FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF TECHNOLOGY

IN

BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

CURRICULUM & SYLLABI

(2018 -2019)

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

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

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Eachanari Post, Coimbatore – 641 021. INDIA

FACULTY OF ENGINEERING

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

REGULATIONS
(2018)

CHIOCE BASED CREDIT SYSTEM

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Semester-I

18BTBT101	**Mathematics-I**	**4H-4C**

Instruction Hours/week: L:3T:1P:0 **Marks:** Internal**:40**External**:60**Total**:100**

End Semester Exam:3Hours

Course Objectives

- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives and integrals.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To develop the knowledge in integral calculus.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To make the student to solve various Engineering problems.

Course Outcomes

1. To understand of the ideas of limits and continuity and ability to calculate with them and apply them.
2. To apply various techniques in solving Partial Differential Equations
3. To Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
4. To apply integration to compute multiple integrals, area, volume, integrals in polar and Cartesian coordinates, in addition change of order and vector integration.
5. To understand the ideas of differential equations and facility in solving simple standard examples.
6. To improve facilities in algebraic manipulation.

UNIT I - DIFFERENTIAL CALCULUS

Representation of functions, New functions from old functions, Limit of a function, Limits at infinity, Continuity, Derivatives, Differentiation rules, Polar coordinate system , Differentiation in polar coordinates, Maxima and Minima of functions of onevariable.

UNIT II - FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives, Homogeneous functions and Euler's theorem, Total derivative, Differentiation of implicit functions, Change of variables, Jacobians, Partial differentiation of implicit functions, Taylor's series for functions of two variables, Errors and approximations, Maxima and minima of functions of two variables, Lagrange's method of undeterminedmultipliers.

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

Double integrals, Change of order of integration, Double integrals in polar coordinates, Area enclosed by plane curves, Triple integrals , Volume of solids, Change of variables in double and triple integrals.

UNIT V - DIFFERENTIAL EQUATIONS

Method of variation of parameters, Method of undetermined coefficients, Homogenous equation of Euler's and Legendre's type, System of simultaneous linear differential equations with constant coefficients.

SUGGESTED READINGS:

1. Hemamalini. P.T, (2014) and (2017), Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi.
2. James Stewart., (2008),Calculus with Early Transcendental Functions, CengageLearning,
3. Narayanan S. and Manicavachagom Pillai T. K., (2007), Calculus Volume I and II, S. Viswanathan Publishers Pvt.Ltd,
4. Erwin kreyszig.,(2014), Advanced Engineering Mathematics, 9th Edition,John Wiley& Sons,
5. B.S. Grewal., (2014), Higher Engineering Mathematics, 43rd Edition, KhannaPublishers,.
6. Ramana B.V, (2010) Higher Engineering Mathematics, 11th Reprint,.Tata McGraw Hill NewDelhi,.
7. Jain R.K. and Iyengar S.R.K., (2007), Advanced Engineering Mathematics, 3rd Edition, NarosaPublications,.
8. Bali N., Goyal M. and Watkins C., (2009), Advanced Engineering Mathematics, 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt.,Ltd),.
9. Greenberg M.D., 5th Reprint. (2009)., Advanced Engineering Mathematics, 2nd Edition,5th Reprint, PearsonEducation.
10. O'Neil, P.V., (2007), Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd,

B.Tech Biotechnology		2018-2019
		Semester-I
18BTBT102	Chemistry-I (Theory & Lab.)	7H-6C

Instruction Hours/week: L:3T:1P:3 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3Hours

(i) Concepts in chemistryforengineering \

Course Objective

- To understand the terminologies of atomic and molecular structure
- To study the basics of Periodic properties, Intermolecular forces
- To study about spectroscopic technique
- To understand the thermodynamic functions
- To comprehend the basic organic chemistry and to synthesis simple drug.
- To understand the chemical principles in the projects undertaken in field of engineering and technology

Course Outcomes

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. Rationalise bulk properties and processes using thermodynamic considerations.
5. List major chemical reactions that are used in the synthesis of molecules.
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I - Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Pi-molecular orbitals of butadiene and benzene and aromaticity.Introduction to Crystal field theory.

UNIT II - Periodic properties, Intermolecular forces and potential energy surfaces

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions.Equations of state of real gases and critical phenomena.Potential energy surfaces of H_2F and HCN and trajectories on these surfaces.

UNIT III - Spectroscopic techniques and applications

Spectroscopy (Principles and Instrumentation only).Electronic spectroscopy.Vibrational and rotational spectroscopy.Applications. Surface characterization techniques.Diffraction and scattering.Fluorescence and its applications in medicine.

UNIT IV - Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.Acid base, oxidation reduction and solubility equilibria.Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT V - Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings.Synthesis of a commonly used drug molecule.

SUGGESTED READINGS

1. B. H. Mahan., (2010), University chemistry, PearsonEducation,.
2. M. J. Sienko and R. A. Plane., Chemistry: Principles andApplications.
3. C. N. Banwell., (1994), Fundamentals of Molecular Spectroscopy,McGraw-Hill,.
4. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTELWeb-book)
5. P. W. Atkins., (2009), Physical Chemistry, Oxford UniversityPress,.
6. K. P. C. Volhardt and N. E. Schore., (2014), 5th Edition, Organic Chemistry: Structure and Function, W.H.Freeman,.
7. P C Jain & Monica Jain., (2015), Engineering Chemistry, Dhanpat Rai Publishing Company,.

(ii) Chemistry Laboratory

Course Objectives

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.
- To estimate the amount of sodium carbonate and sodium hydrogen carbonate, hardness, chloride in water sample
- To make the student acquire practical skills in the determination of conductance of solutions, EMF etc
- To acquaint the students with the determination of rate constant of a reaction
- To carried out different types of titrations for estimation of concerned in materials
- To determine the partition coefficient of a substance between two immiscible liquids.

Course Outcomes

1. The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
2. Estimate rate constants of reactions from concentration of reactants/products as a function of time
3. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
4. Determine the partition coefficient of a substance between two immiscible liquids.
5. Acquaint the students with the determination of acid value of an oil
6. Carrying out different types of titrations for estimation of concerned in materials using comparatively more qualities and quantities of materials involved for accurate results

Choice of 10 experiments from the following:

1. Determination of surface tension andviscosity
2. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixure using volumetrictitration
3. Determination of Ca / Mg using complexometrictitration
4. Thin layerchromatography
5. Determination of chloride content ofwater
6. Determination of the rate constant of areaction
7. Conductometry - Determination of cell constant and conductance ofsolutions
8. pH Metry – Determination of Acid /Base
9. Potentiometry - determination of redox potentials andemfs
10. Saponification/acid value of an oil
11. Determination of the partition coefficient of a substance between two immiscibleliquids
12. Adsorption of acetic acid bycharcoal
13. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part ofegg.

Semester-I

18BTBT103	**Basic Electrical Engineering (Theory &Lab.)**	**6H-5C**

Instruction Hours/week: L:3T:1P:2 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3Hours

(i) Theory

Course Objectives

- To impart the basic knowledge about the Electric circuits.
- To understand the working of Electrical Machines and Transformers.
- To understand the working of Power Converters and components of low-voltage electrical installations.
- To understand the star and delta connections in AC circuits
- To arrive and analyse the energy consumption calculations and PF improvement
- To understand the RLC circulit combinations and its resonance

Course Outcomes

1. To understand and analyse basic electric and magnetic circuits.
2. Attributing the electric circuits with DC and AC excitation by applying various circuit laws.
3. Attributing the electrical machines and transformer.
4. Evaluate the various digital circuits in real time applications.
5. Analysis various semiconductor devices in real time applications.
6. Reproduce the Measuring Instruments and Electrical Installation.

UNIT I - DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation.Superposition, Thevenin and Norton Theorems.Time-domain analysis of first-order RL and RC circuits.

UNIT II - AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and deltaconnections.

UNIT III - Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT IV - Transformers And Power Converters

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.Auto-transformer and three-phase transformer connections. Overviews of DC-DC buck and boost converters, duty ratio control. Introduction to Single-phase and three-phase voltage source inverters.

UNIT V - Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, RCCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

SUGGESTED READINGS

1. D. P. Kothari and I. J. Nagrath.,(2010), Basic Electrical Engineering, Tata McGrawHill
2. D. C. Kulshreshtha.,(2009),Basic Electrical EngineeringMcGraw Hill
3. L. S. Bobrow.,((2011)),Fundamentals of Electrical Engineering, Oxford UniversityPress
4. E. Hughes.,((2010)), Electrical and Electronics, TechnologyPearson
5. V. D. Toro.,(1989),Electrical Engineering Fundamentals, prentice HallIndia

(i) Laboratory

Course Objective

- To impart the basic knowledge about the Electric circuits.
- To understand the working of Electrical Machines and Transformers.
- To observe the speed control experiments in DC motor
- To acquire the knowledge of energy consumption measurements in single phase system
- To observe and analyse the electrical parameters in R load
- To experiment the basic laws in voltage and current

Course Outcomes

At the end of this course, students will demonstrate the ability

1. To understand and analyze basic electric and magnetic circuits.
2. Getting basic practical knowledge about the Electric circuits.
3. Getting knowledge about the testing of Electrical Machines and Transformers.
4. To observe the speed control experiments in DC moto
5. To study the working principles of electrical machines and power converters.
6. Gathered knowledeg of commercial system energy calculations

List of Experiments

1. Experimental verification of electrical circuit problems using Ohms law and Kirchoff'slaw.
2. Measurement of electrical quantities – voltage, current, power & power factor in Rload.
3. Speed control of DC shuntmotor
4. Draw the equivalent circuit of single phase Transformer by conducting OC &SCTest.
5. Measurement of energy using single phase energymeter.

SUGGESTED READING

1. D. P. Kothari and I. J. Nagrath.,(2010), "Basic Electrical Engineering", Tata McGrawHill.
2. D. C. Kulshreshtha.,(2009), "Basic Electrical Engineering", McGrawHill.
3. L. S. Bobrow.,(2011), "Fundamentals of Electrical Engineering", Oxford UniversityPress.
4. E. Hughes.,(2010), "Electrical and Electronics Technology", Pearson.
5. V. D. Toro.,(1989), "Electrical Engineering Fundamentals", Prentice HallIndia.

Semester-I

18BTBT111 **Engineering Graphics And Design** **5H-3C**

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

End Semester Exam:3Hours

COURSE OBJECTIVES

- To understand the importance graphics in engineering
- To learn basic engineering drawing formats
- To develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings.
- To learn to take data and transform it into graphic drawings.
- To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice

COURSE OUTCOMES

Upon completion of this course the students will be able to:

- Know and understand the conventions and the method of engineering drawing.
- Interpret engineering drawings using fundamental technical mathematics.
- Construct basic and intermediate geometry.
- Improve their visualization skills so that they can apply these skill in developing new products.
- Improve their technical communication skill in the form of communicative drawings.
- Comprehend the theory of projection.

UNITI INTRODUCTION

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning– linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Conic sections including the Ellipse, Parabola and Hyperbola (eccentricity method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales

UNITII ORTHOGRAPHICPROJECTIONS

Principles of Orthographic Projections- Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNITIII PROJECTION OF POINTS, LINES AND PLANESURFACES

Projections of Points and lines located in the first quadrant inclined to both planes - Determination of true lengths and true inclinations; Projection of polygonal surface and circular lamina inclined to both referenceplanes

UNITIV PROJECTION OFSOLIDS

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

UNIT V ISOMETRIC PROJECTIONS & COMPUTER GRAPHICS

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple solids, truncated prisms, pyramids, cylinders and cones; Conversion of Isometric Views to Orthographic Views andVice-versa

Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software, Introduction to 3D modeling packages

SUGGESTED READINGS

1. Venugopal K and Prabhu Raja V., (2010),Engineering Graphics, New AgeInternational Publishers,.
2. C M Agrawal and Basant Agrawal., (2012), Engineering Graphics, Tata McGraw Hill,New Delhi,.
3. James D. Bethune., (2016), Engineering Graphics with AutoCAD (2015),Pearson Education,.
4. Narayana, K.L. & P Kannaiah., (2008),Text book on Engineering Drawing,Scitech Publishers,.
5. Bureau of Indian Standards, Engineering Drawing Practices for Schools and Colleges SP 46., (2003), BIS, New Delhi,(2003).
6. Shah, M.B. & Rana B.C., (2008), Engineering Drawing and Computer Graphics,Pearson Education.
7. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, CharotarPublishing House,.

B.Tech Biotechnology		2018-2019
		Semester-II
18BTBT201	Mathematics-II	4H-4C

Instruction Hours/week: L:3T:1P:0 **Marks:** Internal**:40**External**:60**Total**:100**

End Semester Exam:3 Hours

Course Objectives:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To enable the students to apply the knowledge of Mathematics in various Engineering fields by making them to identify the functions in engineering problems as analytic function and their study as a functions of a complex variables.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as fluid dynamics and flow of the electric current etc.
- To make the student understand the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To make the student to solve various Engineering problems.

Course Outcomes:

After successfully completing the course, the student will have a good understanding of the following topics

1. To apply the Eigen values and eigenvectors, diagonalization of a matrix, nature and they will also be able to use matrix algebra techniques for practical applications.
2. To find grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities, to evaluate line, surface and volume integrals in simple coordinate systems and to use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.
3. To find the Analytic functions using the Cauchy Riemann equations and they will learn mapping properties of elementary functions and mapping properties of some special transcendental functions. They will understand relations between conformal mappings and quadratic differentials and how geometric structures are changing under conformal mappings.
4. To evaluate complex integrals using the Cauchy's integral formula and the Residue theorem and to appreciate how complex methods can be used to prove some important theoretical results.
5. To apply Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.
6. In applying the concept of Matrices , Vector calculus, Analytic functions, Complex integration and Laplace transforms in their respective fields.

UNIT I - MATRICES

Eigen values and Eigenvectors of a real matrix, Characteristic equation, Properties of eigenvalues and eigenvectors, Cayley-Hamilton theorem, Diagonalization of matrices , Reduction of a quadratic form to canonical form by orthogonal transformation, Nature of quadratic forms. Simple Problems using Scilab.

UNIT II -VECTOR CALCULUS

Gradient and directional derivative, Divergence and Curl, 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 FUNCTION

Analytic functions, Necessary and sufficient conditions for analyticity, Properties, Harmonic conjugates, Construction of analytic function, Conformal mapping, Mapping by Functions w =z+c, cz, 1/z, z^2 , Bilinear transformation.

UNIT IV- COMPLEX INTEGRATION

Line integral, Cauchy's integral theorem, Cauchy's integral formula, Taylor's and Laurent's series, Singularities, Residues, Residue theorem, Application of residue theorem for evaluation of real integrals, Use of circular contour and semicircular contour with no pole on real axis.

UNIT V - LAPLACE TRANSFORMS

Existence conditions, Transforms of elementary functions, Transform of unit step function and unit impulse function, Basic properties, Shifting theorems, Transforms of derivatives and integrals, Initial and final value theorems, Inverse transforms, Convolution theorem , Transform of periodic functions, Application to solution of linear ordinary differential equations with constantcoefficients.

SUGGESTED READINGS

1. Hemamalini. P.T., (2014 and 2017), Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi.
2. Erwin kreyszig.,(2014), Advanced Engineering Mathematics, 9th Edition, John Wiley& Sons.
3. B.S. Grewal., (2014), Higher Engineering Mathematics, 43rd Edition, KhannaPublishers.
4. Ramana B.V., (2010), Higher Engineering Mathematics, Tata McGrawHill.
5. Glyn James., (2007), Advanced Modern Engineering Mathematics, PearsonEducation.
6. Jain R.K. and Iyengar S.R.K., (2007), Advanced Engineering Mathematics , 3rd Edition, NarosaPublications.
7. Bali N., Goyal M. and Watkins C., (2009), Advanced Engineering Mathematics, 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt.,Ltd).
8. O'Neil, P.V., (2007), Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd.

B.Tech Biotechnology		2018-2019
		Semester-II
18BTBT202	Engineering Physics (Theory & Lab.)	7H-5C

Instruction Hours/week: L:3T:1P:3 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3Hours

Theory

Course Objectives

- To inculcate the basics of properties of matter and its applications.
- To study the basics of laser and optical fiber with appropriate applications.
- To disseminate the fundamentals of thermal physics and their applications.
- To introduce the concepts of quantum mechanics for diverse applications.
- To impart the basic knowledge of crystal and its various crystal structures.
- To develop the idea of quantum mechanics through applications.

Course Outcomes

Upon completion of this course, the students will be able to

1. Identify the elastic nature of materials.
2. Infer the characteristics of laser for various engineering applications.
3. Extend the knowledge on optical fiber for communication purposes.
4. Illustrate the thermal properties of materials through various methods.
5. Develop the idea of quantum mechanics through applications.
6. Identify the different atomic arrangements of crystals ad its defects.

UNIT I – PROPERTIES OF MATTER

Elasticity –Three types of modulus of elasticity – basic definitions, relation connecting the moduli (Derivation)-factors affecting elastic modulus and tensile strength–Poisson's ratio- Torsional pendulum- bending of beams – bending moment – uniform and non-uniform bending – I-shaped girders - stress due to bending in beams.

UNIT II – LASER AND FIBER OPTICS

Introduction – emission and absorption process- Einstein's coefficients derivation. Types of LASER – CO_2, Semiconductor LASER- Applications of LASER in industry and medicine.

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

UNIT III – THERMAL PHYSICS

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints – bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity – Forbe's and Lee's disc method: theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar waterheaters.

UNIT IV – QUANTUM PHYSICS

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

UNIT 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 – crystal Imperfections: point defects, linedefects

SUGGESTED READINGS

1. Bhattacharya D.K. & Poonam T., (2015), Engineering Physics, Oxford UniversityPress.
2. Gaur R.K. andGupta S.L., (2012), Engineering Physics, Dhanpat RaiPublications
3. Pandey .B.K. & Chaturvedi .S., (2012), Engineering Physics, Cengage LearningIndia
4. Halliday.D., Resnick R. & Walker. J., (2015), Principles of Physics,Wiley
5. Serway R.A and Jewett J.W., (2010), Physics for Scientists and Engineers with Modern Physics, Thomson Brooks/Cole PublishingCo
6. TiplerP.A.and Mosca G.P.,(2007), Physics for Scientists and Engineers with Modern Physics,W.H.Freeman

Laboratory

Course Objective:

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

Course Outcomes:

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

LIST OF EXPERIMENTS – PHYSICS

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia ofdisc
2. Non-uniform bending – Determination of young'smodulus
3. Uniform bending – Determination of young'smodulus
4. Lee's disc Determination of thermal conductivity of a badconductor
5. Potentiometer-Determination of thermo e.m.f of athermocouple
6. Laser- Determination of the wave length of the laser usinggrating
7. Air wedge – Determination of thickness of a thinsheet/wire
8. Optical fibre –Determination of Numerical Aperture and acceptanceangle
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility ofliquids
10. Determination of Band gap of asemiconductor.
11. Spectrometer- Determination of wavelength usinggrating.
12. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille'sflow

Semester-II

18BTBT203 **English** **4H-3C**

Instruction Hours/week: L:2T:0P:2 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

Students undergoing this course will be able to

1. Use English language for communication: verbal & non –verbal.
2. Enrich comprehension and acquisition of speaking & writing ability.
3. Gain confidence in using English language in real life situations.
4. Improve word power: lexical, grammatical and communication competence.
5. To guide the students to write business letters and other forms of technical writing.
6. To enable students to prepare for oral communication in formal contexts.

