduce students to the theory behind in each techniques and to describe common applications of each methodology in biological research.

LIST OF EXPERIMENTS
1. Preparation of plasmid DNA
2. Elution of DNA from agarose gels
3. Restriction digestion
4. Ligation of DNA into expression vectors
5. Transformation& Selection of recombinants – Blue white screening assay
6. Optimisation of time of inducer for recombinant protein expression
7. Expression of protein profiling by SDS - PAGE
8. Western blotting, Southern blotting
9. PCR amplification of genes
10. Colony lysate PCR.

TOTAL: 60 PERIODS

OUTCOMES:
By the end of this course, students should be able to:
• Describe the main principles, methods for preparation and cloning of DNA in various organisms.
• Express clearly about the gene amplification and methods for analysis of DNA, such as hybridization, restriction analysis and gene expressions.
• Use genetic and biotechnological techniques to manipulate genetic materials and develops new and improved living organisms.
• Students will be aware of the hazardous chemicals and safety precautions in case of emergency.
Equipment Needed for 30 Students

Electrophoresis Kit    1
PCR     1
Incubators     2
Light Microscopes 4
Incubator Shaker  1
Spectrophotometer  2
Laminar Flow Chamber 2
Tris – EDTA buffer
RNase
Isopropyl alcohol
Potassium acetate
Agarose
Restriction enzyme
Lambda DNA
10X Tango buffer
10X cohesive buffer
T4 DNA ligase
Loading dye
Antibiotics
Glycerol
Bromophenol blue
Ethidium bromide
PCR kit
sodium dodecyl sulfate
TEMED
ammonium persulfate
coommassie brilliant blue
nitrocellulose membrane
polyacrylamide
tween 20
bovine serum albumin (BSA)
Tris buffered saline (TBS)
Phosphate buffered saline
Horseradish peroxidase (HRP)
saline-sodium citrate (SSC) buffer
hybridization probe

REFERENCES:
COURSE OBJECTIVE

- To give a sound understanding of the fundamental principles of modelling in bioprocessing applications
- To give an overview of various methods of process modeling, different computational techniques for simulation.
- The focus shall be on the techniques themselves, rather than specific applications so that the student can take up modeling and simulation challenges in his profession.
- Have an understanding of computational techniques to solve the process models.
- Use economics to derive an objective function.

UNIT I APPROACH TO MODELLING
Significance of modelling and simulation, kinetic models on different approaches; deterministic and stochastic, structured and unstructured, segregated and unsegregated; Compartamental models (two); product formation model; genetically structured models, modelling of extra cellular enzyme production.

UNIT II MODELLING OF BIOPROCESS
Modelling of continuous sterilization of medium; modelling of activated sludge process with a control system; model for anaerobic digestion, model for SCP production form spent sulphite liquor.

UNIT III MODELLING OF BIOREACTORS
Models for external mass transfer, internal diffusion and reaction within biocatalysts, model for antibiotic formation; modelling of therapeutic protein production with recombinant cells. Modelling of Non-ideal Behaviour in Bioreactors-Tanks-in-series and Dispersion models

UNIT IV SIMULATION -SOFTWARE TECHNIQUES
Process simulators such as Aspen (model based) and gPROMS (equation based) simulations Fluent CFX and STAR-CD are designed to perform CFD,FRONTIER

UNIT V SIMULATION -NUMERICAL TECHNIQUES
Programs based on numerical methods like algebraic equations, Newton_Raphson method for algebraic convergence.

TOTAL : 45 PERIODS

COURSE OUTCOMES
CO1: Apply modelling methods in bioprocessing techniques
CO2: Apply simulation of economic bioprocess methods for better quality products.
CO3: Develop mathematical and software techniques
CO4: Correlate the various mechanical separation techniques and evaluate its associated design variables
CO5: Understand the concept of various ideal and non-ideal reactors and assess their performance

TEXT BOOKS

REFERENCES

BT8751 DOWNSTREAM PROCESSING

OBJECTIVES:
To enable the students to
- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D
- Have depth knowledge and hands on experience with on Downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion

UNIT I INTRODUCTION

UNIT II PHYSICAL METHODS OF SEPARATION
Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS
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
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
Crystallization, drying and lyophilization in final product formulation.

TOTAL: 45 PERIODS

OUTCOMES:
Upon success completion of this course, the students will be able to:
- Define the fundamentals of downstream processing for product recovery
- Understand the requirements for successful operations of downstream processing
- Describe the components of downstream equipment and explain the purpose of each
• Apply principles of various unit operations used in downstream processing and enhance problem solving techniques

TEXT BOOKS:

REFERENCES:

BI8702  BIOPROCESS DYNAMICS AND CONTROL  L T P C
3  0  0  3

COURSE OBJECTIVE

• To impart basic knowledge on instrumentation and process control strategies adopted in bioprocess systems
• Systems that vary in time, with some tools for attacking the problems
• Single-loop feedback control of processes - concepts, terminology, methods, and performance
• To enhance feedback control
• To learn the hardware used in a control system

UNIT I  INSTRUMENTATION METHODS
Methods of measuring process variables like temperature, flow measurement, pressure, microbial biomass, dissolved oxygen, inlet and exit gas analysis, pH, Redox, Medium chemical sensors. Online analysis for other biochemical factors

UNIT II  BASICS OF PROCESS CONTROL

UNIT III  PROCESS ANALYSIS
Qualitative analysis of a response of a system. Dynamic behaviour of first order systems. Study of different order systems. Dynamic behaviour of higher order systems

UNIT IV  PROCESS CONTROL
Concept of feedback control. Types of feedback controllers. Block diagrams, manual control, automatic control-proportional, integral, derivative and composite control. Control actions on the dynamic response of a system.

UNIT V  PROCESS STABILITY
Notion of stability. Criterion for stability –Routh test, Frequency response analysis –Bode plot

TOTAL : 45 PERIODS

COURSE OUTCOMES
CO1 : Ability to apply knowledge on process control
CO2 : Develop idea on controlling bioprocess plant and operations
CO3 : Develop mathematical models of various chemical processes.
CO4 : Explain different control modes and their application in controlling various processes.
CO5 : Explain the working of electric, hydraulic and pneumatic controllers.

TEXT BOOKS

REFERENCES
1. P. F. Stanbury, A. Whitaker and S.J. Hall, Principles of Fermentation Technology; Aditya Books (P) Ltd.
2. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals; McGraw Hill

BI8703 GOOD MANUFACTURING PRACTICE AND VALIDATION  L T P C
3 0 0 3

COURSE OBJECTIVES
- To introduce the strategy for producing high quality safe pharmaceutics.
- To focus on traditional approaches to ensure product quality using facility design, validation and good manufacturing practice (GMP).
- Understand the regulatory and application perspective.
- Familiar with technical terms from the field of GMP and their meaning
- To impart fundamental knowledge on various Good Regulatory Practices viz., cGMP, GLP, GALP and GDP for Pharmaceuticals,

UNIT I GOOD MANUFACTURING PRACTICES  9
Concepts and Philosophy of Good Manufacturing Practice (GMP). introduction of CGMP

UNIT II VALIDATION  9
Concepts and Philosophy of Validation. Validation methods of equipment, Validation methods of water supply systems, deionised and distilled water and water for injection

UNIT III CALIBRATION  9
Introduction to calibration of Analytical Instruments. Calibration of Spectrophotometer and HPLC instrument as per ICH guidelines.
UNIT IV  QUALITY CONTROL
Sampling Techniques, Computer applications in GMP and GLP, Statistical quality control and control charts. Concepts and Philosophy of GLP, SOP, ICH and ISO-9000

UNIT V  VALIDATION OF SYSTEMS
Utilities and cleaning validation: validation of pharmaceutical water system and pure steam; validation of HAVC system and air handling units; cleaning of equipment and cleaning of facilities, validation of computer systems

TOTAL : 45 PERIODS

COURSE OUTCOMES
CO1 : Explain the regulatory basics for process validation and outline of prospective validation
CO2 : Use the GMP regulation regarding the utilities in Pharmaceutical manufacturing
CO3 : Examine harmonization, GMPs and validations at global level
CO4 : Assess the environmental impact of an industrial process.
CO5:  Learn and adopt quickly in a GMP environment.

TEXT BOOKS

REFERENCES
2. F.J. Carleton and J.P. Agalloco, Validation of Pharmaceutical process (Sterile products), 2nd Edn., (Revised and Expanded), Marcel Dekker Inc.
3. M.A. Potda, NialiPrakashan, Pharmaceutical Quality Assurance,

BI8711  BIOPROCESS MODELING AND SIMULATION LAB  0 0 4 2

COURSE OBJECTIVES:
 To make the students be aware of modelling and simulation.
 To make the students familiar about MATLAB tool.
 To provide a working introduction to the MATLAB technical computing environment.
 To introduce students the use of a high-level programming language, MATLAB
 Reinforce a structured, top-down approach to formulate and solve problems.