Unit: I – **Basic Writing Skills**

Sentence Structures – Use of phrases and clauses in sentences – Importance of proper punctuation – Creating coherence- Organizing principles of paragraphs in documents – Techniques for writing precisely

Unit: 1I – Vocabulary Building

The concept of Word Formation – Root words from foreign languages and their use in English – Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. – Synonyms, antonyms, and standard abbreviations.

Unit: III – Grammar and Usage

Subject-verb agreement – Noun-pronoun agreement – Misplaced modifiers – Articles – Prepositions – Redundancies – Clichés

Unit: IV – Listening and Reading Skills

Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise

Unit: V. – **Writing Practices**

Comprehension – Précis Writing – Essay Writing Listening Comprehension – Common Everyday Situations: Conversations and Dialogues – Communication at Workplace – Interviews – Formal Presentations

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

SUGGESTED READINGS

1. Sangeeta Sharma , Meenakshi Raman.,(2015),Technical Communication: Principles And Practice, 2nd Edition, OUP, NewDelhi.
2. Sanjay Kumar and PushpLata., (2011), Communication Skills ,Oxford UniversityPress.
3. Liz Hamp – Lyons and Ben Heasly., (2006), Study Writing, Cambridge UniversityPress.
4. F.T. Wood., (2007), Remedial English Grammar, Macmillan,
5. Michael Swan., (1995),Practical English Usage,OUP.,

Semester-II

18BTBT204 **Programming For Problem Solving (Theory & Lab.)** **7H-5C**

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

End Semester Exam:3Hours

(i) Theory

CourseObjectives

- Identify and understand the working of key components of a computerprogram.
- Identify and understand the various kinds of keywords and different data types of C programming
- Understand, analyze and implement software development tools likealgorithm,
- pseudo codes and programmingstructure
- Acquire and analyse the roots of equations
- Study, analyze and understand logical structure of a computer program, anddifferent construct to develop a program in "C"language

Course Outcomes

The course will enable the students

1. To formulate simple algorithms for arithmetic and logicalproblems
2. To translate the algorithms to programs (in Clanguage)
3. To test and execute the programs and correct syntax and logicalerrors
4. To implement conditional branching, iteration andrecursion
5. To decompose a problem into functions and synthesize a complete program using divide and conquerapproach
6. To use arrays, pointers and structures to formulate algorithms andprograms
7. To apply programming to solve matrix addition and multiplication problems and searching and sortingproblems
8. To apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simpleintegration.

Unit I – Introduction to Programming, Arithmetic expressions and precedence

Introduction to Programming-Flowchart / pseudocode, compilation, Variables including data types, Arithmetic expressions and precedence.

Unit II – Conditional Branching and Loops

Conditional Branching – Loops Writingand evaluation of conditionals and consequent branching, Iteration and loops.

Unit III – Arrays and Basic Algorithms

Arrays1-D,2-D,Characterarraysand Strings**Basic Algorithms**: Searching, Basic Sorting Algorithms, Finding roots of equations, idea of time complexity.

Unit IV – Function and Recursion

Functions (including using built in libraries), Recursion with example programs such as Quick sort, Ackerman function etc.

Unit V - Structure, Pointers and File Handling

Pointers, Structures including self-referential structures e.g., linked list, notional introduction, File handling in C.

SUGGESTED READINGS

1. E. Balagurusamy.,(2017), Computing Fundamentals and C Programming, 5th Edition, TMHEducation
2. E. Balaguruswamy., (2017), Programming in ANSI C, 7th Edition, TataMcGraw-Hill,
3. Byron Gottfried., (2017), Schaum's Outline of Programming with C, 3rd Edition, McGraw-Hill
4. Brian W. Kernighan and Dennis M. Ritchie.,(2015), The C Programming Language, 2nd Edition, Prentice Hall ofIndia

(ii) Laboratory

CourseObjectives

- To provide an awareness to Computing and CProgramming
- To know the correct and efficient ways of solvingproblems
- To learn to develop algorithm for simple problemsolving
  - To know different errors in programming
  - To acquire knowledge in array and strings programming
- To get more knowledge in branches and structures

Laboratory Outcomes:

1. To formulate the algorithms for simpleproblems
2. To translate given algorithms to a working and correctprogram
3. To be able to correct syntax errors as reported by thecompilers
4. To be able to identify and correct logical errors encountered at runtime
5. To be able to write iterative as well as recursiveprograms
6. To be able to represent data in arrays, strings and structures and manipulate them through aprogram
7. To be able to declare pointers of different types and use the mind defining self-referentialstructures.
8. To be able to create, read and write to and from simple text files.

List of Experiments

Tutorial 1: Problem solving using computers:
Lab 1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5:1DArrays: searching, sorting:
Lab 5:1DArray manipulation
Tutorial 6:2D arrays and Strings, memory structure:
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions
Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8and 9: Numericalmethods problems
Tutorial 10: Recursion, structure of recursive calls:
Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: Fileoperations

Semester-II

18BTBT205 **Biochemistry (Theory & Lab.)** **7H-6C**

Instruction Hours/week: L:3T:1P:3 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3Hours

(i) Theory

Course Objectives

- To understand the fundamental concepts of biochemistry
- To illustrate the structure and properties of important biomolecules
- To understand the structural and metabolic aspects of amino acids and nucleic acids.
- To understand the major reactions in living cells and metabolism of biomolecules.
- To summarize the biosynthesis of biomolecules
- To explain the consequences of metabolic disorders.

Course Outcomes

1. Explain the basic biochemical concepts, structure, types and properties of carbohydrates.
2. Recall the structure and properties of lipids, proteins and nucleic acids.
3. Summarize the basics of bioenergetics and glucose metabolism.
4. Understand the knowledge on structural and metabolic aspects of amino acids and nucleic acids.
5. Outline the pathway by which lipids are being biosynthesized and metabolized.
6. Understand how diseases are correlated with metabolic disorders.

UNIT I - INTRODUCTION TO BIOMOLECULES - CARBOHYDRATES

Basic principles of organic chemistry, role of carbon, types of functional groups, chemical nature of water, pH and biological buffers, biomolecules. Structure and properties of Carbohydrates (mono, di, oligo & polysaccharides) Proteoglycans, glucosaminoglycans.mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars.Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans, hyaluronic acid, chondroitinsulfate.

UNIT II - STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES

Structure and properties of important biomolecules: Lipids: fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins.

Protein: Amino Acids, Peptides, Proteins, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Steps in sequencing polypeptide.Chemical synthesis of peptides.

Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, RNA, DNA-Watson-Crick structure of DNA.

UNIT III - BIOENERGETICS AND CARBOHYDRATE METABOLISM

Metabolism - Energy relationship between the catabolic and anabolic pathways, Five major reactions in living cells, Ping-Pong mechanism of nucleoside diphosphate kinase. Major pathways of glucose utilization: glycolysis, gluconeogenesis. Pentose phosphate pathway; TCA cycle: Reactions and regulations, genetic disorders affecting carbohydrate metabolism.

UNIT IV - METABOLISM OF AMINOACIDS AND NUCLEIC ACIDS

Biosynthesis of amino acids from acetyl CoA, Biosynthesis of essential amino acids (Met, Thr, Lys, Ile, Val, Leu, Phe, Trp, Tyr).Glucose-alanine cycle, Urea cycle.Pathways of degradation of aromatic, glucogenic and ketogenic amino acids.Inborn errors of amino acid metabolism. Biosynthesis of nucleotides, *de novo* and salvage pathways for purines and pyrimidines, regulatory mechanisms; catabolism of purine & pyrimidine; Metabolic disorders associated with nucleic acid metabolism.

UNIT V - METABOLISM OF LIPIDS

Digestion, mobilization, and transport of fats, fatty acid entry into mitchondria via the acyl-carnitine / carnitine transporter. Biosynthesis of fatty acid, Tricylglycerol and cholesterol.The β-oxidation pathway.Oxidation of monounsaturated and polyunsaturated fatty acid. Genetic defects in fatty Acyl–CoA dehydrogenases causing seriousdiseases.

(ii) Laboratory

CourseObjectives

- Toexplaintheprinciplesbehindthequalitativeestimationofbiomoleculessuchas carbohydrates, amino acid, protein and lipid.
- To analyze the oilproperties.
- To carry out the oleic acidseparation.
- To carry out the preparation of casein frommilk

Course Outcomes

- Distinguish the properties of biomolecules such as carbohydrates, amino acids, proteins and lipid through qualitative analysis.
- Interpret the properties ofoil
- Demonstrate the separation of oleicacid.
- Perform the preparation of casein frommilk.

LABORATORY COMPONENT

1. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldosugars.
2. Quantitative method for amino acid estimation using ninhydrin – distinguishing aminofrom iminoacid.
3. Quantification of proteins (Lowry' s and Bradford'smethod)
4. Quantification of lipids (Zak'smethod)
5. Analysis of oil (Acid number, Saponification number and iodineValue)
6. Separation of Oleicacid
7. Preparation of Casein fromMilk

SUGGESTED READINGS:

1. Nelson. D.L., Cox. M., and Cox. M.M. (2004). Lehninger Principles of Biochemistry.4th Edition Freeman W.H. & Company, New York.
2. Murray. R.K., Granner. B.K., Mayes. P.A. and Rodwell. V.W. (2000). Harper's Biochemistry, Prentice Hall International.
3. Creighton T.E. (1993). Proteins, Structure and Molecular Properties, Freeman andCo.
4. Boyer. R. (2000). Experimental Biochemistry. BenjaminCummings, Redwood City,USA.
5. Palanivelu. P. (2001). Analytical Biochemistry and Separation Techniques. Kalaimani Printers, Madurai.
6. Zubay. G.L. (1996). Principles of Biochemistry. WCB Publishers,London.
7. Voet. G. and Voet. A. (2015). Fundamentals of Biochemistry. 2nd Edition. John Wiley &Sons, Inc.

B.Tech Biotechnology **2018-2019**

18BTBT301	**Mathematics -III**	**Semester-III**
	(Transforms and Partial Differential Equation)	**4H-4C**

Instruction Hours/week: L:3T:1P:0 **Marks:** Internal**:40**External**:60**Total**:100**

End Semester Exam:3 Hours

Course Objectives

- 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.
- To make the student to solve various Engineering problems.

Course Outcomes

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

1. Understand how to solve the given standard partial differential equations.
2. Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
3. Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
4. 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.
5. Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.
6. The learners can equip themselves in the transform techniques and solve partial differential equations

UNIT-I PARTIAL DIFFERENTIAL EQUATIONS

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

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT-III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

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 heatconduction.

UNIT-IV FOURIERTRANSFORMS

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT-V Z - TRANSFORMS AND DIFFERENCEEQUATIONS

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

SUGGESTED READINGS

1. Grewal B.S.,(2014), Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, NewDelhi.
2. Narayanan S., ManicavachagomPillay.T.K and Ramanaiah.G,(1998), "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd,Chennai.
3. Andrews, L.C and Shivamoggi, B.,(1999), "Integral Transforms for Engineers" SPIE Press.
4. Bali. N.P and Manish Goyal., (2014),A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt.Ltd.
5. Erwin Kreyszig.,(2016), Advanced Engineering Mathematics , 10th Edition, John Wiley, India.
6. James, G.,(2007), Advanced Modern Engineering Mathematics, 3rd Edition, Pearson Education.
7. Ramana. B.V.,(2016), Higher Engineering Mathematics, McGraw Hill Education Pvt. Ltd, NewDelhi.
8. Wylie, R.C. and Barrett, L.C.,(2012), Advanced Engineering Mathematics ,Tata McGraw Hill Education Pvt. Ltd, 6th Edition, NewDelhi.

Semester-III

18BTBT302 **Cell Biology** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT-I CELL STRUCTURE AND CELL ORGANELLES

History of cell biology, comparison of eukaryotic and prokaryotic cells, membrane organisation, theories, components; Structure of prokaryotic cells - cilia, flagella, cell wall; Structure of eukaryotic cell organelles: cytoplasm, endoplasmic reticulum, mitochondria, chloroplast, peroxisomes, nucleus, Microscopic techniques for viewing cell organelles.

UNIT-II CYTOSKELETAL PROTEINS & CELL DIVISION

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

UNIT-III TRANSPORT ACROSS CELL MEMBRANES

Passive & active transport, permeases, sodium potassium pump, Ca_2^+ ATPase pumps, lysosomal and vacuolar membrane ATP dependent proton pumps, co-transport symport, antiport, active group translocation; endocytosis and exocytosis; Entry of viruses and toxins into cells.

UNIT-IV RECEPTORS AND CELL SIGNALLING

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

UNIT- V FUNCTION OF MITOCHONDRIA AND CHLOROPLAST

Chloroplast: photosynthetic stages and light-absorbing pigments, Mitochondria: Electron transport chain, Reduction Potentials of Electron Carriers, Electron transfer from reduced cytochrome c to O_2, ATP synthesis.

SUGGESTED READINGS:

1. Lodish. H., Berk A., Zipurursky S.L., Matsudaria P., Baltimore D. and Darnell. J. (2000). Molecular Cell Biology. 4th Edition. Freemanpress.
2. Alberts. B., Johnson. A., Lewis. J., Raff. M., Roberts K., and Walter. P. (2002). Molecular Biology of the Cell, GarlandPUB.
3. Rastogi. S.C. (2004). Cell Biology. New Age International Pub. Ltd.
4. De Robertis. E.D.P. and De Robertis E.M.F. (2005). Cell and Molecular biology. B.I publications PvtLtd.

Semester-III

18BTBT303 **Microbiology** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

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

UNIT- I INTRODUCTION

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

UNIT-II MICROBES-STRUCTURE AND MULTIPLICATION

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

UNIT- III MICROBIAL NUTRITION, GROWTH AND METABOLISM

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

UNIT – IV CONTROL OF MICROORGANISMS

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

UNIT – V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY

Primary metabolites; secondary metabolites and their applications-preservation of food; biogas; bioremediation; leaching of ores by microorganisms; microorganisms and pollution control.

SUGGESTED READINGS:

1. Talaro. K.P. and Chess. B. (2017). Foundations in microbiology. 10th Edition. Tata McGraw-HillEducation.
2. Pelczar. M. J. Chan. E.C.S. and Kreig N.R. (2015). Microbiology. 5th Edition. Tata McGraw-Hill Education.
3. Willey. J.M., Sherwood. L.M. and Woolverton C.J. (2011). Prescott's Microbiology,8th Edition, McGraw-Hill International
4. Kolwzan. B., Adamiak. W., Grabas K. and Pawelczyk. A. (2006). Introduction to Environmental Microbiology,ebook.

Semester-III

18BTBT304 **Principles of Chemical Engineering** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT I - BASIC CHEMICAL CALCULATIONS

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

UNIT II - FIRST AND SECOND LAWS OF THERMODYNAMICS

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

UNIT III - MATERIAL BALANCES

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

UNIT IV - FLUID MECHANICS

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

UNIT V - TRANSPORTATION OF FLUIDS

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

SUGGESTED READINGS:

1. Bhatt. B.I. and Vora. S.M. (2004). Stoichiometry. 4th Edition. Tata McGraw-Hill Education.
2. McCabe. W., Smith. J., and Harriott. P. (2004). Unit Operations of Chemical Engineering. 7th Edition. Tata McGraw HillEducation.

Semester-III

18BTBT305 **Instrumental Methods of Analysis (Theory & Lab.)** **5H-4C**

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

End Semester Exam:3 Hours

(i) Theory

Course Objectives

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

Course Outcomes

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

UNIT I - INTRODUCTION TO SPECTROMETRY

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

UNIT II - MOLECULAR SPECTROSCOPY

Molecular absorption spectrometry –Transmittance and Absorbance – Beer's law – Theory - Instrumentation - Applications - Fluorescence and Phosphorescence spectrometry- Theory, Instrumentation – Applications – Infrared absorption spectrometry – theory - instrumentation – Applications – Interpretation of data- Raman spectroscopy – Theory - Instrumentation – applications-Interpretation of data- Circular dichroism spectroscopy- Theory - Instrumentation – applications-Circular Nucleic acids and Proteins-Use of spectroscopy in biological and clinical analysis.

UNIT III - MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY

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

UNIT IV - SEPARATION METHODS

Chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography - Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography - Affinity chromatography- Gas chromatography& HPLC- - principles - applications Capillary electrophoresis – Applications.

UNIT V - THERMAL METHODS

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

ii) Laboratory

Course Objectives

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

Course Outcomes

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

LABORATORY COMPONENT

1. Precision and validity in an experiment using absorption spectroscopy andvalidating Lambert-Beer's law usingkMnO4
2. Determination of analytical wavelength forKMnO4
3. Determination of iron concentration using 1,10phenanthroline.
4. Finding the pKa of 4-nitrophenol using absorptionspectroscopy.
5. UV spectra of nucleic acids andproteins.

6. Estimation of Sulphate bynephelometry.
7. Determination of $R_f$value usingTLC.

SUGGESTED READINGS:

1. Willard. H.H., Merritt. L.L., Dean. J.A. and Settle F.A. (2004). Instrumental Methods of Analysis. 7th Edition. CBSPublishers.
2. Skoog D.A., Holler. J.F. and Crouch. S.R. (2018). Principles Instrumental Analysis. 7thEdition. Cengage Learning.

Semester-III

18BTBT311 **Cell Biology and Microbiology Lab** **4H-2C**

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

End Semester Exam:3 Hours

Course objective:

- To understand the nature of the cells present in the biological sample through microscope.
- To explain the different staining techniques.
- To understand the stages of mitosis and different types of blood cells.
- To understand the chloroplast isolation from leaves.
- To demonstrate the culturing, growth and control of micro organisms.
- To understand about the chemicals that controls the bacterial growth.

Course outcomes:

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

LIST OF EXPERIMENTS

Laboratory Safety and Aseptic Techniques

1. Identification of given plant, animal and bacterial cells and theirs components by microscopy.
2. Staining Techniques: (i) Leishmann staining (ii) Giemsastaining.
3. Staining for different stages of mitosis in *Allium cepa*(Onion).
4. Identification of different types of bloodcells
5. Isolation of chloroplasts from spinachleaves.
6. Tryphan BlueAssay
7. Culturing of microorganisms – in broth and in plates (spread plate, pour plate, streakplate)
8. Gram staining Techniques & MotilityTest
9. Chemical Control of Microorganisms & Antibiotic SensitivityAssay
10. Bacterial Growth Curve and Effect of different parameters on bacterial growth (temperature/aeration/pH)

SUGGESTED READINGS

1. Bregman. A.A. (2001). Laboratory Investigations in Cell and Molecular Biology.Wiley.
2. Rajan. S. and SelviChristy. R. (2011). Experimental procedures in Life Sciences. Anjanna Book House,Chennai.
3. Leboffee. M.J. (2006). MicroBiology: Laboratory Theory and applications. BE Pierce Morten PublishingHouse.
4. Aneja. K.R. (2001). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology. New Age International (P) Limited Publishers, NewDelhi.

Semester-III

18BTBT351 **Constitution of India** **1H-0C**

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

End Semester Exam:3Hours

Course Objectives

- To explain about Indian constitution.
- To understand the central and state government functionalities in India.
- To discuss about Indian society.
- To describe the functions of the Indian government.
- To explain the rules of the Indian constitution.
- To understand the different culture among the people

Course outcomes:

1. Define the laws of Indian constitution.
2. Understand the central and state government functionalities in India.
3. Discuss about Indian society.
4. Describe the functions of the Indian government.
5. Tell about the rules of the Indian constitution.
6. Understand and appreciate different culture among the people.