LIST OF EXPERIMENTS
1. Parameters estimation in adsorption kinetics using curve fitting tool in MATLAB
2. Estimation of bacterial growth kinetic parameter using curve fitting tool in MATLAB
3. Modeling of batch culture using MATLAB
4. Modeling in continuous culture using MATLAB
5. Modeling in product formation using MATLAB
6. Modelling of batch culture by Berkeley-Madonna
7. Modelling of continuous culture by Berkeley-Madonna
8. Modelling of fed batch culture by Berkeley-Madonna
9. Simulation by simulink in batch culture
10. Simulation by simulink in continuous culture
11. Simulation by simulink in fed batch culture
12. Solving material balance using superpro design

TOTAL : 60 PERIODS

COURSE OUTCOMES:
CO1 : Complete understanding about MATLAB tool.
CO2 : Familiarize with microbiological techniques
CO3 : Better understanding about various methods to detect pathogens
CO4: Use MATLAB effectively to analyze and visualize data
CO5: Create and control simple plot and user-interface graphics objects in MATLAB

BT8711 DOWNSTREAM PROCESSING LAB L T P C
0 0 4 2

OBJECTIVES:
To provide hands on training in Down stream processing through simple experimentations in the laboratory. This will be a pre-requisite for project work.

The objectives of this course is to practice the students

- To understand the nature of the end product, its concentration, stability and degree of purification required
- To design processes for the recovery and subsequent purification of target biological products.

LIST OF EXPERIMENTS:
1. Solid liquid separation – centrifugation
2. Solid liquid separation - microfiltration
3. Cell disruption techniques – ultrasonication or French pressure cell or Dynomill
4. Precipitation – ammonium sulphite precipitation
5. Ultra filtration separation
6. Aqueous two phase extraction of biologicals
7. High resolution purification – affinity chromatography
8. High resolution purification – ion exchange chromatography
9. Product polishing – spray drying or freeze drying
10. Size exclusion chromatography

TOTAL: 60 PERIODS

List of Equipment for 30 students
Centrifuge 1
Cross flow filtration set up 2
FPLC 1
Sonicator or French press or Dynomill 1
OUTCOMES:
Upon success completion of this course, the students would have
- Acquired knowledge for the separation of whole cells and other insoluble ingredients from the culture broth.
- Learned cell disruption techniques to release intracellular products
- Learned various techniques like evaporation, extraction, precipitation, membrane separation for concentrating biological products
- Learned the basic principles and techniques of chromatography to purify the biological products and formulate the products for different end uses.

REFERENCES:

BI8811 PROJECT WORK L T P C
0 0 20 10

OBJECTIVE:
- To objective of the project is to make use of the knowledge gained by the student at various stages of the degree programme.

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.
OBJECTIVE:

- To develop a fundamental knowledge of the physical principles that govern the transport of momentum, energy and mass, with emphasis on the mathematical formulation of the conservation principles.

UNIT I TRANSPORT PHENOMENA BY MOLECULAR MOTION 9

- Vectors/Tensors, Newton’s law of viscosity, Newtonian & Non-Newtonian fluids, rheological models, Temperature, pressure and composition dependence of viscosity, Kinetic theory of viscosity, Fourier’s law of heat conduction, Temperature, pressure and composition dependence of thermal conductivity, Kinetic theory of thermal conductivity, Fick’s law of diffusion, Temperature, pressure and composition dependence of diffusivity, Kinetic theory of diffusivity.

UNIT II ONE DIMENSIONAL MOMENTUM TRANSPORT 9

- Shell Momentum balances, boundary conditions, velocity profiles, average velocity, momentum flux at the surfaces, of Newtonian and non-Newtonian for flow of a falling film, flow through circular tube, slits, flow through an Annulus, Adjacent flow of two Immiscible fluids. Equations of Change (Isothermal), equation of continuity, equation of motion, equation of energy (isothermal) their applications in fluid flow problems.

UNIT III ONE DIMENSIONAL HEAT TRANSPORT 9

- Shell energy balances, boundary conditions, temperature profiles, average temperature, energy fluxes at surfaces for different types of heat sources such as electrical, nuclear viscous and chemical, Equations of change (non-isothermal), equation of motion for forced and free convection, equation of energy (non-isothermal).

UNIT IV ONE DIMENSIONAL MASS TRANSPORT 9

- Shell mass balances, boundary conditions, concentration profiles, average concentration, mass flux at surfaces for Diffusion through stagnant gas film, Diffusion with homogeneous and heterogeneous chemical reaction, Diffusion in to a falling liquid film, Diffusion and chemical reaction in porous catalyst and the effectiveness factor, equation of continuity for binary mixtures, equation of change to set up diffusion problems for simultaneous heat and mass transfer.

UNIT V TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW 9

- Turbulence phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface. Introduction to macroscopic balances for isothermal flow systems, non-isothermal systems and multicomponent systems.