UNIT I -INTRODUCTION

Historical Background – Constituent Assembly of India – Philosophical foundations of the IndianConstitution – Preamble – Fundamental Rights – Directive Principles of State Policy – FundamentalDuties – Citizenship – Constitutional Remedies for citizens.

UNIT II - STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT

Union Government – Structures of the Union Government and Functions – President – Vice President– Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III - STRUCTURE AND FUNCTION OF STATE GOVERNMENT

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – StateLegislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV - CONSTITUTION FUNCTIONS

Indian Federal System – Center – State Relations – President‟s Rule – Constitutional Amendments –Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V - INDIAN SOCIETY

Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India;Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women,Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

SUGGESTED READINGS

1. Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India, NewDelhi
2. R.C.Agarwal., (1997), Indian Political System, S.Chand and Company, NewDelhi.
3. Maciver and Page, Society: An Introduction Analysis, Mac Milan India Ltd, NewDelhi
4. K.L.Sharma., (1997), Social Stratification in India: Issues and Themes, Jawaharlal Nehru University, NewDelhi.
5. Sharma, Brij Kishore., (2011), Introduction to the Constitution of India, Prentice Hall of India, NewDelhi.
6. U.R.Gahai., (1998), Indian Political System, New Academic Publishing House, NewDelhi.
7. R.N. Sharma., (1987), Indian Social Problems, Media Promoters and Publishers Pvt. Ltd, New Delhi.

Semester-III

18BTBT352 **Synthesis of Organic molecules** **1H-0C**

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

End Semester Exam:3 Hours

Course Objectives

- To carry out the synthesis of Aspirin.
- To carry out the synthesis ofp-nitroacetanilide.
- To carry out the preparation of Acetanilide fromAniline.
- To carry out the extraction of Lycopene
- To carry out the preparation of alpha D-glucopyranose pentaacetate.
- To carry out the preparation of 1,2:5,6- dicyclohexylidine- alpha-Dglucofuranose.

Course Outcomes

- Demonstrate the synthesis of organic molecules
- Demonstrate the synthesis ofp-nitroacetanilide.
- Demonstrate the preparation of Acetanilide fromAniline.
- Demonstrate the extraction of Lycopene
- Demonstrate the preparation of alpha D-glucopyranose pentaacetate.
- Demonstrate the preparation of 1,2:5,6- dicyclohexylidine- alpha-Dglucofuranose.

1. Synthesis ofAspirin.
2. Synthesis ofp-nitroacetanilide.
3. Preparation of Acetanilide fromAniline.
4. Extraction of Lycopene
5. Preparation of alpha D-glucopyranose pentaacetate.
6. Preparation of 1,2:5,6- dicyclohexylidine- alpha-Dglucofuranose.

Semester-IV

18BTBT401	**Probability and Statistics**	**4H-4C**

Instruction Hours/week: L:3T:1P:0 **Marks:** Internal**:100**External**:**-Total**:100**

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

1. Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
2. Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
3. Apply the concept of testing of hypothesis for small and large samples in real life problems.
4. Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
5. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.
6. To expose statistical methods designed to contribute to the process of making the judgements.

UNIT I PROBABILITY AND RANDOM VARIABLES

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES

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

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, Chisquare and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness offit.

UNIT IV DESIGN OF EXPERIMENTS

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.

SUGGESTED READINGS

1. Johnson, R.A., Miller, I and Freund J., (2015), Miller and Freund's Probability and Statistics for Engineers, Pearson Education, Asia, 8thEdition.
2. Milton. J. S. and Arnold. J.C., (2007), Introduction to Probability and Statistics, Tata McGraw Hill, 4 th Edition.
3. Devore. J.L., (2014), Probability and Statistics for Engineering and the Sciences, Cengage Learning, New Delhi, 8thEdition.
4. Papoulis, A. and Unnikrishnapillai, S.,(2010), Probability, Random Variables and Stochastic Processes, McGraw Hill Education India, 4th Edition, NewDelhi.
5. Ross, S.M., (2004), Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Elsevier.
6. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., (2004), Schaum's Outline of Theory and Problems of Probability and Statistics, Tata McGraw HillEdition.

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Semester-IV

18BTBT402 **Unit Operations** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

- To infer the basic knowledge on agitation and its flow pattern in differentsystems.
- To explain the concept of filtration and its industrialapplication.
- To understand the different modes of heat transfer and its transfer through different dimesnsionalsurfaces.
- To discuss the types of convectional heat transfer and itsapplication.
- To explain the different types and designing parameters of heat exchangers and evaporators.
- To explain the basics of design, equipmentation and calculations of evaporators and heat exchangers.

Course Outcomes

1. Interpret the properties of mixing and agitation in different flowsystems.
2. Outline the basic principle of filtration and its application in different filtrationmethods.
3. Discuss the modes of heattransfer.
4. Illustrate the mechanism of heat transfer through different dimensionalsurfaces.
5. Infer the basics of convectional heat transfer in differentsurfaces.
6. Appraise the basics of design, equipmentation and calculations of evaporators and heat exchangers.

UNIT I - MIXING AND AGITATION

Units and dimension, Agitation: purpose, equipments, flow pattern, dimensional analysis; power; agitation of liquids; gas-liquid systems; gas-solid suspensions; agitator scale up.

UNIT II - FILTRATION

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

UNIT III - MECHANISM OF HEAT TRANSFER

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

UNIT IV - CONVECTION HEAT TRANSFER

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

UNIT V - HEAT EXCHANGERS

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

SUGGESTED READINGS:

1. McCabe W.L., Smith. J.C. and Harriot P.I. (2004). Unit Operations in Chemical Engineering. 7th Edition. McGraw-HillInc.
2. Geankoplis C.J. (2016). Transport Processes and separation process principles (Includes unit operations). 4th Edition,Pearson.

Semester-IV

18BTBT403 **Chemical Thermodynamics** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

- To explain the thermodynamic properties of fluids and itscalculations.
- To discuss the basic concepts of solutionproperties.
- To illustrate the phase equilibria concepts for varioussystems.
- To outline the equilibrium criteria for various chemicalreactions.
- To infer the knowledge on general thermodynamicprocesses.
- To explain the working principles and the process involved in the refrigeration and Liquefactionsystem.

Course Outcomes

1. Discuss the various properties of the fluids and itscalculations.
2. Explain the concept of solution thermodynamics and compositionmodels.
3. Analyze the criteria of phase equilibria for different componentsystem.
4. Apply the concept of chemical reaction equilibria and equilibriumconversion.
5. Analyze the thermodynamic flowprocess.
6. Illustrate the working principles and the process involved in the refrigeration and Liquefactionsystem.

UNIT-I THERMODYNAMIC PROPERTIES OF FLUIDS

Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties - equations of state; Actual property exchanges - Calculations; Maxwell's relations and applications.

UNIT- II SOLUTION THERMODYNAMICS

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

UNIT- III PHASEEQUILIBRIA

Criteria - phase equilibria; V-L-E calculations for binary and multi component systems; liquid-liquid equilibria and solid-solidequilibria.

UNIT- IV CHEMICAL REACTION EQUILIBRIA

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

UNIT- V THERMODYNAMIC ANALYSIS OF PROCESSES

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

SUGGESTED READINGS:

1. Smith. J.M., Van Ness H.C. and Abbot. M.M. (2001). Chemical Engineering Thermodynamics.McGraw-Hill.
2. Narayanan. K.V. (2001). A Text Book of Chemical Engineering Thermodynamics. Prentice HallIndia.
3. Sandler. S.I. (1989). Chemical and Engineering Thermodynamics. JohnWiley.
4. Stockar. U.V., Luuk A.M. and Wielen V.D. (2013). Biothermodynamics: The Role of Thermodynamics in Biochemical Engineering. EPFLPress.

Semester-IV

18BTBT404 **Basics of Industrial Biotechnology** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

1. Outline the scope of biotechnology and its commercialpotential.
2. Interpret the modern biotechnological processing techniques for the production of commercialbioproducts.
3. Illustrate the production methods of primarymetabolites.
4. Illustrate the production methods of secondarymetabolites.
5. Infer the knowledge on commercial enzyme and bioproductproduction.
6. Explain the production of various commercially available products using recombinant technology.

UNIT I- INTRODUCTION TO INDUSTRIAL BIOPROCESS

Biotechnology: Scope and importance, Commercial potential of Biotechnology in India. Traditional and modern biotechnology. Products relating to modern biotechnology, industrially important organisms, fermentation processes – modes of operation.

UNIT II - PRODUCTION OF PRIMARY METABOLITES

Production of commercially important organic acids - citric acid, lactic acid, acetic acid, amino acids - glutamic acid, phenyalanine, aspartic acid , alcohols - ethanol,butanol.

UNIT III- PRODUCTION OF SECONDARY METABOLITES

Secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin), aminoglycosides (streptomycin) macrolides (erythromycin), vitamins (B12) and steroids (progesterone).

UNIT IV- PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS

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

UNIT V-PRODUCTION OF RECOMBINANT DNA PRODUCTS

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

SUGGESTED READINGS:

1. Casida Jr. L.E. (2006). Industrial Microbiology. 2nd Edition. New AgeInternational.
2. Reed G. (2004). Prescott & Dunn's Industrial Microbiology. 4th Edition. CBS Publishers & Distributors.
3. Dubey. R.C. (2014). Text book of Biotechnology. 5th Edition. S ChandPublishers.
4. Cruger. W. (2017). Crueger's Biotechnology: A Textbook of Industrial Microbiology. 3rdEdition.Medtech.

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18BTBT405	Molecular Biology	3H-3C

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

End Semester Exam:3Hours

Course Objectives

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

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Course outcomes

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

UNIT I - CLASSICAL GENETICS

Eukaryotic genetics - Mendelian genetics, linkage, crossing over, classical experiments – Hershey and Chase, Avery McLeod & McCarty.Prokaryotic genetics - Bacterial conjugation, transduction andtransformation.

UNIT II - STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION

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

UNIT III - TRANSCRIPTION

Conformation of RNA- Prokaryotic and Eukaryotic transcription, RNA polymerase, Transcription signals, transcription factors, Features of promoters and enhancers, ribozymes. Post transcriptional

modification – 5’ capping, adenylation, splicing, processing of rRNA and tRNA, RNA editing.

UNIT IV - TRANSLATION

Genetic code, Salient features - Wobble hypothesis, basic machinery of translation and its mechanism,codon usage, Post translational modifications, proteintargeting.

UNIT V - REGULATION OF GENE EXPRESSION

Regulation of genes – replication, transcription & translation factors, Lac operon, ara operon and trp operon, phage life cycle,Mutation – transition, transversion, artificial & natural mutation, suppressor mutation and repair of DNA.

SUGGESTED READINGS:

1. David. F. (2008). Molecular Biology. NarosaPubilcation.
2. Benjamin. L. (2004). Gene VIII. PearsonEducation.
3. Watson. J.D., Baker Bell, Gann, Levine and Losick. (2004). Molecular Biology of the Gene. PearsonEducation.
4. Weaver. R.F. (2005). Molecular Biology. Mc GrawHill.

Semester-IV

18BTBT406	**Environmental Studies**	**3H-3C**

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

End Semester Exam:3Hours

Course Objectives

- To educate the ways and means of the environment.
- To give a comprehensive insight into natural resources.
- To understand the concept of ecosystem and biodiversity.
- To protect the environment from various types of pollution.
- To impart some fundamental knowledge on human welfare measures.
- To apply systems concepts and methodologies in their core fields.

Course Outcomes (COs)

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

Unit I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS

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

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

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

Unit III - BIODIVERSITY AND ITS CONSERVATION

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

Unit IV - ENVIRONMENTAL POLLUTION

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

Unit V - SOCIAL ISSUES AND THE ENVIRONMENT

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

Suggested Readings

1. Anonymous.,(2004). A text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, NewDelhi.
2. AnubhaKaushik., and Kaushik, C.P.,(2004), Perspectives in Environmental Studies, New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar ,(2004),A Textbook of Environmental Science, APH Publishing Corporation, NewDelhi.
4. Daniel, B. Botkin., and Edward, A. Keller.,(1995), Environmental Science John Wiley and Sons, Inc., NewYork.
5. Mishra, D.D.,(2010), Fundamental Concepts in Environmental Studies, S.Chand&CompanyPvt. Ltd., NewDelhi.
6. Odum,E.P., Odum, H.T. and Andrews, J.,(1971), Fundamentals of Ecology, Philadelphia: Saunders.
7. Rajagopalan, R.,(2016),Environmental Studies: From Crisis to Cure, Oxford University Press.
8. Sing, J.S., Sing. S.P. and Gupta, S.R.,(2014),Ecology, Environmental Science and Conservation, S. Chand & Publishing Company, NewDelhi.
9. Singh, M.P., Singh, B.S., and Soma, S. Dey.,(2004), Conservation of Biodiversity and Natural Resources.Daya Publishing House, New Delhi.

10. Tripathy. S.N.,and Sunakar Panda.,(2004), Fundamentals of Environmental Studies (2nd ed.). Vrianda Publications Private Ltd, NewDelhi.
11. Verma, P.S., and Agarwal V.K.,(2001), Environmental Biology (Principles of Ecology).S.Chand and Company Ltd, NewDelhi.
12. Uberoi, N.K.,(2005), Environmental Studies. Excel Books Publications, NewDelhi.

Semester-IV

18BTBT411 **Chemical Engineering Lab** **4H-2C**

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

End Semester Exam:3 Hours

Course Objectives

- To understand chemical engineering principles and itsoperations.
- To understand the concept of pressure drops inpipes
- To understand the concept of pressure drops in differentreactors.
- To understand the concept of filtration and heattransfer.
- To explain the different separationtechniques.
- To understand the process involved in leaching

Course outcomes

Students undergoing this course will be able to

1. Outline the chemical engineering principles andoperations.
2. Calculate the flow measurements and pressure drop in pipes and differentreactors.
3. Analyze the process of filtration and heat transfer.
4. Perform the distillation andextraction.
5. Demonstrate the process involved in adsorption equilibrium.
6. Demonstrate the process involved in leaching

LIST OF EXPERIMENTS

1. Flow measurement inpipes
2. Pressure drop inpipes.
3. Pressure drop across Fluidizedbed.
4. Pressure drop across packedcolumn
5. Continuous rotaryfiltration
6. Heatexchanger
7. Simple and steamdistillation
8. Liquid-liquid equilibria inextraction
9. Adsorptionequilibrium
10. Leaching

SUGGESTED READINGS:

1. Geankoplis. C.J. (2007). Transport Processes and Unit Operations. Prentice Hall ofIndia.
2. McCabe W.L., Smith. J.C. and Harriot P.I. (2004). Unit Operations in Chemical Engineering. 7th Edition. McGraw-HillInc.

3. Coulson. M. and Richardson. J.F. (2004). Coulson and Richardsons Chemical Engineering. (Vol. 2). ButterworthHeineman.

Semester-IV

18BTBT451 Production of commercially valuable bioproducts 1H-0C

Instruction Hours/week: L:0T:0P:1 **Marks:** Internal**:100** External**:0T**otal**:100**

End Semester Exam: 3Hours

Course Objective

- To understand the manufacturing of industrially important bioproducts from different natural source.
- To carry out the production of ethanol from molasses andgrapes
- To carry out the production ofBiofertilizers
- To carry out the production of Single cell protein(Spirullina)
- To carry out the mushroom cultivation
- To carry out the production of jam from mixedfruits

Course Outcome

- Demonstrate the production of commercially valuable bioproducts from different natural source.
- Demonstrate the production of ethanol from molasses andgrapes
- Demonstrate the production of Biofertilizers
- Demonstrate the production of Single cell protein (Spirullina)
- Demonstrate the mushroom cultivation
- Demonstrate the production of jam from mixed fruits

1. Production of ethanol from molasses andgrapes
2. Production ofBiofertilizers
3. Production of Single cell protein(Spirullina)
4. Mushroom cultivation
5. Production of jam from mixedfruits

Semester-V

18BTBT501 **Bioprocess Principles** **3H-3C**

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

End Semester Exam: 3Hours

Course Objectives

- To understand the process of fermentation and basic fermentorconfiguration.
- To explain the medium requirements and media optimization methods for fermentation process.
- To explain the different sterilization methods and its kinetics anddesign.
- To discuss and solve the problems related to metabolic stoichiometry andenergetics.
- To understand the modes of operations and various kinetic models for productformation.
- To analyze the different kinetic models for microbial growth and productformation.

Course outcomes

1. Discuss the general process of fermentation and fermentorconfiguration.
2. Analyze the medium requirements and medium formulations for fermentationprocess.
3. Outline the thermal death kinetics and different sterilizationmethods.
4. Solve problems related to stoichiometry of cell growth andenergetic.
5. Illustarte the various modes of operation in fermentationprocess.
6. Analyze the different kinetic models for microbial growth and productformation.

UNIT I - OVERVIEW OF FERMENTATION PROCESSES

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

UNIT II - RAW MATERIALS AND MEDIA DESIGN

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

UNIT III - STERILIZATION KENETICS

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

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking-piret models, substrate and product inhibition on cell growth and product formation.

SUGGESTED READINGS:

1. Bailey and Ollis. (2015). Biochemical Engineering Fundamentals, 2nd Edition, McGraw-Hill.
2. Shuler and Kargi. (2017). Bioprocess Engineering Basic concepts. 2nd Edition,Pearson.
3. Pauline M. Doran. (2015). Bioprocess Engineering principles. 2nd Edition.Elsevier.
4. Harvey W. Blanch and Douglas. S. Clark. (2012). Biochemical Engineering. 2nd Edition. MarcelDekker.
5. StanburyP.F.,HallS.J.andWhitaker.A.(2017).PrinciplesofFermentationtechnology.3rd Edition.Elsevier.

Semester-V

18BTBT502 **Genetic Engineering** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

1. Discuss the knowledge on the basics of rDNAtechnology.
2. Outline the usage of recombinant molecules in research anddevelopment.
3. Understand gene libraries construction and to perform blottings.
4. Interpret the indepth knowledge acquired to perform PCR reactions and theirtypes.
5. Infer the importance of DNA sequencingmethods.
6. Summarize the concept of rDNA technology and its importance in cloning, gene therapy and relate itsapplications.

UNIT I - BASICS OF RECOMBINANT DNA TECHNOLOGY

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

UNIT II - CREATION OF RECOMBINANT MOLECULES

Restriction mapping, design of linkers and adaptors, gene editing.Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors.Insect, Yeast and Mammalian vectors.

UNIT III - CONSTRUCTION OF LIBRARIES

Construction of cDNA and genomic libraries.Screening of libraries with DNA probes and with antisera.Cloning : Characterization of recombinant clones by southern, Northern, western and PCR analysis, factors affecting foreign gene expression,over expression and purification of recombinant proteins.

UNIT IV –THEORIES OF rDNA TECHNIQUES

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

UNIT V –APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY

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

SUGGESTED READINGS:

1. Primrose. S.B. and Twyman. R.M. (2006). Principles of Gene Manipulation and Genomics. 7thEdition. BlackwellPublishers.
2. Ansubel. F.M., Brent. R., Kingston. R.E. and Moore D.D. (2003). Current Protocols in Molecular Biology. Greene PublishingAssociates.