TOTAL: 45 PERIODS

OUTCOME:

- Students would gain the knowledge of fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes. The students would be able to understand the mechanism of fluids in motion under different conditions.
TEXT BOOKS:

REFERENCES:

BT8403 ENZYME TECHNOLOGY AND BIO-TRANSFORMATIONS L T P C
3 0 0 3

OBJECTIVES:
To enable the students
- To learn enzyme reactions and its characteristics along with the production and purification process
- To give the student a basic knowledge concerning biotransformation reactions with the usage of enzymes

UNIT I INTRODUCTION TO ENZYMES
Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION

UNIT III ENZYME IMMOBILIZATION AND BIOSENSORS
Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages, design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.
UNIT IV  PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES  9
Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays

UNIT V  BIOTRANSFORMATION APPLICATIONS OF ENZYMES  9

TOTAL: 45 PERIODS

OUTCOMES:
- The knowledge on enzyme and enzyme reactions will be the key step in to proceed towards various concepts in biotechnology.
- The theoretical and practical aspects of kinetics will provide the importance and utility of enzyme kinetics towards research.
- The process of immobilization has been increased steadily in food, pharmaceutical and chemical industries and thus this study will provide simple and easy method of implementation.
- Ideas on Processing, Production and Purification of enzymes at an industrial scale will be helpful to work technologically.

TEXT BOOKS:
1. Trevor Palmer, Enzymes IInd Horwood Publishing Ltd

REFERENCES:
1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. James M. Lee, Biochemical Engineering, PHI, USA.
OBJECTIVE:

- To enable the students to understand the process plant utilities and optimization techniques to optimize various parameters in chemical industries.

UNIT I IMPORTANT OF UTILITIES 9
Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

UNIT II STEAM AND STEAM GENERATION 9
Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT III REFRIGERATION 9
Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluoro Methane, Chlorofluoro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.

UNIT IV COMPRESSED AIR 9

UNIT V FUEL AND WASTE DISPOSAL 9

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students will understand the importance of health, safety and the environment in process industries. Steam, power, water, air are extensively used in process industries and their efficient operation is imperative for economic and safe operation is essential for the survival of industries.

TEXT BOOKS:


REFERENCE:

AIM:
- To give an understanding on the fundamentals of conventional genetics and its relevance in disease and therapy

OBJECTIVES:
- To describe various genetic laws, learn the chromosome structure function and understand methodologies for cytogenetic applications

UNIT I  BACTERIAL GENETICS  9
Transformation, Transduction, Conjugation – mapping, fine structure mapping in merozygotes-plasmids and episomes

UNIT II  CLASSICAL GENETICS  9
Mendel’s principles and experiments, segregation, multiple alleles – Independent Assortments, Genotypic interactions, epistasis and Sex chromosomes, Sex determination, Dosage compensation, sex linkage and pedigree analysis

UNIT III  APPLIED GENETICS  9
Chromosome organization, structure and variation in prokaryotes and eukaryotes, Giant chromosomes – polytene and lampbrush, deletion, inversion, translocation, duplication. variation in chromosomal numbers – aneuploidy, euploidy, polyploidy, Ames test, karyotyping, Linkage, Crossing over – cytological basis of crossing over, chromosome mapping – two and three factor cross – interference, somatic cell hybridization

UNIT IV  POPULATION GENETICS  9
Hardy-Weinberg equilibrium, Extensions of Hardy- Weinberg equilibrium, non random mating, population analysis, Models for population genetics. Mutation and Migration size, Genetic variation and Sociobiology

UNIT V  GENETIC DISEASES  9
Inborn errors of metabolism, Sickle cell, hemochromatosis, cystic fibrosis, hypogonadotropic hypogonadism, Gaucher’s disease, achondroplasia, phenylketonuria, Huntington’s Disease, Cystic fibrosis, hemoglobinopathies, Age-related macular degeneration, Obesity, Type 2 diabetes, Psychiatric disease, including missing heritability, autism

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To improve the programming skills of the student
- To let the students know the recent evolution in biological science

UNIT I  INTRODUCTION (9 + 6)
Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

UNIT II  SEQUENCE ALIGNMENT (9 + 6)
Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT III  PHYLOGENETIC METHODS (9 + 6)
Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

UNIT IV  PROTEIN STRUCTURE ANALYSIS (9 + 6)

UNIT V  PERL PROGRAMMING (9 + 6)
Basics of PERL programming for Bioinformatics: Data types: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

TOTAL: 75 PERIODS

OUTCOMES:
Upon completion of this course, students will be able to
- Develop bioinformatics tools with programming skills.
- Apply computational based solutions for biological perspectives.
- Pursue higher education in this field.
- Practice life-long learning of applied biological science.
TEXT BOOKS:
1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O’Reilley Media

REFERENCE:

BT8005 ANIMAL BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:
To provide the fundamentals of animal cell culture, details of the diseases and therapy
- To offer the knowledge about the micromanipulation and transgenic animals

UNIT I ANIMAL CELL CULTURE
Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.