Semester-V

18BTBT503 **Biopharmaceutical Technology** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT-I INTRODUCTION

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

UNIT-II BASICS OFPHARMACOKINETICS

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

UNIT- III MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS

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

UNIT- IV MANUFACTURE OF SOILD DOSAGE FORMSS

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation, Biology based dosage forms

UNIT- V MANUFACTURE OF LIQUID ORALS AND TOPICALS

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

SUGGESTED READINGS

1. Gareth Thomas. (2000). Medicinal Chemistry - An introduction. 2nd Edition. JohnWiley.
2. Katzung. B.G. (1995). Basic and Clinical Pharmacology. 13th Edition. Prentice Hall ofIntl.
3. Remington. (2005). The Science and practice of pharmacy. 21st Edition. LippincottWilkins.
4. Mahato. R.I. and Naran A.S. (2012). Pharmaceutical Dosage forms and Drug Delivery. 2ndEdition. CRCPress.
5. Augusburge.L.L.andHoang.S.W.(2008).Pharmaceuticaldosageforms:Tablets.3rd Edition Volume 3. Manufacture and process control, Informa health care.

B.Tech Biotechnology		2018-2019
		Semester-V
18BTBT504	Cancer Biology	3H-3C

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

At the end of the course students will be able to

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

UNIT I - FUNDAMENTALS OF CANCER BIOLOGY

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

UNIT II - PRINCIPLES OF CARCINOGENESIS

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

UNIT III - PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Signal amplification:Current models of signal amplification– Phosphorlyation of protein kinases; regulation of protein kinases: serine threonine kinase, TNF receptor families, tumor suppressor genes, Oncogenes, identification of oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases.

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 - CANCER THERAPY

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

SUGGESTED READINGS:

1. Ruddon. R.W. (2007). Cancer Biology. 4th Edition. Oxford UniversityPress.
2. Stella Pelengaris and Michael Khan. (2006). The Molecular Biology of Cancer. Blackwell Publishing,Oxford.
3. Lodish. H., Berk. A., Zipurursky. S.L., Matsudaria. P., Baltimore. D. and Darnell. J. (2000). Molecular Cell Biology. Freemanpress.
4. Ian F.Tannock.(2013). The Basic Science of Oncology McGraw HillProfessional,

B.Tech Biotechnology		2018-2019
		Semester-V
18BTBT505	Bioinformatics (Theory & Lab)	5H-4C

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

End Semester Exam:3Hours

Course Objectives

- To understand the basics of operating systems and biologicaldatabases.
- To understand the basics on available tools and databases for performing research in bioinformatics.
- To explain the dynamic programming approach and methods of pair wisealignment.
- To explain the various methods for the construction of phylogenetictrees.
- To understand the machine learning techniques and protein structureanalysis.
- To understand the basics of PERL programming and itsfunctions.

Course Outcomes

1. Illustrate the basics of operating systems and biologicaldatabases.
2. Outline the various biological databases and database management systemmodels.
3. Discuss the different algorithms for the sequenceanalysis.
4. Construct the phylogenetic trees using various methods and protein predictionmethods.
5. Outline the machine learning techniques and various techniques for protein structure analysis.
6. Explain the basics of PERL programming and its operations andfunctions.

UNIT-I INTRODUCTION

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 ANALYSIS

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

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphologicaltraits, 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

Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

UNIT V PERL PROGRAMMING

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.

SUGGESTED READINGS:

1. Dan E. Krane and Michael L. Raymae. (2004). Fundamental Concepts of Bioinformatics. Pearsoneducation.
2. Andreas D. Baxevanis and Francis Ouellette. B.F. (2004). Bioinformatics: A practical Guide to the Analysis of Genes and Proteins. Wiley-Interscience.
3. David W. Mount. (2004). Bioinformatics Sequence and Genome Analysis. Cold Spring HarborLaboratory.
4. Jonathan. (2003). Bioinformatics and Functional Genomics. Wiley-Liss
5. Arthur M. Lesk. (2008). Introduction to Bioinformatics. Oxford UniversityPress.
6. Dun Gusfield. (2008). Algorithms on Strings, Trees and Sequences, Computer science and computational Biology. Cambridge universitypress.
7. James Tisdall. (2009). Beginning Perl for Bioinformatics An introduction to Perl for Biologists. O'ReillyMedia.
8. Rastogi. S.C., Mendiratta. N. and Rastogi. P. (2013). Bioinformatics - Methods & Applications, Genomics, Proteomics and Drug Discovery. Prentice Hall of India Learning PvtLtd.

ii) Laboratory

Course Objectives

- To explain the sequence retrieving techniques from biologicaldatabases.
- To explain how to utilize the tools such as BLAST, FASTA CLUSTAL OMEGA,EMBOSS, PHYLIPetc.
- To illustrate the basics of pattern matching by pairwise and multiple sequencealignment.
- To understand the 3D structure of protein.
- To explain the molecular visualization tools and impart knowledge on ExPASyServer.
- To understand the basics of Perl programming

Course Outcomes

1. Outline the techniques to retrieve sequences from different biological databases.
2. Discuss the pattern matching by pairwise and multiple sequencealignment
3. Construct phylogenetic tree by using distance based and character basedmethods
4. Predict and validate 3D structure ofprotein
5. Predict the protein parameters using ExPASy proteomicstools.
6. Understand the programming using PERLlanguage.

LABORATORY COMPONENT

1. Introduction to UNIX basic commands and UNIX Filters
2. Biological Databases- Sequence Databases, Structure Databases, Specialized Databases;Data Retrieval tools and methods; Database fileformats.
3. Pairwise alignment & Multiple sequence alignment- Dotplot analysis - Clustal OMEGA, ClustalX, ClustalW,T-Coffee
4. Database similarity searching using Heuristic methods- BLAST,FASTA
5. Construction of phylogenetic tree - Maximum Parsimony & Maximum Likelihood method - NJ, UPGMA method - PHYLIPprogram
6. Protein sequence analysis -ExPASy proteomicstools
7. Molecular visualization tools – Pymol, Chimera, DS visualizer, and Swiss PDBViewer.
8. Perl Programming and applications toBioinformatics.

SUGGESTED READINGS:

1. Bosu and Simminder Kaur Thukral. (2017). Bioinformatics Databases, Tools and Algorithms, Oxford UniversityPress.
2. Mani. K. and Vijayaraj N. (2004). Bioinformatics, a Practical Approach. AparnaPublications.

Semester-V

18BTBT511 Molecular Biology and Genetic Engineering Lab 4H-2C

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

1. Carry out agarose gel electrophoresis and isolation of DNA samplesindividually.
2. Develop the knowledge of techniques involved in DNA isolation andpurification.
3. Perform the restriction enzyme digestion and ligation of DNAsamples.
4. Produce recombinant DNA and implement blue white screening techniques to screenthem.
5. Develop methods to produce recombinant proteins and understand their applications and perform SDS PAGE and PCRreactions.
6. Summarize the overall structure of rDNA technology and implement its techniques in research anddevelopment.

LABORATORY COMPONENT

1. Agarose gelelectrophoresis
2. Isolation of plasmid & chromosomal DNA from bacterial cell
3. Isolation of plant cell genomic DNA from plantsource
4. Isolation of genomic DNA from animal cell
5. Purification of DNA from agarosegel
6. Restriction enzyme digestion andligation
7. Competent cells preparation ($CaCl_2$method)
8. Transformation and screening forrecombinants
9. Blue and white selection forrecombinants
10. Optimization of inducer concentration and time of induction for recombinant protein expression.
11. SDS PAGE
12. PCR

SUGGESTED READINGS:

1. Chaitanya. K.V. (2013). Cell and Molecular Biology, A Lab Manual. Prentice Hall India Learning PrivateLimited.
2. Vennison. S.J. (2009). Laboratory Manual for Genetic Engineering. Prentice Hall India Learning PrivateLimited.

Semester-V

18BTBT551 Separation of Bioactive compounds from plant material 1H-0C

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

End Semester Exam:3 Hours

Course Objective

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

Course Outcome

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

UNIT-I GENERAL CONCEPT OF NATURAL PRODUCTISOLATION

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

UNIT-I I LABORATORY- EXTRACTION AND ISOLATION OF CAFFEINE FROM TEA LEAVES

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

SUGGESTED READINGS:

1. Satyajit D. Sarker, Zahid Latif and Alexander I. Gray. (2005). Methods in biotechnology, Natural products isolation. Springer.
2. Corrado Tringali. (2011). Bioactive Compounds from Natural Sources. CRCpress.

3. Mayo. D.W., Pike. R.M. and Butcher. S.S. (1986). Microscale Organic Laboratory. John Wiley & Sons.
4. Hill.R.andBarbaro.J.(2005).ExperimentsinOrganicChemistry.3rd Edition,Contemporary Publishing Company.

Semester-VI

18BTBT601 **Mass Transfer Operations** **4H-4C**

Instruction Hours/week: L:3T:1P:0 **Marks:** Internal**:40**External**:60**Total**:100**

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT-I DIFFUSION AND MASSTRANSFER

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

UNIT-II GAS LIQUID OPERATIONS

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

UNIT-III VAPOUR LIQUID OPERATIONS

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE- THIELE & PONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

UNIT-IV EXTRACTION OPERATIONS

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leachingprinciples.

UNIT-V SOLID FLUIDOPERATIONS

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

SUGGESTED READINGS:

1. Trebal R.E. (2012). Mass-Transfer Operations. 3rd Edition, McGraw Hill Education (India) Edition.
2. Geankoplis.C.J.(2016).TransportprocessesandSepartionprocessprinciple.4thEdition, Prentice Hall.
3. Coulson. J.M. and Richardson J.F. (2012). Chemical Engineering Volume I & II. 6th Edition, Elsevier.

Semester-VI

18BTBT602 **Immunology** **4H-3C**

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

End Semester Exam:3Hours

Course objectives:

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

Course outcomes:

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

UNIT-I INTRODUCTION

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

UNIT-II CELLULAR RESPONSES

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

UNIT-III INFECTION ANDIMMUNITY

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

UNIT-IV TRANSPLANTATION AND TUMORIMMUNOLOGY

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

UNIT-V AUTOIMMUNITY

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

SUGGESTED READINGS:

1. Roitt I. Male and Brostoff. (2012). Immunology. 8th Edition. Mosbypublications.
2. Judy Owen, Jenni Punt and Sharon Stranford. (2013). Kuby Immunology. 7thEdition. W. H. Freeman.
3. David W. Mount. (2004). Bioinformatics: Sequence and Genome Analysis. 2nd Edition. Cold Spring Harbor Laboratory Press,U.S.
4. Chakravarty. A.K.. (2006). Immunology and Immunotechnology. 1st Edition. Oxford UniversityPress.

Semester-VI

18BTBT603 **Bioprocess Engineering** **4H-3C**

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

End Semester Exam:3Hours

Course Objectives

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

Course outcomes

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

UNIT-I ANALYSIS OF STR

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

UNIT-II ANALYSIS OF OTHERCONFIGURATIONS

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

UNIT-III BIOREACTOR SCALE – UP

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

UNIT-IV MODELLING AND SIMULATION OF BIOPROCESSES

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

UNIT-V BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS

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.

SUGGESTED READINGS:

1. Bailey J.E. and Ollis D.F. (2015). Biochemical Engineering Fundamentals. 2nd Edition. TataMcGraw-Hill.
2. Shuler and Kargi. (2017). Bioprocess Engineering Basic concepts. 2nd Edition.Pearson.
3. Pauline M. Doran. (2015). Bioprocess Engineering principles. 2nd Edition.Elsevier.
4. Blanch H.W. and Clark D.S. (2012). Biochemical Engineering. 2nd Edition. Marcel Dekker.
5. Stanbury P.F., Hall. S.J. and Whitaker. A. (2017). Principles of Fermentation technology.3rd Edition.Elsevier.

Semester-VI

18BTBT604 **Enzymology &Enzyme technology** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT-I INTRODUCTION TO ENZYMES

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

UNIT- II EXTRACTION, PURIFICATION AND CHARACTERIZATION OF ENZYMES

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

UNIT-III KINETICS OF MULTISUBSTRATE-ENZYME ACTION

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

UNIT- IV ENZYME IMMOBILIZATION

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

UNIT- V ENZYME ENGINEERING AND BIOSENSORS

Chemical and genetic methods, Property alteration, Prediction of enzyme structure, design and construction of novel enzymes; Enzyme Biosensor – Classification, Design, Application - industry, healthcare,food and environment.

SUGGESTED READINGS:

1. Palmer. T. (2007). Enzymes. Affiliated East West Press PvtLtd.
2. Wiseman. (1995). Enzyme Biotechnology. Ellis Horwood Publishers.
3. Chaplin and Bucke. (1990). Enzyme technology. Cambridge UniversityPress.
4. Price and Stevens. (2002). Fundamentals of Enzymology. Oxford UniversityPress.
5. Blanch. H.W. and Clark. D.S. (1996). Biochemical engineering. Marcel DekkerInc.
6. Bailey J.E. and Ollis D.F. (1986). Biochemical Engineering Fundamentals. McGrawHill.
7. Pye E.K. and Wingard L.B. (1974). Enzyme Engineering II. PlenumPress.

Semester-VI

18BTBT611 **Immunology Lab** **4H-2C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes:

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

LIST OF EXPERIMENTS

1. Handling of animals, immunization and raisingantisera
2. Identification of cells in a bloodsmear
3. Identification of blood group
4. Immunodiffusion
5. Immunoelectrophoresis
6. Testing for typhoid antigens by Widaltest
7. Enzyme Linked Immuno Sorbent Assay(ELISA)
8. Isolation of peripheral blood mononuclearcells
9. Identification of T cells by T-cell rossetting using sheepRBC.
10. Western blotting

Semester-VI

18BTBT612	**Bioprocess Lab**	**4H-2C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

LIST OF EXPERIMENTS

1. Thermal deathkinetics
2. Batch sterilizationdesign
3. Media designing using Plackett Burman andRSM
4. Batch cultivation
5. Estimation of k_La – dynamic gassingmethod
6. Estimation of k_La – sulphite oxidationmethod
7. Estimation of k_La – power correlationmethod
8. Residence timedistribution
9. Enzyme kinetics – Michaelis Mentenparameters.
10. Enzymeimmobilization.

SUGGESTED READINGS:

1. Lydersen. B.K. (2010). Bioprocess Engineering: Systems, Equipment and Facilities. Wiley India PvtLtd.
2. Shukla. A.N. (2013). Laboratory Bioprocess Technology. Discovery PublishingHouse.

Semester-VI

18BTBT651 **Technical Presentation & Seminar** **1H-0C**

Instruction Hours/week: L:0T:0P:1 **Marks:** Internal**:100** External**:0T**otal**:100**

End Semester Exam:3Hours

Course Objectives:

- To equip the students for effective technicalpresentation
- To improve body language and posture for effective publicspeaking.

Course Outcomes:

1. To get familiarize in the teaching presentationskills.
2. To gain confidence in the teachingprocess.

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

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

Semester-VII

18BTBT701 **Professional Ethics, Principles of Management and Entrepreneurship development** **3H-3C**

Instruction Hours/week: L:3T:1P:0 **Marks:** Internal**:40**External**:60**Total**:100**

End Semester Exam:3Hours

Course Objectives:

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

Course Outcomes:

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

UNITI ENGINEERINGETHICS

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

UNITII FACTORS OFCHANGES

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

UNITIII HISTORICAL DEVELOPMENT, PLANNING,ORGANISING

Definition of Management – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management –Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies,

Policies and Planning Premises– Forecasting – Decision–making – Formal and informal organization – OrganizationChart

UNITIV DIRECTING ANDCONTROLLING

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

UNITV ENTREPRENEURSHIP ANDMOTIVATION

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth– Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need,Objectives.

SUGGESTED READINGS

1. Harold Kooritz and Heinz Weihrich. (2010). Essentials of Management. Tata McGraw Hill, NewDelhi.
2. Khanka S.S. (2006). Entrepreneurial Development. S.Chand and Co. Ltd., NewDelhi.
3. Mike Martin and Roland Schinzinger. (2005). Ethics in Engineering. McGraw–Hill,NewYork.

Semester-VII

18BTBT702 **Downstream processing** **4H-4C**

Instruction Hours/week: L:3T:1P:0 **Marks:** Internal**:40**External**:60**Total**:100**

End Semester Exam:3Hours

Course Objectives:

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

Course Outcomes:

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

UNIT-I DOWNSTREAMPROCESSING

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

UNIT-II PHYSICAL METHODS OFSEPARATION

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

UNIT-III ISOLATION OFPRODUCTS

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

UNIT-IV PRODUCT PURIFICATION

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

UNIT-V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

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

SUGGESTED READINGS:

1. Belter P.A., Cussler E.L. and Wei-Houhu. (1988). Bioseparations - Downstream Processing For Biotechnology. Wiley Interscience Pub.
2. Jenkins R.O. (1992). Product Recovery In Bioprocess Technology - Biotechnology By Open Learning Series,Butterworth-Heineman.
3. Janson J.C. and Ryden L. (1989). Protein Purification - Principles, High Resolution Methods and Applications. VCH PubPress.
4. Roger G. Harrison, Paul Todd, Scott R. Rudge and Demetr P. Petrides. (2003). Bioseparation Science and Engineering, Oxford UniversityPress.

Semester-VII

18BTBT711 **Downstream processing lab** **4H-2C**

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

End Semester Exam:3Hours

Course Objectives

- To understand the concept of purification by different precipitation process.
- To demonstrate the various methods of extraction process.
- To perform the final product finishing operations.
- To perform the process of centrifugation for cell fractation
- To practice the fractionation of cells and dialysis process.
- To design and select the appropriate techniques for the purification of a bioproduct.

Course Outcomes

1. Perform the various methods of precipitation for the protein purification.
2. Practice and evaluate the extraction of various products from the given sample.
3. Demostrate the finishing operations such as crystallization and drying.
4. Execute the process of centrifugation for cell fractation.
5. Inspect the purification of diven sample through dialysis.
6. Design and develop appropriate techniques for the purification of given enzyme.

LIST OF EXPERIMENTS

1. Protein Purification by isoelectric pointprecipitation.
2. Ammonium Sulphateprecipitation.
3. Liquid–Liquid extraction.
4. Solid–Liquid extraction.
5. Crystallization.
6. Cell fractionation usingcentrifuge.
7. Drying of solid by heatsource.
8. Dialysis
9. Purification of á–Amylase from*Bacillus*

SUGGESTED READINGS:

1. Michael S. Verrall. (1996). Downstream Processing of Natural Products: A Practical Handbook, Wiley.

Semester-VII

18BTBT791	**Project Work PhaseI**	**6H-3C**

Instruction Hours/week: L:0T:0P:6 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3Hours

The students will be directed to do a project work which will be the Phase I if their main project work that will be performed in the eigth semester during. Their projects will be evaluated for forty percentages in Continuous Internal Assessment and sixty percentages in End Semester Examination.

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

Semester-VIII

18BTBT891 **Project Work PhaseII** **24H-12C**

Instruction Hours/week: L:0T:0P:24 **Marks:** Internal**:120** External**:180**Total**:300**

End Semester Exam:3Hours

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

End Semester Examination evaluation will be based on the report submitted and presentation of his/her work by the student to a panel of evaluators after the completion of the projectwork.

PROFESSIONAL ELECTIVES

SEMESTER V

B.Tech Biotechnology **2018-2019**

Semester- V

18BTBT5E01 **ENVIRONMENTAL BIOTECHNOLOGY** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- To explain basic knowledge on soil microbes and its characteristics.
- To demonstrate the effects of xenobiotic compounds.
- To discuss various methods for industrial waste water management.
- To explain the effects of various industrial wastes and to infer basic concepts for its management.
- To outline the natural and engineered bio-treatment methods to remediate the pollutants.
- To discuss the different environmental issues using biotechnology.

Course Outcomes

1. Summarize the characteristics of soil microbes and its interactions.
2. Evaluate the different xenobiotics present and methods to degrade them.
3. Describe the industrial waste management systems.
4. List the opportunities in waste treatment industries and its management.
5. Recognize natural and engineered biotreament methods to remediate pollutants.
6. Identify and list different environmental issues and its remedy.

UNIT I –INTRODUCTION

Microbial flora of soil, growth and ecological adaptations of soil microorganisms, interactions among soil microorganisms, biogeochemical role of soil microorganisms.

UNIT II –DEGRADATION OF XENOBIOTIC COMPOUNDS

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

UNIT III –INDUSTRIAL WASTE WATER MANAGEMENT

Wastewater characteristics – physical, chemical and biological, Biological processes - unit operations, aerobic treatment processes, activated sludge process–characteristics of activated sludge and process configuration, anaerobic treatment by methanogenesis

UNIT IV –TREATMENT OF INDUSTRIAL WASTE

Dairy, Paper & Pulp, Textile, leather, hospital and pharmaceutical industrial waste management, e-waste-radioactive and nuclear power waste management.

UNIT V –DEVELOPMENTS PERTAINING TO ENVIRONMENTAL BIOTECHNOLOGY

Solid waste management, Role of biosensors in Environmental monitoring, Heavy metal pollution and their control strategies, Prevention of environmental damage with respect to nitrogen fixation, Bioremediation, Production of bioelectricity from microbial fuel cell (MFC), Improvement of water quality by denitrification, Role of biotechnology on agricultural chemical use

SUGGESTED READINGS:

1. Rittmann. B. E. and Mccarty. L. P. (2001). Environmental Biotechnology: Principleand Applications. McGrawHill.
2. Mecalf and Eddy. (1991). Waste water engineering: Treatment Disposal Reuse. McGrawHill.
3. Connell.D.W. (2005). Basic concepts of Environmental chemistry. Lewispublishers.
4. Scragg. A. H. (2005). Environmental Biotechnology. Oxford Universitypress.
5. Prescott. M., Harley. J. P. and Klein. D. A. (2008). Microbiology. Boston. McGraw-Hill HigherEducation.

Semester-V

18BTBT5E02 **DEVELOPMENTAL BIOLOGY** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT I –INTRODUCTION

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

UNIT II– GERM CELLS AND PATTERNING THE VERTEBRATE BODY PLAN

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

UNIT III– DEVELOPMENT OF VERTEBRATES

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

UNIT IV– MORPHOGENESIS AND ORGANOGENESIS

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

UNIT V– EMBRYOGENESIS

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

SUGGESTED READINGS:

1. Gilbert. S. F. (2013). Developmental Biology. SinauerAssociates.
2. Arumugam. A. (1995). Developmental Biology. Saras Publications.

Semester-V

18BTBT5E03 **BIOORGANIC CHEMISTRY** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

- To explain the various properties and concepts in stereochemistry.
- To classify the steady state kinetics.
- To understand the basic notion on stereochemistry on enzyme reaction.
- To differentiate and organize the distinct enzyme structure and mechanism.
- To explain the basic theory of protein folding.
- To understand the problems related to reactions involving enzymes.

Course Outcomes

1. Compare and contrast different properties of organic chemistry.
2. Synthesize the different kinetics involved.
3. Prioritize diverse properties of stereochemistry on enzyme reaction.
4. Construct and design the enzyme structure and mechanism.
5. Apply the knowledge on protein folding.
6. Examine and solve the problems related to reactions involving enzymes.

UNIT-I CONCEPTS IN ORGANICCHEMISTRY

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

UNIT-II ENZYME KINETICS AND INHIBITION

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

UNIT-III STEREOCHEMISTRY OF ENZYMATICREACTIONS

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

UNIT-IV ENZYME STRUCTURE ANDMECHANISM

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

UNT-V PROTEIN FOLDING KINETICS AND FOLDINGPATHWAYS

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

SUGGESTED READINGS:

1. Fersht A. R. (1999). Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding. W HFreeman.
2. Morrison R. T. and Boyd R. N. (1999). Organic Chemistry. Prentice hall of India Pvt.Ltd.
3. Eliel. E. L. and Samuel H. W. (1994). Stereochemistry of Organic compounds.Wiley.

Semester-V

18BTBT5E04 **BIOMASS ENERGY** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT I– OVERVIEW OF ENERGY USE

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

UNIT II– BIOMASS AND BIO-ENERGY

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

UNIT III– PROPERTIES OF FUELS

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

UNIT IV– AGRICULTURAL BIOMASS

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

UNIT V– DOWNSTREAM PROCESSING

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

SUGGESTED READINGS:

1. Stout. B.A. (1985). Biomass energy Texas University Press, CollegeStation.
2. Chahal. D. S. (1992). Food, Feed and Fuel from Biomass. South AsiaBooks.
3. Chakraverty. A. (1993). Biotechnology and other alternate technologies for utilisation of biomass. Oxford & IBH PublishingCo.
4. Klass. D. L. and George. E. H. (1982). Fuels from Biomass and wastes. Technomic Publishing Company.
5. Chavla. O. P. (1986). Advances in Biogas Technology. ICARPub.

Semester-V

18BTBT5E05 **MOLECULAR PATHOGENESIS** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

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

UNIT I–HOST-MICROBE INTERACTIONS

Normal Flora-Protective role-dyanamic nature, Principles of Infectious diseases-pathogenicity-pathogen types and modes of entry, causes of infectious disease- Koch's postulates molecular postulates-mechanisms of pathogenesis. Epidemiology - principles.

UNIT II– HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES

Defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms.

UNIT III– MOLECULAR PATHOGENESIS

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

UNIT IV– EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS

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

UNIT V– MODERN APPROACHES TO CONTROL PATHOGENS

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

SUGGESTED READINGS:

1. Groisman. E. A. (2001). Principles of Bacterial Pathogenesis. AcademicPress.
2. Tizard. I. R. (2005). Immunology: An introduction. CengageLearning.
3. Williams. P., Ketley. J. and Salmond. G. (1998). Methods in Microbiology: Bacterial Pathogenesis. Academic Press.
4. Wilson. B. A. and Salyers. A. A. (2011). Bacterial Pathogenesis – A molecular Approach. ASM PressWashington.
5. Anderson.D.G., Salm.S.and Allen.D.(2018).Microbiology:AHumanPerspective,9th Edition.McGraw Hill.

Semester-V

18BTBT5E06 HUMAN ANATOMYAND PHYSIOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To understand the basic knowledge on cell structure and function.
- To explain the different parts and functions of cardiac and nervous system.
- To explain the various functions of respiratory and musculo skeletal systems.
- To discuss about the organization of GI systems.
- To describe the anatomy and physiology of eye, ear and endocrine system.
- To discuss the problems in human system and can give solutions for its extension.

Course Outcomes

1. Summarize the basics of cell structure andfunction.
2. Locate different parts and functions of cardiac and nervous system.
3. Explain the various functions of respiratory and musculo skeletal system problems.
4. Predict the different solutions for various problems in GI systems.
5. Rrelate the various issues of eye, ear and endocrine system.
6. Measure and judge the problems in human system and can give solutions for its extension.

UNIT-I CELL

Structure of Cell – Organelles and description – Function of each component of the cell – Membrane potential – Action Potential – Generation and Conduction – Electrical Stimulation.Blood Cell – Composition – Origin of RBC – Blood Groups – Estimation of RBC, WBC and Platelet.

UNIT-II CARDIAC AND NERVOUS SYSTEM

Heart, Major blood vessels – Cardiac Cycle – ECG – Blood Pressure – Feedback Control for Blood Pressure – Nervous Control of Heart - Cardiac output – Coronary and Peripheral Circulation – Structure and function of Nervous tissue – Neuron - Synapse - Reflexes -Receptors -Brain - Brainstem -Spinal cord – Reflex action – Velocity of Conduction of Nerve Impulses - Electro Encephalograph – Autonomic NervousSystem.

UNIT-III RESPIRATORY SYSTEM AND MUSCULO SKELETAL SYSTEM

Physiological aspects of respiration – Trachea and lungs - Exchange of gases – Regulation of Respiration - Disturbance of respiration function - Pulmonary function test - Muscles - tissue - types - structure of skeletal muscle - types of muscle andjoints.

UNIT-IV DIGESTIVE AND EXCRETORY SYSTEM

Organisation of GI System, Digestion and absorption – Movements of GI tract – Intestine - Liver - Pancreas - Structure of Nephron – Mechanism of Urine formation – Urine Reflex – Skin and Sweat Gland – Temperatureregulation.

UNIT-V EYE, EAR, ENDOCRINE GLANDS

Optics of Eye – Retina – Photochemistry of Vision – Accommodation - Neurophysiology of vision – EOG. Physiology of internal ear – Mechanism of Hearing – Auditory Pathway, Hearing Tests - Endocrineglands.

SUGGESTED READINGS:

1. Subramanyam. S., Madhavan Kutty. K. and Singh. H. D. (2010) Text Book of 'Human Physiology. S.Chand &Company.
2. Ranganathan. T. S. (2000). Text Book of Human Anatomy. 5th edition. S. Chand & Co.Ltd., Delhi
3. Tobin. C. E. (1997). Basic Human Anatomy. McGraw-Hill Publishing Co.Ltd.
4. Gibson. J. (1981). Modern Physiology and Anatomy for Nurses. Blackwell SCPublishing
5. Guyton. A. C. and Hall. J. E. (2010). Textbook of Medical Physiology, 12th edition, W.B. SaundersCompany.

SEMESTER VI

B.Tech Biotechnology **2018-2019**

Semester-VI
3H-3C

18BTBT6E01 RECOMBINANT ENZYME AND THERAPEUTIC AGENTS PRODUCTION

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

COURSE OBJECTIVES:

- To explain the concepts involved in biopharmaceutical industries.
- To illustrate the functions of DNA, RNA and protein synthesis in enzyme production.
- To organize the need for enzyme production and types of enzymes.
- To outline the importance of recombinant enzymes or proteins in therapeutics.
- To explain how monoclonal antibodies plays a major role in research.
- To discuss the production and purification of enzymes and metabolites at an industrial scale.

COURSE OUTCOMES:

1. List basics about pharma industrial processes.
2. Examine about DNA, RNA and protein synthesis.
3. Explain the clone methods of commercially important genes.
4. Discuss the commercially important recombinant proteins.
5. Conceptualize on enzyme and enzyme reactions will be the key step in to proceed towards various concepts in biotechnology.
6. Express views on Processing, Production and Purification of enzymes and metabolites at an industrial scale will be helpful to work technologically.

UNITI INTRODUCTION TO BIOPHARMACEUTICALINDUSTRIES

Major top ten Biotech industries in India and their products.State-of the art facilities available in these industries.Guidelines and basic principles of current good manufacturing practices.

UNITII PRODUCTION SYSTEMS

Microbial systems, cell line culture systems, plant, animal systems – parameters, regulations

UNIT III PRODUCTION OF ENZYMES AND METABOLITES

Production of Proteases, Cellulas, Lipase, Amylase, Glucose isomerase, Pectinase, Peroxidase
Production of primary metabolites– organic acids (Citric acid, Lactic acid), aminoacids (Glutamic

acid, Lysine),alcohols (ethanol, butanol). Production of secondary metabolites – amino acids (Glutamic acid, Lysine), antibiotics (Penicillin, streptomycin), Vitamins (Vitamin B_{12},Riboflavin).

UNIT IV RECOMBINANT PROTEIN THERAPEUTICS

Function and their applications: Insulin, Interferon alpha, Interferon gamma, Interleukin-2, Gm-CSF, G-CSF, Hepatitis B vaccine,Erythropoietin, Strptokinase, EGF, Chymotrypsin, Modification of proteins to increase their life.Monoclonal antibodies as therapeutics: antibodies, hybridoma technology, FDA approvedtherapeutic antibodies, humanization. Methods for production ofvaccines.

UNIT V APPLICATION OF ENZYMES

Enzymes in organic synthesis – Enzymes as biosensors – Enzymes for food, pharmaceutical, tannery, textile, paper and pulp industries – Enzyme for environmental applications- Enzymes for analytical and diagnostic applications – Enzymes for molecular biologyresearch.

SUGGESTED READINGS:

1. Brown. T. A. (2010). Gene cloning and DNA analysis: An introduction. 6th Edition. Wiley Blackwell.
2. Winnacker. E. L. (2006). Frome Genes to Clones: Introduction to Gene Technology. Wiley Blackwell.
3. Copeland. R. A. (2012). Enzymes- A Practical Introduction to Structure, Mechanism and data analyses. 2nd Edition.Wiley–VCH.
4. Palmer. T. and Bonner. P. (2007). Enzymes Biochemistry, Biotechnology, Clinical chemistry-2nd edition. WoodHeadPublishing.

Semester- VI

18BTBT6E02 BIOLOGICAL WASTEWATER TREATMENT 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To understand the variations of stoichiometry and kinetics of biochemical operations.
- To classify the different activities of microbes in waste water treatment.
- To record the basic notion on design and evaluation of growth process.
- To differentiate and organize the distint methods for modeling reactors..
- To explain the basic applications of bioreactors.
- To discuss the problems related to biochemical operations in different industries.

Course Outcomes

1. Compare and contrast fundamentals and properties of biochemical operations.
2. Demonstrate various waste water treatment activities through biological methods.
3. Prioritize design and evaluation of growth process in bioreactors.
4. Construct and design the methods for modeling bioreactors.
5. Apply the knowledge on applications of modeling bioreactors.
6. Examine and solve the problems related to biochemical operations in different industries.

UNITI BIOCHEMICAL OPERATIONS

Classification of Biochemical operations, fundamentals of biochemical operations, Stoichiometry and Kinetics of Biochemical Operations.

UNIT II REACTORS IN WASTE WATER TREATMENT

Theory, modeling of ideal suspended Growth Reactors, Modeling Suspended Growth Systems. Aerobic Growth of Heterotrophs in a single Continuous Stirred Tank, Reactor Receiving Soluble Substrate, Multiple Microbial Activities in a Single Continuous Stirred Tank Reactor, Multiple Microbial Activities in Complex Systems, Techniques for Evaluating Kinetics and Stoichiometric parameters.

UNIT III PROCESSES IN WASTE WATER TREATMENT

Applications: Suspended Growth Reactors, Design and Evaluation of Suspended Growth Processes, Activated Sludge, Biological Nutrient Removal, Aerobic – digestion, Anaerobic Processes,Lagoons.

UNIT IV MODELING OF REACTORS

Theory: Modeling of Ideal Attached Growth Reactors, Bio- film Modeling. Aerobic Growth of Biomass in Packed Towers, Aerobic Growth of Heterotrophs in Rotating Disc Reactors, Fluidized Bed Biological Reactors.

UNIT V APPLICATIONS OF BIOREACTORS

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

SUGGESTED READINGS:

1. Henze. M. (2008). Biological Wastewater Treatment: Principles, Modelling and Design. IWA Publishing
2. Graty. C. P. L., Daigger. G. T. and Lim H. C. (2011). Biological Wastewater Treatment. CRC Press.
3. Mizahi. A. (1989). Biological Waste Treatment. John Wiley SonsInc

Semester-VI

18BTBT6E03 FOOD BIOTECHNOLOGY 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- To explain the variations of requirements and directives of GMP.
- To classify the key personnel for GMP.
- To record the basic notion on production area.
- To differentiate and organize the distint documentation types and its manufacturing.
- To discuss the basic theory of Quality Control and various testing methods.
- To analyse the problems related to manufacturing flaws.

Course Outcomes

1. Compare and contrast requirements for GMP.
2. Summarize the upgraded personnel for maintain GMP.
3. Prioritize diverse properties production area and equipment.
4. Construct and design the correct documentation.
5. Apply the knowledge on quality control department.
6. Examine and solve the problems related to manufacturing flaws.

UNITI FOOD AND ENERGY

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

UNIT II FOOD MICROBIOLOGY

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

UNITIII FERMENTATIONPRODUCTS

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

UNIT IV FOOD ADDITIVES

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

UNITV FOOD PROCESSING & PRESERVATION

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

SUGGESTED READINGS:

1. Jay. J. M., Loessner. M. J. and Golden. D. A. (2005). Modern Food Microbiology. Springer Science & Business Media.
2. Frazier. W. C. (2017). Food Microbiology. Tata MC Graw hill.
3. Belitz. H. D., Grosch. W. and Schieberle. P. (2009). Food Chemistry. Springer Science & BusinessMedi
4. Sivashankar. B. (2002). Food processing and preservation. Prentice – Hall of India Pvt.Ltd. NewDelhi.

Semester-VI

18BTBT6E04 GOOD MANUFACTURING PRACTICE 3H-3C

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

Course Objectives

- To explain the variations of requirements and directives of GMP.
- To classify the key personnel for GMP.
- To record the basic notion on production area.
- To differentiate and organize the distint documentation types and its manufacturing.
- To discuss the basic theory of Quality Control and various testing methods.
- To analyse the problems related to manufacturing flaws.

Course Outcomes

1. Compare and contrast requirements for GMP.
2. Summarize the upgraded personnel for maintain GMP.
3. Prioritize diverse properties production area and equipment.
4. Construct and design the correct documentation.
5. Apply the knowledge on quality control department.
6. Examine and solve the problems related to manufacturing flaws.

UNIT I– INTRODUCTION

Basic requirements of good manufacturing products, importance of GMP, directives of GMP, principle and overview of the pharmaceutical quality system, principles and approaches in medical devices, principle and approaches in human cell tissue products, principle and approaches in biological products.

UNIT II– PERSONNEL

Key personnel, background and duties of the qualified person, duties of the head of the production department, duties of the head of quality department, person releasing the batch, consultants, personnel training and hygiene.

UNIT III– PREMISES AND EQUIPMENT

Premises, production area, storage area, quality control areas, ancillary areas, equipment.

UNIT IV– DOCUMENTATION

Generation and control of documents, types of documents and specifications, manufacturing formula and processing instruction, packaging instructions, procedures and records.

UNIT V– PRODUCTION AND QUALITY CONTROL

General principles, prevention of cross contamination in production, guidelines for starting materials, processing operations, packaging materials and operations, guidelines for finished products, Quality control – principles, main tasks of QC department, technical transfer of testing methods, transfer protocol.

SUGGESTED READINGS:

1. Oechslein. C., Maas and Peither. (2015). GMP Fundamentals – A Step-by-Step Guide for Good Manufacturing Practice. 1st edition. AG GMPPublishing.
2. Bunn. G. P. (2018). Good Manufacturing Practices for Pharmaceuticals. Seventh Edition. CRC Press.
3. Tobin. E. (2015). A Guide to Good Manufacturing Practices (GMP). 1st edition.Validation resources.org.

Semester-VI

18BTBT6E05 NANOBIOTECHNOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To explain basic knowledge on nanotechnology.
- To demonstrate the structural and functional principles of bionanotechnology.
- To discuss various methods for microfluidic components.
- To explain the effects of various protein and DNA based nanostructures.
- To outline the basic concepts of nanoparticles in cancer therapy.
- To identify the different nanoparticles using different controlling measures.