UNIT II ANIMAL DISEASES AND THEIR DIAGNOSIS
Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, in-situ hybridization; northern and southern blotting; RFLP.

UNIT III THERAPY OF ANIMAL DISEASES
Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases.

UNIT IV MICROMANIPULATION OF EMBRYO’S
What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT V TRANSGENIC ANIMALS
Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.
OUTCOMES:
Upon completion of this subject the student will be able to
- Understand the animal cell culture, animal diseases and its diagnosis
- Gain the knowledge for therapy of animal infections
- Know the concepts of micromanipulation technology and transgenic animal technology
- Use the knowledge gained in this section to apply in the field of clinical research

TEXT BOOKS:

REFERENCE:

BI8001       BIOREACTOR DESIGN  L T P C
                          3 0 0 3

COURSE OBJECTIVES

- To provide an understanding about the basic principles of design of reactors for bioprocesses
- To develop mathematical descriptions of reaction kinetics
- To provide relationships between reactor design and use them to analyze their behavior, and
- To understand the basic introduction about scale-up and scale-down concepts. To understand the concept of ideal and non-ideal behaviour of the reactor

UNIT I        OVERVIEW OF BIOREACTORS & BIOCHEMICAL ASPECTS  9
Classification of bioreactors, major components of a typical stirred tank bioreactor with functions, basic features of special purpose bioreactors. Stoichiometry of bioreactions, mass balances for bioreactors, yield factors, application of yield factors to arrive at single-carbon and energy yielding substrate, biomass and product formation, and nitrogen and oxygen requirements.

UNIT II       DESIGN OF BIOREACTORS  9
Process and mechanical design of fermenters, volume, sparger, agitator-type, size and motor power, heat transfer calculations for coil and jacket, sterilization system.

UNIT III      ANALYSIS OF BIOREACTOR  9
Development of performance equations for ideal reactors, non-ideal behaviour in bioreactors, models for non-ideal reactors, prediction of conversion in non-ideal chemostat,

UNIT IV       BIOREACTOR PERFORMANCE  9
Transient Behaviour in bioreactors, stability of bioreactors, phase-plane analysis, bifurcation analysis.

TOTAL: 45 PERIODS
UNIT V  SCALE-UP AND SCALE-DOWN OF BIOREACTORS  
Strategies and methods for scale-up, similarity criteria, Hubbard method, method of Wang et al., Ettler’s method, dimensionless numbers and scale up and the scale-down bioreactor.

TOTAL : 45 PERIODS

COURSE OUTCOMES
CO1 : To select a suitable bioreactor and mode of operation for a bioprocess.
CO2 : To apply mass/energy balances and reaction kinetics for the design
CO3 : To analyse bioreactors and use scale-up and scale-down considerations for bioprocess intensification
CO4 : To analyse the similarity criteria in scale up of reactor
CO5 : To understand the methods for scale up techniques

TEXT BOOKS

REFERENCES

CH8076                     PIPING AND INSTRUMENTATION           L T P C
                                    3 0 0 3

OBJECTIVE:
• To impart knowledge on piping technology and instrumentation on pipelines.

UNIT I  FUNDAMENTALS OF PIPING ENGINEERING  
Definitions, Piping Components their introduction, applications. Piping MOC, Budget Codes and Standards, Fabrication and Installations of piping.

UNIT II  PIPE HYDRAULICS AND SIZING  
Pipe sizing based on velocity and pressure drop consideration cost, least annual cost approach, pipe drawing basics, development of piping general arrangement drawing, dimensions and drawing of piping.

UNIT III  PLOT PLAN  
Development of plot plan for different types of fluid storage, equipment layout, process piping layout, utility piping layout. Stress analysis -Different types of stresses and its impact on piping, methods of calculation, dynamic analysis, flexibility analysis.

UNIT IV  PIPING SUPPORT  
Different types of support based on requirement and its calculation.
UNIT V INSTRUMENTATION
Final Control Elements; measuring devices, instrumentation symbols introduction to process flow diagram (PFD) and piping & instrumentation diagram (P&ID)  

TOTAL: 45 PERIODS

OUTCOME:
• Students gain knowledge on fundamentals of piping engineering, pipe hydraulics, piping supports and instrumentation.

TEXT BOOKS:

BT8024 BIOSAFETY AND HAZARD MANAGEMENT L T P C
3 0 0 3

AIM:
• To introduce awareness on the importance of plant safety and risk analysis

OBJECTIVE:
• Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification

UNIT I INTRODUCTION
Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II QUALITY CHECKS
Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety

UNIT III RISK ANALYSIS
Overall risk analysis–emergency planning–on site &off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment – rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV SAFETY AUDITS
Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras- Vizag Bopal analysis.

UNIT V HAZARDOUS OPERATIONS
Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL: 45 PERIODS
TEXT BOOKS:

REFERENCES:

BT8016 GENOMICS AND PROTEOMICS L T P C
3 0 0 3

OBJECTIVE:
- To provide the students a broader knowledge on the structure and function of genomes, the technologies developed for genomics, functional genomics and proteomics.

UNIT I INTRODUCTION 9
Introduction to genome, transcriptome, and proteome; Overview of genomes of bacteria, archae, and eukaryote; Genomes of organelles.

UNIT II GENOME MAPPING AND SEQUENCING 9
Genetic and physical mapping, Linkage analysis, RFLP, SNP, SSLP, Restriction mapping, STS mapping, FISH, Top-down and bottom-up sequencing strategies, Whole genome sequencing, Gap closure, Pooling strategies.

UNIT III FUNCTIONAL GENOMICS 9
Genome annotation, ORF and functional prediction, Gene finding, Subtractive DNA library screening, Differential display and Representational difference analysis, SAGE,TOGA, Introduction to DNA microarray.

UNIT IV TECHNIQUES IN PROTEOMICS 9
In-vitro and in vivo-labeling of proteins, One and two-dimensional gel electrophoresis, Detection of proteins on SDS gels, Protein cleavage, Edman protein microsequencing, Mass spectrometry-principles of MALDI-TOF, Peptide mass fingerprinting.
UNIT V PROTEIN PROFILING

Large-scale protein profiling using proteomics, Post-translational modifications, Phosphoprotein and glycoprotein analyses; Analysis of protein-protein interactions, Protein microarrays.

TOTAL: 45 PERIODS

OUTCOMES:
- The students would have gained a better understanding of the organization of genomes in multiple levels of taxa, and the methodologies and approaches used for the study of structural and functional genomics. The students would have also acquired knowledge on various genome mapping and sequencing methods, genomic markers, microarray technology and methods for proteomics.

TEXT BOOKS:

REFERENCES:

BT8503 PROTEIN ENGINEERING

OBJECTIVES:
To enable the students
- To identify the importance of protein biomolecules.
- To realize the structure-function relationships in proteins

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).
UNIT II  PROTEIN ARCHITECTURE
Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass spec.
High-throughput protein sequencing setup
Secondary structure: Alpha, beta and loop structures and methods to determine
Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin),
beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures
nucleotide binding folds, prediction of substrate binding sites.

UNIT III  TERTIARY STRUCTURE
Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to
determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer
exercise on the above aspects

UNIT IV  STRUCTURE-FUNCTION RELATIONSHIP
DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp
Repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain,
Leucine zippers. Membrane proteins: General characteristics, Transmembrane segments,
prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light
chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding
catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis
other commercial applications. Computer exercise on the above aspects

UNIT V  PROTEOMICS
Introduction to the concept of proteome, components of proteomics, proteomic analysis,
importance of proteomics in biological functions, protein-protein interactions and methods to study
it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.
Computer exercise on the above aspects

OUTCOMES:
Upon completion of this course, students will be able:
• To analyze the various interactions in protein makeup.
• To be familiar with different levels of protein structure.
• To know the role of functional proteins in various field of study.
• To practice the latest application of protein science in their research.

TEXT BOOKS:

REFERENCES:
2. Haggerty, Lauren M. “Protein Structure: Protein Science and Engineering”. Nova Science
OBJECTIVES:
To enable the students to understand
- Basic biology of cancer
- Impact of antibodies against cancer in the human body leading to more effective treatments
- Enhanced immunology based detection methods and imaging techniques
- Development of cell based and cytokine based immunotherapy against cancer.