Course Outcomes

1. Summarize the characteristics different nanoparticles.
2. Evaluate the different structural and functional principles of biotechnology.
3. Explain the microfluidic devices.
4. Discuss the protein and DNA based nanostructures.
5. Recognize cancer curingnanoparticles.
6. Identify and list different nanoparticles for different controlling measures.

UNIT-I INTRODUCTION TONANOTECHNOLOGY

Background and definition of nanotechnology, chemical bonds in nanotechnology – Scales at the bio-nano interface – Basic capabilities of nanobiotechnology and nanomedicine – Biological tradition and mechanical tradition biotechnology – Applications of Nanotechnology in biotechnology.

UNIT-II STRUCTURAL AND FUNCTIONAL PRINCIPLES OF BIONANOTECHNOLOGY

Biomolecular structure and stability – Protein folding – Self-assembly – Self-organization – Molecular recognition – Information driven nanoassembly – Energetics –Chemical transformation – Biomaterials – Biomolecular motors – Traffic across membranes – Biomolecular sensing – Self-replication – Machine-phasebionanotechnology.

UNIT-III MICROFLUIDICS

Concepts and advantages of microfluidic devices – Materials and methods for the manufacture of microfluidic component – Fluidic structures – Surface modifications – Lab-on-a-chip for biochemical analysis

UNIT-IV PROTEIN AND DNA BASEDNANOSTRUCTURES

S-Layers – Engineered nanopores – Microbial nanoparticle production – DNA-Protein nanostructures – Biomimetic fabrication of DNA based metallic nanowires and networks –DNA-Gold nanoparticle conjugates – Nanoparticles as non-viral transfectionagents

UNIT-V NANOPARTICLES IN CANCERTHERAPY

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

SUGGESTED READINGS:

1. Niemeyer. C. M. and Mirkin. C. (2004). A Nanobiotechnology: Concepts, Applications and Perspectives.Wiley-VCH.
2. Goodsell. D.S. (2004). Bionanotechnology. John Wiley and Sons,Inc
3. Shoseyov. O. and Levy. I. (2007). Nanobiotechnology: Bioinspired Devices and Materials of the future. HumanPress
4. Bhushan. B. (2004). Springer Handbook of Nanotechnology. Springer-Verlag Berlin Heidelberg.
5. Freitas. R. A. (2004). Nanomedicine. LandesBiosciences.
6. Kohler. M. and Fritzsche. W. (2004). Nanotechnology-An Introduction to Nanostructuring Techniques. WileyVCH.

Semester- VI

18BTBT6E06 IPR AND ETHICAL ISSSUES IN BIOTECHNOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNITI BIOSAFETY

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

UNITII INTELLECTUAL PROPERTY RIGHTS

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

UNITIII IPR –POLICIES

International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities -History - General Agreement on Trade and Tariff (GATT). Indian Position Vs WTO

and Strategies - Indian IPR legislations - commitments to WTO-Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.

UNITIV CASE STUDIES

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

UNITV IPR ISSUES &BIOETHICS

Trade Secrets, Copy Rights, Farmer's Rights, Plant Breeder's rights; Traditional knowledge and their commercial exploitation and protection. Bioethics – Disease prevention Vs right to privacy,

SUGGESTED READINGS:

1. Heywood. V. H. and Watson. R.T. (1996). Global Biodiversity Assessment. Cambridge UniversityPress.
2. Brody. B. A. and Engelhardt. H. T. (2007). Bioethics: Readings and Cases. Prentice John-Wiley andSons.
3. Joshi. R. (2006). Biosafety and Bioethics. Isha Books, NewDelhi
4. Subbaram. N. R. (1998). Handbook of Indian Patent Law and Practice. S. Viswanathan Printers and PublishersPvt.Ltd.
5. Singh. K. (2015). Intellectual property rights on Biotechnology. BCIL.
6. Sasson. A. (1988). Biotechnologies and Development. UNESCO Publications,

Semester-VI

18BTBT6E07 PHYTOCHEMICALS AND HERBAL MEDICINE 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To illustrate the scope and importance of crude drugs.
- To understand the basic ideas on cultivation and utilization of medicinal and aromatic plants.
- To list the various functions of plant tissue culture as asource.
- To label the basic theory of methods of drug evaluation.
- To develop a picture about applications of phytochemicals in industry and healthcare.
- To discuss the different stages of developments in using phytochemicals and medicinal plants.

Course Outcomes

1. Summarize about the importance of crude drugs in different medicinal system.
2. Determine the modern cultivation techniques through plants.
3. Express the functions of plant tissue culturing.
4. Be aware of the conceptuation behind various methods for drug evaluation.
5. Describe the various functions and application of phytochemicals in different industries.
6. Summarize and predict the different stages of developments in using phytochemicals and medicinal plants.

UNIT-I CRUDEDRUGS

Crude Drugs – Scope & Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection & processing of Crude Drugs. Indian System of medicine: Ayurveda, Siddha and Unani and its significance

UNIT-II MEDICINAL & AROMATIC PLANTS

Cultivation and Utilization of Medicinal & Aromatic Plants in India. Genetics as applied to Medicinal herbs. Modern Biotechnological tools and its influence in Medical and Aromatic plant cultivation.

UNIT-III TISSUE CULTURE OF MEDICINALPLANTS

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

UNIT-IV ANALYSIS OFPHYTOCHEMICALS

Methods of Drug evaluation (Morphological, Microscopic, Physical & Chemical).Preliminary screening, Assay of Drugs – Biological evaluation / assays, Microbiological methods. Types of

Phytochemicals: Glycosides - extraction methods (Aloe); Volatile Oils - extraction methods (Clove); Alkaloids - extraction methods (Cinchona); Flavonoids extraction methods, Resins- extraction methods; Lectins.

UNT-V APPLICATIONS OFPHYTOCHEMICALS

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

SUGGESTED READINGS:

1. Kokate. C. K., Purohit. A. P. and Gokhale. S. B. (1996). Pharmacognosy. NiraliPrakasan.
2. Dewick. P. M. (2009). Natural Products in medicine: A Biosynthetic approach.Wiley.
3. Hornok. L. (1992). Cultivation & Processing of Medicinal Plants. Wiley &Sons.
4. Trease and Evans. (1989). Pharmacognosy. Harcourt Brace & Company.

Semester-VI

18BTBT6E08 PROGRAMMING IN BIOINFORMATICS 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- To explain about the object oriented and procedural programming.
- To predict about the multi-thread programming in Java.
- To interpret knowledge on java applets and database connection.
- To demonstrate a sound knowledge on scripting in python.
- To describe about a brief knowledge on python classes.
- To understand the concept of biopython.

Course Outcomes

1. Predict the object oriented and procedural programming.
2. List exposure on multi-thread programming in java.
3. Judge usefulness on java applets and database connection.
4. Develop and manage the python scripting.
5. Organize practicing skills in python classes.
6. Develop knowledge in biopython.

UNIT I INTRODUCTION TO JAVA

Introduction to Object Oriented Programming and Procedural Programming, Java, JAVA - Keywords, Constants, Variables, Operators, Expressions, Decision Making, Branching and Looping, Classes – Objects – Methods, Arrays, Strings and Vectors.

UNIT II MULTI-THREAD PROGRAMMING

Java Interfaces - Multiple Inheritance, Packages, Multithreading , Exception handling – Event handling, Managing Inputs/Output Files in Java

UNIT III JAVA APPLETS AND DATABASE CONNECTION

Graphics - Applet basics – passing parameters to applets – applet display methods – drawing lines, ovals, rectangles and polygons – Threads and Animation, Java and Database connection

UNIT IV INTRODUCTION TO PYTHON

Introduction to Python Expressions, tuples, lists, dictionaries, and sets, Functions - Modules – Files, Control Statements-Loops-Iterations, Pattern Matching- Fixed length and Variable length matching

UNIT V PYTHON CLASSES AND BIOPYTHON

Python Classes-Objects-Methods, Inheritance, Biopython – Introduction- Biopython Components – Alphabet, Seq, MutableSeq, SeqRecord, Align, ClustalW, SeqIO, AlignIO, Blast, PDB

SUGGESTED READINGS:

1. Schildt. H. (2012). Java: The completer Reference.TMH.
2. Balagurusamy. E. (2012). Programming with Java: A Primer. Tata McGraw-Hill Education.
3. Model. M. L. (2009). Bioinformatics Programming Using Python- Practical Programming for Biological Data. O'ReillyMedia
4. Bassi. S. (2009). Python for Bioinformatics. CRCPress.
5. Zelle. J. (2010). Python Programming: An Introduction to Computer Science. Franklin Beddle and AssociatesInc.

Semester- VI

18BTBT6E09 INDUSTRIAL SAFETY AND HAZARDS MANAGEMENT 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

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

UNIT I FIRE AND EXPLOSION

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

UNIT II RELIEF SYSTEMS

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

UNIT III TOXICOLOGY

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

UNIT IV LEAKS AND LEAKAGES

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

UNIT V CASE STUDIES

Flixborough, Bhopal, Texas, ONGC offshore, HPCLVizagand Jaipur IOC oil-storagedepot incident; Oil, natural gas, chlorine and ammonia storage and transportationhazards.

SUGGESTED READINGS:

1. Crowl. D. A. and Louvar. J. F. (2011). Chemical Process Safety Fundamentals with Applications. PrenticeHall.
2. Mannan. S. (2005). Lee's Loss Prevention in the Process Industries. Butterworth-Heinemann.

Semester-VI

18BTBT6E10 PLANT BIOTECHNOLOGY 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

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

UNIT-I ORGANIZATION OF GENETICMATERIAL

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

UNIT-II CHLOROPLAST &MITOCHONDRIA

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

UNIT-III NITROGENFIXATION

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

UNIT-IV AGROBACTERIUM & VIRALVECTORS

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

UNT-V APPLICATION OF PLANTBIOTECHNOLOGY

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

SUGGESTED READINGS:

1. Gamburg. O. L. and Philips. G. C. (1995). Plant Tissue & Organ Culture fundamentalMethods. NarosaPublications.
2. Singh. B. D. (1998). Text book of biotechnology. Kalyanipublishers.
3. Heldt. H. W. (1997). Plant Biochemistry & Molecular Biology. Oxford UniversityPress.
4. Ignacimuthu. S. (1996). Applied Plant Biotechnology. Tata McGraw HillPublishers.

Semester-VI

18BTBT6E11 INTRODUCTION TO DATA ANALYTICS 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To explain descriptive statistics and ANOVA
- To illustrate Differentiating algorithm and regression analysis
- To descriminate various validation approaches to data.
- To evaluate various data by regression methods.
- To interpret clustering and mining techniques.
- To create data for analytics by various methods.

Course Outcomes

1. Elaborate the concept of Data analytics.
2. Learn Statistics and evaluate ANOVA.
3. Explain the Machine learning and various validation approaches.
4. Discuss the various regression methods and classification
5. Identify basic views in clustering and mining techniques.
6. Make up perspective analytics and create data analytics through various approaches.

UNIT IINTRODUCTION

Descriptive Statistics, Probability Distributions, Inferential Statistics through hypothesis tests, Regression, ANOVA (Analysis of Variance)

UNIT II MACHINE LEARNING: INTRODUCTION AND CONCEPTS

Differentiating algorithmic and model based frameworks, Regression : Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification

UNIT III SUPERVISED LEARNING WITH REGRESSION AND CLASSIFICATION

Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees Support VectorMachines.

UNIT IV UNSUPERVISED LEARNING AND CHALLENGES FOR BIG DATA ANALYTICS

Clustering, Associative Rule Mining, Challenges for big data anlalytics

UNIT V PRESCRIPTIVE ANALYTICS

Creating data for analytics through designed experiments, Active learning, Reinforcement learning

SUGGESTED READINGS:

1. Hastie. T., Tibshirani. R. and Friedman. J. (2008). The Elements of Statistical Learning Data Mining, Inference, and Prediction. 2nd Edition.Springer.
2. James. G., Witten. D., Hastie. T. and Tibshirani. R. (2013). An Introduction to Statistical Learning with Applications in R.Springer.
3. Montgomery. D. C. and Runger. G.C. (2003). Applied Statistics and Probability for Engineers. 6th Edition. John Wiley & Sons,Inc.

Semester- VI

18BTBT6E12 ENTREPRENEURSHIP IN BIOTECHNOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNITI OVERVIEW OF BIOTECHNOLOGYINDUSTRIES

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

UNITII NEW VENTURE CREATION –ENTREPRENEURSHIP

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

UNITIII PRODUCT DEVELOPMENT

Beer, wine and ethanol production using different sources– Enzyme: production, purification and characterization - Organic acids (Citric, lactic) production - Antibiotic production - Biogastechnology

- Azolla cultivation - Product development and project management, transition from R&D to business units. Institute– industry interaction and partnership/ alliances

UNITIV BIOBUSINESS PLANS

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

UNITV INTELLECTUAL PROPERTY, BIOETHICS AND LEGALISSUES

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

SUGGESTED READINGS:

1. Oliver. R. (1999). The coming Biotech age: The business of Biomaterials. McGraw Hill PublicationsNewyork.
2. Karthikeyan. S. and Ruf. A. (2009). Biobusiness. MJP Publications Chennai, India.

SEMESTER VII

B.Tech Biotechnology **2018-2019**

Semester-VII

18BTBT7E01 **PROTEIN ENGINEERING** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

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

UNIT- I BASIC STRUCTURAL PRINCIPLES OF PROTEINS

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

UNIT- II TECHNIQUES OF MUTAGENESIS

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

UNIT- III ENGINEERING ENZYMES

Engineering stability (*Bacillus subtilis*netural protease, Pseudomonas isoamylase, carbamylase from Agrobacterium radiobacter), specificity and features to ease protein purification, Engineering

antibodies- Engineering signal molecules (hormones/ receptors), Engineering protein to facilitate recovery. Affinity purification(Strep-Tag).

UNIT- IV METAGENOMICS

Metegenomics and ecosystems Biology- conceptual framework, tools and methods- Analyses of metagenomics, Single gene approach, Targeted partial metagenome sequencing, Analyses of metatranscriptome- Limitation in anlaysing the metatranscriptome- 17s rRNa sequencing and metatranscriptomepyrosequencing, metaproteome-molecular methods to study complex microbial communities, metabolomics- metabolome of an ecosystem and metagenomics. Metabolomics for natural product perception

UNIT-V PROTEIN ENGINEERING ININDUSTRIES

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

SUGGESTED READINGS:

1. Alberghina. L. (2005). Protien Engineering in Industrial Biotechnology. Harwood Academic publications.
2. Moody. P. C. E. and Wilkinson. A. J. (1990). Protein Engineering. IRL Press,Oxford.
3. Nelson. K. E. (2010). Metagenomics of Human Body. Springer.
4. Creighton. T. E. (2013). Proteins, Structure and Molecular properties. Freeman W. H & Company.
5. Branden. C. and Tooze. J. (1999). Introduction to Protein Structure. GarlandPublications

Semester-VII

18BTBT7E02 RECOMBINANT DNA TECHNOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To present basic knowledge about the various cloning vectors and its features.
- To demonstrate the various techniques and enzymes involved in cloning.
- To explain and practice diverse concepts on expression vectors for cloning.
- To practice the basic views on preparation of genomic and cDNA library.
- To identify and organize differeing views on applications of gene cloning in rDNA research.
- To compile the basic concepts of rDNA technology.

Course outcomes

1. Compose about basic concepts about the features of cloning vectors.
2. Assemble different techniques and enzymes involved in cloning.
3. Classify about expression vectors for cloning.
4. List the techniques in preparation of genomic and cDNA library.
5. Propose knowledge on applications for rDNA research.
6. Summarize concepts of rDNA technology.

UNITI CLONINGVECTORS

Ideal features of cloning vectors – plasmids and bacteriophages – cloning vectors for E.coli ; pBR322, pUC vectors, M13 and other plasmid vectors – Cosmids, Phagemids – vectors for Bacillus, Streptomyces Restriction mapping andanalysis

UNITII ENZYMES AND TECHNIQUES FOR CLONING

DNA modifying enzymes – ligases – Nucleic acid probe preparation; Radioactive and nonradioactive labels – Hybridization techniques – PCR; different types and applications – DNA sequencing – DNA fingerprinting – RFLP, RAPD – chromosome walking.

UNITIII EXPRESSION VECTORS

Expression vectors in prokaryotes – Expression vectors in Eukaryotes-Yeast cloning vectors – selectable markers for eukaryotes – SV40, Papilloma, Retrovirus, Baculoviral vectors – mammalian cell expression system – Gene transfer techniques – Agrobacterial plasmids – Ti plasmid and viral vectors – cloning in plants.

UNITIV GENOMIC AND cDNALIBRARY

Different strategies for in vitro and in vivo cloning – Preparation of rDNA, Preparation of cDNA and genomic DNA libraries – screening procedures – linkers, adapters, homopolymer tailing and TA cloning – gene transfer technologies – Mutagenesis – site directed mutagenesis –application.

UNITV APPLICATION OF GENECLONING

Fusion protein- down-stream processing of recombinant proteinsApplications in medicine – Gene therapy- Diagnostics, pathogenesis, recombinant vaccines –humanized antibodies and their applications genetically modified food – bioremediation with recombinant micro organisms– forensic science – genetic diversity – Agriculture, crop improvement – production of biosensors, enzymes – safety guidelines in rDNA research – containment and disposal.

SUGGESTED READINGS:

1. Dale. J. W., Schantz. M. V. and Plant. N. (2011). From Genes to Genomes: Concepts and Applications of DNA Technology. Wiley- Blackwell.
2. Primrose. S. B. and Twyman. R. (2016). Principles of Gene Manipulation and Genomics. Wiley
3. Green. M. R. and Sambrook. J. (2012). Molecular Cloning: A Laboratory Manual. Cold Spring HarborPress.
4. Brown. T. A. (2016). Gene Cloning and DNA Analysis: An Introduction.Blackwell
5. Krebs. J. E., Goldstein. E. S. and Kilpatrick. S. T. (2017). Lewin's GENES XI. Jones & BartlettLearning.

Semester-VII

18BTBT7E03 **MOLECULAR DIAGNOSTICS** **3H-3C**

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

Course Objectives

- To discuss about the history of molecular diagnostics.
- To model the traditional disease diagnosis methods.
- To record the basic notion on disorders and its origin.
- To explain the instrumentation on molecular diagnosis.
- To elaborate the hybridization techniques in diagnosis.
- To determine the exact method for different molecular diagnostics.

Course Outcomes

1. Appraise the process and origin of molecular diagnosis.
2. Formulate and compose diverse traditional disease diagnosis methods.
3. Prioritize diverse disorders and its origin.
4. Analyze and choose the instrumentation for molecular diagnostics.
5. Apply the hybridization techniques for diagnostics.
6. Deduct and determine the exact method for different molecular diagnostics.

UNIT I– INTRODUCTION AND HISTORY OF DIAGNOSTICS

Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites. Philosophy and general approach to clinical specimens, Sample collectionmethod of collection, transport and processing of samples, Interpretation of results, Normal microbial flora of the human body, Host - Parasite relationships.

UNIT II– TRADITIONAL DISEASE DIAGNOSIS METHODS AND TOOLS:

Diagnosis of infection caused by Streptococcus, Coliforms, Salmonella, Shigella, Vibrio, and Mycobacterium., Diagnosis of fungal infections. Major fungal diseases: Dermetophytoses, Candidiosis and Aspergillosis. Diagnosis of DNA and RNA viruses- Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and Retroviruses. Diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis. Study of helminthic diseases- Fasciola hepatica and Ascaris lumbricoides. Filariasis and Schistosomiasis.