UNIT I  FUNDAMENTALS OF CANCER BIOLOGY
Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT II  PRINCIPLES OF CARCINOGENESIS

UNIT III  PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

UNIT IV  PRINCIPLES OF CANCER METASTASIS
Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V  NEW MOLECULES FOR CANCER THERAPY
Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

TOTAL: 45 PERIODS

OUTCOMES:
The course would facilitate the students
- To appreciate the role of immune system in cancer
- To describe self – tolerance machinery and immune surveillance
- To understand the cancer microenvironment and its influence on immune cells
- To have awareness on medical applications of cytokines and immune cells against cancer

TEXT BOOKS:
REFERENCES:

BI8002 MOLECULAR MODELING AND DRUG DESIGN

COURSE OBJECTIVES
- To gain knowledge on modern approaches used in molecular modelling and computer-based technology.
- To identify and design molecules for new medications greatly shortening the discovery phase of drug development by powerful computer-based technology.
- To help the students to be familiar about the concepts of bioinformatics to be implemented in drug design and development.
- To find new targets to treat disease; mechanism of drug designing.
- To make the students understand the concept of molecular modeling, mechanics and interactions.

UNIT I QUANTUM MECHANICS & CONCEPTS IN MOLECULAR MODELING 9

UNIT II MOLECULAR MECHANICS & ENERGY MINIMIZATION 9

UNIT III MOLECULAR DYNAMICS AND MONTE CARLO SIMULATION 9
Introduction – Using single Model – time steps – Multiple steps – Setting up MD – energy conservation in MD Simulation Examples – Monte Carlo – Random number generation – Difference in MD & MC.

UNIT IV HOMOLOGY MODELLING 9

UNIT V DRUG DESIGN 9

TOTAL : 45 PERIODS
**COURSE OUTCOMES**
CO1: To describe different types of protein-ligand interactions and characterise binding pockets
CO2: To use various tools for silico drug designing.
CO3: To account for and set up molecular dynamics simulations and free energy calculations
CO4: To analyze and provide solutions to new drug discovery by using modern CADD tools.
CO5: To understand the theory of inhibition and inactivation of enzymes, drug deactivation and susceptibility

**TEXT BOOKS:**
2. Tamar Schlinck “Molecular Modelling and Simulation”, Springer Edn, 2002

**REFERENCES**

**BT8008 MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES**

**OBJECTIVES:**
To enable the students
- To understand about the microbial toxins and modern molecular pathogenesis
- To know about the host pathogen interaction and identifying virulence factors
- To control pathogens by modern approaches.

**UNIT I OVERVIEW**
Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.

**UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES**
Attributes & components of microbial pathogenesis, Host defence: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defence mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defences.

**UNIT III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES)**
Virulence, virulence factors, virulence- associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-
regulated pili, filamentous phage, survival E.coli pathogens: Enterotoxigenic E.coli (ETEC), labile & stable toxins, Enteropathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohaemorrhagic E.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteroaggregative E.coli (EAEC). Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitophorous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS 8
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 APPROACHES TO CONTROL PATHOGENS 8
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.

OUTCOMES:
Upon completion of this course, the student will be able to understand the
- Host pathogen interactions at the level of cellular and molecular networks.
- Diagnosis of diseases through the examination of molecules.
- Modern therapeutic strategies on various pathogens.

REFERENCES:
OBJECTIVE:
- The course objectives are imparting the basic knowledge of students about stem cell, culturing and its clinical applications.

UNIT I  STEM CELLS AND TYPES
Stem cells: Definition, Classification, Sources and Properties – Types of stem cells: methods of isolation, study of stem cells and their viability IPSC, embryonic stem cells, cancer stem cells. – Preservations of Stem cell. Embryonic stem cell: Isolation, Culturing, Differentiation, Properties – Adult stem cell: Isolation, Culturing, Differentiation, Trans-differentiation, Plasticity, and Properties

UNIT II  STEM CELLS IN PLANTS AND ANIMALS
Stem cell and founder zones in plants – particularly their roots – stem cells of shoot meristems of higher plants. Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles – tumour stem cells.

UNIT III  STEM CELLS DIFFERENTIATION
Factors influencing proliferation, physical, chemical and molecular methods for differentiation of stem cells – hormonal role in differentiation.

UNIT IV  REGENERATION AND EXPERIMENTAL METHODS
Germ cells, hematopoietic organs, and kidney, cord blood transplantation, donor selection, HLA matching, patient selection, peripheral blood and bone marrow transplantation, - Stem cell Techniques: fluorescence activated cell sorting (FACS), time lapse video, green fluorescent protein tagging

UNIT V  APPLICATION AND ETHICAL ISSUES
Stem cell Therapy for neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns, skin ulcers, muscular dystrophy and orthopaedic applications. Stem cell policy and ethics, stem cell research: Hype, hope and controversy.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES

- To give the students a working knowledge on design principles as applied in chemical engineering processes and operations.
- To learn how to design major equipment used in most chemical processes.
- To learn how unit operations fit together and interact in these processes and the basic procedure in process engineering design.
- To learn the impact of engineering solution on the environment.
- To provide comprehensive knowledge of various process parameters and economics involved in the development of process and plant design.