UNIT III– MAJOR METABOLIC DISORDERS AND ITS CAUSES:

Traditional methods for the diagnosis of metabolic errors.Disease due to genetic disorders - Identifying human disease genes.Cancer- different types of cancers, genetics of cancer- oncogenes, tumour suppressor genes.Methods available for the diagnosis of genetic diseases and metabolic disorders. Genetic disorders- Sickle cell anemia, Duchenne muscular Dystrophy, Retinoblastoma, Cystic Fibrosis and Sex – linked inheriteddisorders.

UNIT IV– MOLECULAR DIAGNOSIS:

Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Multiplex PCR, Nested PCR, Alu-PCR, Hot-start, In situ PCR, Long-PCR, PCR-ELISA, Arbitrarily primed PCR, Ligase Chain Reaction. Proteins and Amino acids, Qualitative and quantitative techniques: Protein stability, denaturation; amino acid sequenceanalysis

UNIT V– HYBRIDIZATION TECHNIQUES AND DNA SEQUENCING METHODS IN MOLECULAR DIAGNOSIS:

Southern, Northern, in-situ (including FISH), microarrays – types and applications; Protein extraction and analysis (including PAGE and its variations); Western Blot Automated DNA sequencing- Principles, Methods and Instrumentation- Advances in DNA sequencing- New Generation sequencing Methods, Pyrosequencing, · Microarrays- Personalised Medicine- Pharmacogenomics (ADMET)

SUGGESTED READINGS:

1. Bruns. D. E., Ashwood. E. R. and Burtis. C. A. (2007). Fundamentals of Molecular Diagnostics, 1st edition. SaundersGroup.
2. McPherson. R. A. and Pincus. M. R. (2011). Henry's Clinical Diagnosis and Management By Laboratory Methods, 22 edition. SaundersGroup.
3. Buckingham. L. and Flaws. M. L. (2007). Molecular Diagnostics: Fundamentals, Methods & Clinical applications, 1st edition. F.A. DavisCompany.
4. Coleman. W. B. (2005). Molecular Diagnostics for the Clinical Laboratorian 2nd edition, HumanaPress.

18BTBT7E04 CHEMICAL REACTION ENGINEERING 3H-3C

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT-I KINETICS OF HOMOGENOUSREACTIONS

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

UNIT-II REACTORDESIGN

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

UNIT-III NON IDEALFLOW

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

UNIT-IV DESIGN FOR HETEROGENOUSSYSTEMS

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

UNT-V SOLID CATALYSEDREACTIONS

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

SUGGESTED READINGS:

1. Levenspiel. O. (1999). Chemical Reaction Engineering. JohnWiley.
2. Fogler. H. S. (2002). Elements of Chemical Reaction Engineering. Prentice HallIndia.
3. Missen. R.W., Mims. C.A. and Saville. B. A. (1999). Introduction to Chemical Reaction Engineering and Kinetics. JohnWiley.

Semester-VII

18BTBT7E05 **IMMUNOTECHNOLOGY** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

- To explain basic knowledge on antigen structure and preparation.
- To discuss the structural and functional principles of antibodies and immunodiagnosis.
- To construct various parameters of B cells and T cells.
- To explain the effects of preparation and storage of tissues in immunopathology.
- To outline the basic concepts of preparations of vaccine in molecular immunology.
- To discuss the different techniques for antigen and antibody synthesis.

Course Outcomes

1. Summarize the characteristics of different methods of antigensproduction.
2. Evaluate the different structural and functional principles of antibodies and immunodiagnosis.
3. List the various parameters of B cells and Tcells.
4. Explain the preparation and storage of antibodies and immunodiagnosis.
5. Recognize basic concepts of vaccine preparation in molecular immunology.
6. Identify and list different techniques for antigen and antibody synthesis.

UNITI ANTIGENS

Types of antigens, their structure, factors affecting antigenicity, preparation of antigens for raising antibodies, handling of animals, adjuvants and their modeofaction.

UNIT II ANTIBODIES & IMMUNODIAGNOSIS

Monoclonal and polyclonal antibodies – their production and characterization, Westernblotanalysis, Immunoelectrophoresis, SDS-PAGE - purification and synthesis of antigens, ELISA – principle and applications, adioimmunoassay (RIA) - principles and applications,nonisotopic methods of detection of antigens-enhanced chemiluminescence assay.

UNITIII ASSESMENT OF CELL MEDIATEDIMMUNITY

Identification of lymphocytes and their subsets in blood. T cell activation parameters,estimation of cytokines, macrophage activation,macrophage microbicidal assays, in-vitro experimentation – application of the above technology to understand the pathogenesis of infectious diseases.

UNITIV IMMUNOPATHOLOGY

Preparation of storage of tissues, identification of various cell types and antigens in tissues, isolation and characterization of cell types from inflammatory sites and infected tissues, functional studies on isolated cells, immune cytochemistry – immuno fluoresecence,immune enzymatic and immuno ferritin techniques, immuno electron microscopy.

UNIT V MOLECULAR IMMUNOLOGY

Preparation of vaccines, application of recombinant DNA technology for the study of the immune system, production of anti idiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies and other immunological reagents, immuno therapy with genetically engineered antibodies – Tetramer, recombinantvaccines.

SUGGESTED READINGS:

1. Talwar. G.P. and Gupta. S. K. (2006). A hand book of practical and clinical immunology (Vol 1 & 2), 2nd edition. CBSPublications.
2. Weir. D.M. (1990). Practical Immunology. Blackwell Scientific PublicationsOxford.
3. Austin. J. M. and Wood. K. J. (1993). Principle of cellular and molecular immunology. Oxford university.

Semester-VII

18BTBT7E06 **ANIMAL BIOTECHNOLOGY** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

UNIT-I ANIMAL CELLCULTURE

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

UNIT-II MICROMANIPULATION OFEMBRYOS

Breeding of farm animals to biopharming - equipments - enrichment of x and y bearing sperms from semen samples - artificial insemination - germ cell manipulations – Invitro fertilization - embryo transfer - micromanipulation technology and breeding of farmanimals.

UNIT-III TRANSGENICANIMALS

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

UNIT-IV ANIMAL DISEASES AND THEIRDIAGNOSIS

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

UNT-V THERAPY OF ANIMALDISEASES

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

SUGGESTED READINGS:

1. Masters. J.R.W. (2000). Animal Cell Culture: Practical Approach. Oxford UniversityPress.
2. Ranga. M. M. (2002). Animal Biotechnology. Agrobios IndiaLtd.
3. Ramadass. P., Meera and Rani. S. (1997). Text Book of Animal Biotechnology.Akshara Printers.

SEMESTER VIII

B.Tech Biotechnology **2018-2019**

Semester-VIII

18BTBT8E01 AGRICULTURE BIOTECHNOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To describe the micropropagation and tissue engineering in plants.
- To explain the mechanism and regulation of agricultural biotechnology.
- To discuss the basic notion on solving environmental issues through phytoremediation.
- To differentiate and organize the distinct case studies with bioremediation.
- To explain the basic theory of molecular farming.
- To understand the various applications in agricultural biotechnology.

Course Outcomes

1. Distinguish various techniques in improving agriculture through biotechnology.
2. Compare different mechanisms and regulations in recent agricultural biotechnology.
3. Solve many environmental issues using biotechnology techniques with plant as origin.
4. Construct and design the bioremediation for different issues.
5. Apply the knowledge on molecular farming.
6. Explain the various applications in agricultural biotechnology.

UNIT I– INTRODUCTION

Introduction to Agricultural biotechnology. Crop improvement hybridization and plant breeding techniques. Micropropagation and plant tissue culture technique and its application in agriculture. Somatic hybridization, haploid production and cryopreservation. Study of biopesticides used in agriculture (neem as example). integrated pest management.

UNIT II– MECHANISM AND REGULATION

Mechanism of biological nitrogen fixation process.study of NIF, NOD and HUP genes in nitrogen fixation process. Production of biofertilizers and applications of rhizobium, azotobacter, azolla and mycorrhiza.Use of plant growth regulators in agriculture and horticulture.

UNIT III– ENVIRONMENTAL STUDIES

Introduction to Environmental studies Ecosystem and ecological pyramids Treatment of municipal water & industrial effluents Environmental pollution

UNIT IV– CASE STUDIES ON AGRICULTURAL BIOTECHNOLOGY

Biodegradation & Bioremediation Environmental Impact Assessment Case studies of Environmental pollutions.

UNIT V– MOLECULAR FARMING

Farming of carbohydrates (e.g.starch, polyfructans) Metabolic engineering of Lipids (e.g. Bioplastics) Molecular farming of proteins (e.g.oleosin system:hirudinand insulin production). Medically related proteins (e.g.custom made antibodies, Edible vaccines).

SUGGESTED READINGS:

1. Bagyaraj. D. J. and Rangaswami. G. (2009). Agricultural Microbiology by, Prentice Hall of India PvtLtd.
2. Nag and Ahindra. (2008). Textbook of Agricultural Biotechnology. Prentice Hall India Learning PrivateLimited
3. Altman. A. and Hasegawa. P. M. (2011). Plant Biotechnology and Agriculture: Prospects for the 21st Century, 1 edition. AcademicPress.
4. Singh. A., Srivastava. A. K., Shukla. S. K. and Singh. A. (2018). Agricultural Biotechnology, 1st Edition. Scientific International Pvt.Ltd.

18BTBT8E02 **STEM CELL TECHNOLOGY** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- To explain basic knowledge on definition and scope of stem cells.
- To demonstrate the structural and functional principles of in vitro fertilization.
- To discuss the various identification and cell differentiation of somatic stem cells.
- To explain the effects of stem cell in drug discovery and tissue engineering.
- To outline the basic concepts of cellular therapy and gene therapy of stem cells.
- To compile the application of stem cells.

Course Outcomes

1. Summarize the characteristics stem cells.
2. Evaluate the different structural and functional parameters of invitro fertilization.
3. List the properties of adult stem cells in differentiation.
4. Explain the uses of stem cells in drug discovery and tissue engineering.
5. Recognize various stem cell therapies.
6. Summarize the application of stem cells.

UNIT I - STEM CELLS AND CELLULAR PEDIGREES

Scope of stem cells – definition of stem cells – concepts of stem cells – differentiation, maturation , proliferation , pluripolericy, self – maintenance and self – renewal – problems in measuring stem cells – preservationprotocols.

UNIT II - EMBRYONICSTEMCELLS

In vitro fertilization –culturing of embryos-isolation of human embryonic stem cells – blastocyst – inner cell mass – growing ES cells in lab – laboratory tests to identify ES cells – stimulation ES cells for differentiation – properties of EScells.

UNIT III - ADULT STEM CELLS

Somatic stem cells – test for identification of adult stem cells – adult stem cell differentiation – trans differentiation – plasticity – different types of adult stem cells – IPS and cancer stem cells.

UNIT IV - STEM CELL IN DRUG DISCOVERY AND TISSUE ENGINEERING

Target identification – Manipulating differentiation pathways – stem cell therapy Vs cell protection - stem cell in cellular assays for screening – stem cell based drug discovery, drug screening and toxicology, stem cell markers

UNIT V - POTENTIAL USES OF STEM CELLS

Cellular therapies – vaccines – gene therapy – immunotherapy – tissue engineering – blood and bone marrow – Fc cells.

SUGGESTED READINGS

1. Potten. C. S. (1997). Stem cells.Elsevier.
2. Kursad and Turksen. (2012). Adult and Embryonic Stem cells, 2nd edition. HumanaPress.
3. Lanza. R. P. (2013). Essentials of stem cell biology, 3rd edition. AcademicPress.
4. Svendensen. C. and Ebert. A. D. (2008). Encyclopedia of stem cell research vol 1 & 2. Sage pub

SemesterVIII

18BTBT8E03 **TISSUE ENGINEERING** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

- To explain the various cell types and their advances in tissue engineering.
- To demonstrate the various biomaterials for tissue engineering.
- To explain and practice diverse concepts on tissue engineering and tissue creation.
- To discuss the techniques in tissue typing.
- To practice the basic views on gene therepy.
- To identify and organize differeing views on advances on tissue engineering.

Course outcomes

1. Compose about basic concepts in tissue engineering
2. Assemble different biomaterials for tissue engineering
3. Classify about methods for Tissue Engineering.
4. List the techniques in tissue typing
5. Explain the principles of gene therapy
6. Summarize the concepts of tissue engineering in different fields.

UNIT I BIOLOGICAL STUDY OF DIFFERENT CELL TYPES

Cell line, Establishment of cell lines, Different cell types: Endothelial cell, Fibroblast cells, Epithelial cell, Myoblast cells, chromaffin cell, Smooth muscle cells & plasma cell.

UNITII BIOMATERIALS FOR TISSUEENGINEERING

Biomaterials: Degradable polymeric scaffolds, Acellular Bio-Matrices, Biological derived polymersin tissue engineering: Natural BD Polymers & Synthetic BD polymers, Cell seeding of scaffolds, Cell source: Allogenic cells, Autologous cells & stem cells. Bioreactors used in tissue engineering: Gail Naughtom's Bioreactor, Pulsatile Bioreactor.

UNITIII TISSUE ENGINEERING AND CONCEPTS OF TISSUECREATION

Concepts of Tissue Creation: Sources, StemCells, Cells from Tissues, Culture Methods for Tissue Engineering, Maturation of Tissue Construct- Tissue Constructs, Cell therapies, Organ Modules, Cosmetic Measures.

UNITIV PRINCIPLES AND PRACTICE OF GENETHERAPY

Introduction to gene therapy, Requirements of gene therapy, Genetic defects, Target cells for gene therapy, process of gene therapy, Factors responsible for gene therapy for making effective treatment of genetic disease, Recent developments in gene therapy research, ethical considerations of gene therapy.

UNITV ADVANCES IN TISSUE ENGINEERING

Development of artificial tissues; Transplantation biology: Tissue typing, Techniques of tissue typing, Minor histocompatibility antigens, Immuno-suppression, Side effects of immuno-suppression.

SUGGESTED READINGS:

1. Bhojwani. S. S. and Razdan. M. K. (1996). Plant Tissue Culture (Theory and Practice). Elseveir
2. Ranga. M. M. (2010). Animal Biotechnology.Agrobios
3. Watson. J. D. and Gilman. M. (1992). Recombinant DNA. Scientific AmericanBooks.

Semester-VIII

18BTBT8E04 MARINE BIOTECHNOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To explain descriptive properties of seawater.
- To illustrate differentiating marine organisms and their industrial applications.
- To descriminate various pollution controlling marine organisms.
- To evaluate various marine toxins used in pharmaceutical industries.
- To interpret recombinations in marine aquaculture.
- To understand the usage of marine organism for different situations.

Course Outcomes

1. Discuss the basic knowledge on biogeochemical cycles.
2. Organize and manage marine organism in different industries.
3. Organize and manage pollution controlling measures through marine organisms.
4. Perceive the basics on combining marine toxins in pharma industries.
5. Compile different proteins of marine organism to develop a new variety.
6. Explain how to use marine organism for different situations.

UNIT I INTRODUCTION TO MARINE ENVIRONMENT

World oceans and seas – ocean currents – physical and chemical properties of sea water – abiotic and biotic factors of the sea – ecological divisions of the sea – history of marine biology – biogeochemical cycles – food chain and food web**.**

UNIT II MARINE ORGANISMS AND THEIR INDUSTRIAL APPLICATIONS

Phytoplanktons – zooplanktons – nektons – benthos – marine mammals – marine algae – mangroves – coral reefs – algal products, fuels from algae, algal cell culture

UNIT III MARINE ENVIRONMENTAL BIOTECHNOLOGY

Marine pollution – biological indicators (marine micro , algae) – biodegradation & bioremediation – marine fouling andcorrosion.

UNIT IV MARINE PHARMACOLOGY

Medicinal compounds from marine flora and fauna – marine toxins , anti cancer agents, antiviral and antimicrobial agents. Marine Toxins

UNITV AQUACULTURE TECHNOLOGY

Importance of coastal aquaculture – marine fishery resources – common fishing crafts and gears – Aqua farm design and construction, transgenic fish.

SUGGESTED READINGS:

1. Fingerman. M. and Nagabhushanam. R. (2003). Recent advances in marine biotechnology volume 8. CRCPress
2. Fingerman. M. and Nagabhushanam. R. (1999). Recent advances in marine biotechnology volume 2. Sciencepublishers
3. Becker. E. W. (1994). Microalgae: Biotechnology and Microbiology. Cambridge University Press
4. Lee. J. S. and Newman. M. E. (1996). Aquaculture: An Introduction. Interstate Publishers, Incorporated

Semester-VIII

18BTBT8E05 GENOMICS AND PROTEOMICS 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To explain basic knowledge on genome organization of prokaryotes and eukaryotes.
- To discuss the effects of cytogenetic mapping.
- To construct various methods for gene finding and annotations in functional genomics.
- To explain the effects of various protein level estimation in proteomics
- To understand the different protein analysis techniques.
- To outline the post translational modification and other protein interactions.

Course Outcomes

1. Summarize the characteristics of genomic organization of prokaryotes and eukaryotes.
2. Evaluate the different physical mapping techniques.
3. Discuss the gene findings in functional genomics.
4. Explain the protein estimation through different techniques.
5. Recognize different protein analysis techniques.
6. Identify and list different protein interactions.

UNIT I - OVERVIEW OF GENOMES OF BACTERIA, ARCHAE AND EUKARYOTA

Genome organization of prokaryotes and eukaryotes, gene structure of bacteria, archaebacterial and eukaryotes, Human genome project, Introduction of functional and comparative genomics.

UNIT II - PHYSICAL MAPPING TECHNIQUES

Cytogenetic mapping, radiation hybrid mapping, Fish, STS mapping, SNP mapping optical mapping, Top down and bottom up approach, linking and jumping of clones, gap closure, pooling strategies, genome sequencing.

UNIT III - FUNCTIONAL GENOMICS

Gene finding; annotation; ORF and functional prediction; Substractive DNA library screening; differential display and representational difference analysis; SAGE.

UNIT IV - TECHNIQUES IN PROTEOMICS

Protein level estimation; Edman protein microsequencing; protein cleavage; 2 D gel electrophoresis; metabolic labeling; detection of proteins on SDS gels.Mass spectrometry- principles of MALDI-TOF; Tandem MS-MS; Peptide mass fingerprinting.

UNIT V - PROTEIN PROFILING

Post translational modification; protein-protein interactions; glycoprotein analysis; phosphor protein analysis.

SUGGESTED READINGS

1. Cantor and Smith. (1999). Genomics. John Wiley &Sons.
2. Pennington and Dunn. (2001). Proteomics. BIOS ScientificPublishers.
3. Brown. T. A. (2018). Genomes, 4th edition. Bios Scientific PublishersLtd
4. Livesey. H. (2000). Functional Genomics. Oxford Universitypress.

Semester-VIII

18BTBT8E06 **STRUCTURAL BIOLOGY** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- To describe the fundamentals of protein and Nucleic acid structure.
- To iilustrate principle and mechanism of X-Ray Crystallography and NMR.
- To explain how to solve phaseproblems.
- To assess the students to the various methods of secondary structure prediction strategies.
- To classify and compare the protein 3D structures.
- To discuss the protein structures using different techniques.