UNIT I PROCESSES DESIGN ASPECTS

Basic consideration in chem.engg. plant design, project identification, preliminary techno-economic feasibility, Selection of process, factors affecting process selection, types of flow diagrams. Standard versus special equipment, materials of construction, selection criteria

UNIT II PROCESS AUXILIARIES & UTILITIES

Piping design, layout, support for piping insulation, types of valves, process control & instrumentation control system design, Process water, boiler feed water, water treatment & disposal, steam, oil heating system, chilling plant, compressed air and vacuum system.

UNIT III COST ESTIMATION

Factors involved in project cost estimation, total fixed & working capital, types & methods of estimation of total capital investment, estimation of total product cost, factors involved.

UNIT IV DEPRECIATION & PROFITABILITY

Types and methods of determination, evaluation, Alternative investment & replacement methods for profitability evaluation, economic consideration in process and equipment design, inventory control.

UNIT V OPTIMUM DESIGN & SCHEDULING AND CONTROL

General products rates in plant operation, optimum conditions; Introduction- PERTS & CPM.

COURSE OUTCOMES

CO1 : To apply various algorithms to synthesize a process flow sheet.
CO2 : To calculate different costs involved in a process plant.
CO3 : To calculate interest and time value of investments.
CO4 : To measure profitability on investments.
CO5 : To perform breakeven analysis and optimum design of a process

TEXT BOOKS


REFERENCES:


BT8017 BIOFUEL

UNIT I OVERVIEW OF BIOFUELS 9
Generation of biofuels − Development of biological conversion technologies − Integration of biofuels into biorefineries − Energy security and supply − Environmental sustainability of biofuels − Economic sustainability of biofuels.

UNIT II BIODIESEL 9
Biodiesel − Microorganisms and raw materials used for microbial Oil production − Treatment of the feedstocks prior to production of the Biodiesel − Current technologies of biodiesel production − Purification of biodiesel; Industrial production of biodiesel − Biodiesel production from single cell oil.

UNIT III BIOETHANOL 9
Bioethanol − Properties − Feedstocks − Process technology − Pilot plant for ethanol production from lignocellulosic feedstock − Environmental aspects of ethanol as a biofuel.

UNIT IV BIOMETHANE AND BIOHYDROGEN 9

UNIT V OTHER BIOFUELS 9

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES

- To provide a working knowledge of a variety of computational techniques that can be used for solving engineering problems
- To develop a capability to write computer programs.
- To develop the ability for result presentations and data visualization of engineering problems
- To understand the basic concepts of Finite Difference and Finite Volume Methods. Comprehend the methodology and algorithms of CFD analysis.

UNIT I    INTRODUCTION  9
Illustration of the CFD approach, CFD as an engineering analysis tool, Review of governing equations, Modelling in engineering, Partial differential equations-Parabolic, Hyperbolic and Elliptic equation, CFD application in Chemical Engineering, CFD software packages and tools.

UNIT II    PRINCIPLES OF SOLUTION OF THE GOVERNING EQUATIONS  9
Finite difference and Finite volume Methods, Convergence, Consistency, Error and Stability, Accuracy, Boundary conditions, CFD model formulation.

UNIT III    MESH GENERATION  9
Overview of mesh generation, Structured and Unstructured mesh, Guideline on mesh quality and design, Mesh refinement and adaptation.

UNIT IV    SOLUTION ALGORITHMS  9
Discretization schemes for pressure, momentum and energy equations - Explicit and implicit Schemes, Firstorder upwind scheme, second order upwind scheme, QUICK scheme, SIMPLE, SIMPLER and MAC algorithm, pressure-velocity coupling algorithms, velocity-stream function approach, solution of Navier-Stokes equations

UNIT V    CFD SOLUTION PROCEDURE  9
Problem setup –creation of geometry, mesh generation, selection of physics and fluid properties, initialization, solution control and convergence monitoring, results reports and visualization

TOTAL : 45 PERIODS

COURSE OUTCOMES
Upon completion of the course, the students shall be able to
CO1 : Solve PDE.
CO2 : Use Finite Difference and Finite Volume methods in CFD modelling
CO3 : Generate and optimize the numerical mesh
CO4 : Simulate simple CFD models and analyze its results

TEXT BOOKS
1. Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu, A Computational Fluid Dynamics, 3rd Edn, ELSEVIER, 2018
4. P.S. Ghoshadastidar, Computational Fluid Dynamics and Heat Transfer, 1st Edn, 2017
REFERENCES