Course Outcomes

1. Outline fundamentals of protein and Nucleic acid structure.
2. Summarize the principle and mechanism of xray crystallography and NMR.
3. Solve phase relatedproblems.
4. Explain the secondary structureprediction.
5. Differentiate and distinguish various 3D structures of protein.
6. Interpret and catogarize the protein structures on different techniques.

UNITI MACROMOLECULES

DNA and RNA: types of base pairing – Watson-Crick and Hoogstein; types of double helices A, B, Z and their geometrical as well as structural features; structural and geometrical parameters of each form and their comparison; various types of interactions of DNA with proteins, small molecules. RNA secondary and tertiary structures, t-RNA tertiary structure.

Proteins: Principles of protein structure; anatomy of proteins – Hierarchical organization of protein structure – Primary. Secondary, Super secondary, Tertiary and Quaternary structure; Ramachandran Map.

UNIT II XRAY CRYSTALLOGRAPHY

Electromagnetic radiation, X-rays, principles, Bragg's Law, Types of solids: Crystal and amorphous, solids, Crystal Systems: Seven crystal system, Bravies Lattices, Space group, Symmetry. Crystallization Techniques: Small and Protein Molecules.

UNITIII PHASE PROBLEM

What is phase problem, How to solve the phase problem, Patterson function, Direct methods, Isomorphism replacement method, heavy atom method. Nuclear Magnetic Resonance:Chemical Shift, Coupling constant, spin-spin relaxation, spin-lattice relaxation, COSY, NOESY and NOE.

UNITIV STRUCTURE PREDICTION STRATEGIES

Secondary structure prediction: Algorithms viz. Chou Fasman, GOR methods; analysis of results and measuring the accuracy of predictions using Q3, Segment overlap, Mathew's correlation coefficient Identification/assignment of secondary structural elements from the knowledge of 3-D structure of macromolecule using DSSP and STRIDE methods

UNITV CLASSIFICATION AND COMPARISON OF PROTEIN 3DSTRUCTURES

Purpose of 3-D structure comparison and concepts; Algorithms such as FSSP, CE, VAST and DALI, Fold Classes. Databases of structure-based classification: CATH and SCOP. Structures of oligomeric proteins and study of interaction interfaces.

SUGGESTED READINGS:

1. Leach. A. R. (2008). Molecular Modeling Principles and Applications, 3rd edition.Wiley.
2. Schulz. G. E. (2009). Principles of Protein Structure.Springer.
3. Nelson. D. L. and Cox. M. M. (2012). Principles of Biochemistry. W. H.Freeman.

Semester- VIII

18BTBT8E07 CLINICAL TRIAL AND MANAGEMENT 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To explain descriptive views of clinical practices and its scope.
- To illustrate Differentiating ethical theories and foundations of clinical trials.
- To discuss various evolution and regulation of clinical research.
- To evaluate various designing protocols and amendments of clinical research.
- To interpret different biostatistics and data management.
- To create data on different clinal research.

Course Outcomes

1. Elaborate the concept of scope and types of clinal research.
2. Evaluate the ethical theories of clinical research.
3. Discuss the history and regulation of clinical research.
4. Explain the various protocol developments in clinical research.
5. Identify basic views in different situations of biostatictics in clinical trials.
6. Make up perspective techniques and create data on different clinal research.

UNITI INTRODUCTION TO CLINICAL RESEARCH

Definition, Types and Scope of Clinical Research, Good Clinical Practices - Introduction to study designs and clinical trials - Careers in Clinical Research.

UNITII ETHICS IN CLINICAL RESEARCH

Ethical Theories and Foundations, Ethics Review Committee, Ethics and Historically derived principles - Nuremberg Code, Declaration of Helsinki, Belmont Report, Equipoise, Informed consent, Integrity & Misconduct.

UNITIII REGULATIONS IN CLINICAL RESEARCH

Evolution and History of Regulations in Clinical Research, Patents US Regulatory Structure, IND, NDA, ANDA, Post Drug Approval Activities, PMS, FDA Audits and Inspections EURegulatory Affairs, EMEA Organization and Function, INDIAN Regulatory system, Schedule Y- Rules and Regulations, Description of trial phases (Phase 0, Phase I, II, III, and IV), Trial contexts (types of trials: pharma, devices, etc.), Trialexamples.

UNITIV CLINICAL RESEARCH METHODOLOGY ANDMANAGEMENT

Designing of Protocol, CRF, e-CRF, IB, ICF, SOP; Study Protocol -Introduction, background, Objectives Eligibility, Design, Randomization - Intervention details, assessments and data collection, case report forms –Violations -. Amendments. Study/ Trial Design- Phase I designs - Dose-finding designs. Phase II designs - Pilot studies, Single arm, Historical control designs. Phase III designs - Factorial designs, Crossover designs, Multicenter studies, Pilot studies. Phase IV designs- Preparation of a successful clinical study, Study management, Project management Documentation, Monitoring, Audits and Inspections, Pharmacovigilance training in clinical research budgeting in clinical research, Supplies and vendor management.

UNITV BIOSTATISTICS AND DATAMANAGEMENT

Introduction to Power and Sample Size- Hypothesis testing, P-values, confidence intervals, General power/sample size, estimating effect size, Matching sample size calculations to endpoints. Importance of statistics in clinical research Statistical considerations at the design, analysis and reporting stage Data management - Data collection, Paper or electronic, Parsimony, Data validation, SAE reconciliation, query management Software considerations. Data Monitoring, Trial Conduct - Data quality assurance, Data delinquency, Data Monitoring, d. Trial Conduct, Occurrence and control of variation and bias.

SUGGESTED READINGS:

1. Friedman. M., Furberg. C. and Demets D. L. (2015). Fundamentals of clinical trails.Springer.
2. Machin. D. and Fayers. P. (2010). Randomized Clinical Trails: Design Practice and Reporting. Wiley-Blackwell
3. Piantadosi. S. (2017). Clinical Trials: A Methodologic Perspective. John Wiley andsons.

Semester-VIII

18BTBT8E08 INTRODUCTION TO SYSTEMS BIOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To explain about basics of system biology,
- To discuss about microarray technology
- To compare and conclude developmental system biology.
- To explain the basic mechanisms of expression networks.
- To explain the use of various networks in system biology.
- To formulate knowledge in experimental system biology.

Course Outcomes

1. Outline the basis of system biology.
2. Relate the microarray and its allied technology
3. Illustrate the concept of developmental system biology.
4. List the basic mechanisms of expression networks.
5. Experiment with the mechanisms associated with experimental system biology.
6. Describe the application of system biology

UNITI INTRODUCTION

Introduction to systems biology, biological networks, protein interaction networks- computational prediction of protein interactions, network topology analysis; bus-star-ring networks.

UNITII MICROARRAYTECHNOLOGY

Microarray data analysis - Microarray analysis platforms - Introduction to Concepts and principles of Microarray technology - Application of Microarrays in Life Sciences.Different Markup languages used in systems biology.Introduction to NGS technology.

UNITIII DEVELOPMENTAL SYSTEMS BIOLOGY

Building an Organism Starting From a Single Cell -Quorum Sensing – Programmed Population Control by Cell-Cell Communication and Regulated Killing- Drosophila Development. Establishment

of Developmental Precision and Proportions in the Early Drosophila embryo.

UNITIV GENE EXPRESSIONNETWORKS

Gene regulation at a single cell level- Transcription Networks -basic concepts -coherent Feed Forward Loop (FFL) and delay gate -The incoherent FFL -Temporal order, Signaling networks and neuron circuits -Aspects of multi-stability in genenetworks.

UNIT V EXPERIMENTAL SYSTEMBIOLOGY

Building an Organism Starting From a Single Cell -Quorum Sensing – Programmed Population Control by Cell-Cell Communication and Regulated Killing- Drosophila Development.

SUGGESTED READINGS:

1. Kriete. A. and Elis. R. (2014). System Biology: Computational Systems Biology, 2nd edition. AcademicPress.
2. Wilkinson. D. J. (2018). Stochastic Modelling for Systems Biology, 3rd edition. Chapman and Hall/CRC
3. Causton. H., Quackenbush. J. and Brazma. A. (2008). Microarray Data Analysis: Gene Expression Data Analysis. A Beginner's Guide, 1st edition.Wiley-Blackwell.
4. DiStefano. J. (2015). Dynamic Systems Biology Modeling and Simulation, 1st edition. AcademicPress.

Semester-VII

18BTBT8E09 GENOME INFORMATICS AND BIGDATA ANALYSIS 3H-3C

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

End Semester Exam:3Hours

Course Objectives

- To explain the structure and function of genomes
- To understand the technologies developed for genomics, functional genomics and NGS.
- To originate and predict the big data analytics as the next wave for businesses looking for competitive advantage
- To explain about the financial value of big data analytics
- To predict and propose the various tools and practices for working with big data
- To identify and make use of how big data analytics can leverage into a key component

Course Outcomes

1. Compile the fundamental concepts of Genome informatics and NGS.
2. Perceive and prioritize the fundamentals of various big data analytics techniques.
3. Summarize the big data platform and explore the big data analytics techniques business applications.
4. Analyse health care data using appropriate analytical techniques.
5. Appraise how to mine the data
6. Organize the techniques adopted to analyse health care data.

UNIT – I INTRODUCTION TO GENOME INFORMATICS

Microarray analysis definition, types of microarray, microarray analysis life cycle (sample preparation and labeling, hybridization, washing and image acquisition), microarray data analysis, tools, databases and software for microarray data analysis. Past, present and feature of sequencing technology. Platform overview: Illumina, Pacific Biosciences. Comparison of NGS Systems: Recent scientific breakthroughs using NGS technology. Major biological databases and its classification, sequence database - NCBI, GenBank, EMBL, DDBJ. NGS Database: SRA, DRA, ENA. File/Data formats overview: FASTA, FASTQ, FNA, CSFASTA, GFF, SAM and BAM. Genome alignment and analysis tools- BWA (Burrows-Wheeler Aligner), SAMtools, GATK (The Genome Analysis Toolkit), IGV (Integrative Genomics Viewer), HISAT, StringTie, Cuffcompare, Velvet, Oases, Trinity. Advantage and disadvantage of NGSTechnology.

UNIT - II WHOLE GENOME / EXOME / TARGETED RESEQUENCING ANALYTICS

Introduction to genome Re-Sequencing, Indexing the reference genome, Sequence Alignment Tools and its Parameters, Alignment quality Assessment, Exome Enrichment Analysis, Target /Non-Target Enrichment Analysis, Statistical Analysis and genome Visualization, Introduction to Variation Analysis, Variation analysis to identify SNV / MNV / SV, dbSNP Annotation / Variation Effect Prediction, Variation Frequency Analysis, Exome Copy Number Variation Analysis, Data Visualization, Function & Structure based Comparative Genome Analysis.

UNITIII INTRODUCTION TO BIGDATA

Analytics – Nuances of big data – Value – Issues – Case for Big data – Big data options Team challenge – Big data sources – Acquisition – Nuts and Bolts of Big data. Features of Big Data - Security, Compliance, auditing and protection - Evolution of Big data – Best Practices for Big data Analytics - Big data characteristics - Volume, Veracity, Velocity, Variety – Data Appliance and Integration tools – Greenplum – Informatica

UNITIV PREDICTIVE ANALYTICS AND VISUALIZATION

Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen models – Normal – Deviations from normal patterns – Normal behaviours – Expert options – Variable entry - Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications:

UNITV APPLICATIONS

Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer-Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.

SUGGESTED READINGS:

1. Nejad. A. M., Narimani. Z. and Hosseinkhan. N. (2013). Next Generation Sequencing and Sequence Assembly, Methodologies and Algorithms.Springer.
2. Das. S. (2017). Unix Concepts and Applications 4th edition.Mcgraw-Hill
3. Reddy. C.K. and Aggarwal. C. C. (2015). Healthcare data analytics. Taylor&Francis
4. Yang.H.andLee.E.K.(2016).HealthcareAnalytics:FromDatatoKnowledgetoHealthcare

Improvement. Wiley
5. Berthold. M. and Hand. D. J. (2007). Intelligent Data Analysis.Springer
6. Han. J. and Kamber. M. (2008). Data Mining Concepts and Techniques. 2nd Edition.Elevier

Semester-VIII

18BTBT8E10 **HEALTH INFORMATICS** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives

- To explain the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/ international policies with a futuristic vision along with socio-economic impact and issues
- To discuss ICT applications in medicine with an introduction to health informatics.
- To demonstrate the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats.
- To understand the recent trends in Hospital Information Systems.
- To distinguish and utilize basic impression on health informatics.
- To explain data mining in health care systems.

Course Outcomes

1. Comprehend and appreciate the significance and role of this course in the present contemporary world
2. Discuss about health informatics and different ICT applications in medicine.
3. Explain the function of Hospital Information Systems
4. Analyze medical standards
5. Decide and determine medical data formats and recent trends in hospital information system.
6. Originate and plan data acquisition for healthcare.

UNITI MEDICAL INFORMATICS

Introduction – Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics –Functional capabilities of Hospital Information System - On-line services and Off – line services - History taking by computer, Dialogue with the computer

UNITII MEDICAL STANDARDS

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA – Electronics Patient Records –Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

UNITIII MEDICAL DATA STORAGE AND AUTOMATION

Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface - Medical Data formats – Signal, Image and Video Formats – Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System - PACS , Datamining.

UNITIV HEALTHINFORMATICS

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training

UNITV RECENT TRENDS IN MEDICALINFORMATICS

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment - Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine.

SUGGESTED READINGS:

1. R.D.Lele, (2005) Computers in medicine progress in medical informatics I: Tata McGraw Hill Publishing computers Ltd, New Delhi.
2. Mohan Bansal,(2003) Medical informatics I: Tata McGraw Hill Publishing computers Ltd, NewDelhi

Semester-VIII

18BTBT8E011 **MOLECULAR MODELING** **3H-3C**

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

Course Objectives

- To define the basic view of concept of molecular modelling.
- To demonstrate the computational quantum mechanics through different methods.
- To explain the general features of molecular mechanics.
- To discuss the molecular dynamics simulation methods.
- To outline the basic concept on cheminformatics molecular modeling.
- To explain the diverse techniques on molecular modeling.

Course Outcomes

1. Identify different views on global and local energy minima through molecular modeling.
2. Differentiate various calculations on molecular properties.
3. Illustrate the concept behind molecular mechanics through derivative methods.
4. Evaluate and characterize molecules simulation through dynamics methods.
5. Analyze and categorize the structure based drug design for targets.
6. Explain the diverse techniques on molecular modeling.

UNIT-I MOLECULARMODELLING

Introduction to concept of molecular modeling, molecular structure and internal energy, applications of molecular graphics, coordinate systems, potential energy surfaces, discussion of local and global energyminima

UNIT-II QUANTUMMECHANICS

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

UNIT-III MOLECULARMECHANICS

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

UNIT-IV MOLECULARDYNAMCS

Molecular dynamics simulation methods; molecular dynamics using simple models, molecular dynamics with continuous potential, setting up and running a molecular dynamic simulation, constraint dynamics; Monte Carlo simulation; Monte Carlo simulation ofmolecules.

UNT-V MODELLING AND DRUGDESIGN

Introduction to cheminformatics,Macromolecular modeling, design of ligands for known macro molecular target sites, Drug- receptor interaction, classical SAR /QSAR studies and their implications to the 3 D modeler, 2-D and 3-D database searching, pharmacophore identification and novel drug design, molecular docking, Structure-based drug design for all classes of targets.

SUGGESTED READINGS:

1. Leach. A. (2001). Molecular modeling: Principles and application. PrenticeHall.
2. Cohen. N. C. (1996). Guide book on molecular modeling in drug design. AcademicPress.
3. Yvonne, Martin. C. and Willett. P. (1998). Designing bioactive molecules: threedimensional techniques and applications. Washington, DC. American chemical society.
4. Schlecht. M. F. (1998). Molecular modeling on the PC. Wiley - Blakwell;Har.

Semester VIII

18BTBT8E12 NEUROBIOLOGY AND COGNITIVE SCIENCE 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

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

Course Outcomes

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

UNITI - NEUROANATOMY

Overview of central and peripheral nervous system, Neurons and its structure, types and functions, Glial cells and types, synapses: types and functions, myelination, Blood Brain barrier, Neural Development; Cerebrospinal fluid – origin and compostion, Spinal cord and its functions.

UNIT II - NEUROPHYSIOLOGY

Resting and action potential, mechanism of action potential conduction, voltage dependent channels: sodium and potassium channels, electrical transmission; information representation and coding by neurons.

UNITIII- NEUROPHARMACOLOGY

Synapse formation, synaptic transmission, neurotransmitters and their mechanism of action: acetyl choline, serotonin and dopamine, fast and slow transmission; hypothalamic control of neuronal function.

UNITIV- APPLIED NEUROBIOLOGY

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

UNITV- BEHAVIOURAL SCIENCE

Basic mechanisms associated with motivation, regulation of feeding, sleep, hearing and memory, Disorders associated with nervous system: Parkinson's disease, Alzheimer's disease, Schizoprenia, Anxiety and mood disorders: depression, Agrophobia.

SUGGESTED READINGS:

1. Bear. F. B., Connors. B. W. and Paradiso. M. A. (2006). Neuroscience – Exploring the Brain, 3rd revised edition. USA, Lippincott Williams &Wilkins.
2. Mathews. G. G. (2000). Neurobiology: Molecule, cell and systems, 2nd edition, UK. Blackwell Science.
3. Mason. P. (2011). Medical Neurobiology. Oxford UniversityPress.
4. Squire. L. R., Bloom. F., Spitzer. N. C. and Berg. D. (2008). Fundamental Neuro Science, 3rdedition. Elsevierpublication.
5. Gazzaniga. M., Ivry. R. B. and Mangun. G.R.(2008). Cognitive Neuroscience 3rd edition. W. W. Norton & Company
6. Jaaskelainen. L. P. (2012). Introduction to Cognitive Science. Venus publishingAps.

OPEN ELECTIVES

B.E/B.Tech **2018-2019**

18BESHOE01/18BTSHOE01 **3H-3C**

SOLID WASTE MANAGEMENT

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

End Semester Exam:3Hours

Course Objectives:

- To make the students conversant with basics of Solid waste sand its classification.
- To make the student acquire sound knowledge of different treatments of solid wastes.
- To acquaint the student with concepts of waste disposals.
- To develop an understanding of the basic concepts of Hazardous waste managements.
- To acquaint the students with the basics of energy generation from waste materials.
- To understand the chemical principles in the projects undertaken in field of engineering and technology

Course Outcome:

1. Outline the basic principles of Solid waste and separation of wastes (K)
2. Identify the concepts of treatment of solid wastes(S)
3. Identify the methods of wastes disposals.(S)
4. Examine the level of Hazardousness and its management. (S)
5. Examine the possible of the energy production using waste materials. (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNITI SOLID WASTE

Definitions – Sources, Types, Compositions, Properties of Solid Waste – Municipal Solid Waste – Physical, Chemical and Biological Property – Collection – Transfer Stations – Waste Minimization and Recycling of Municipal Waste

UNITII WASTE TREATMENT

Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/ Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNITIII WASTE DISPOSAL

Sanitary Land Fill Method of Solid Waste Disposal – Land Fill Classficaition, Types, Methods &Siting Consideration – Layout & Preliminary Design of Land Fills – Composition, Characteristics generation, Movement and Control of Landfill Leachate & Gases – Environmental Monitoring System for Land Fill Gases, Waste landfillRemediation

UNIT IV HAZARDOUS WASTE MANAGEMENT

Definition & Identification of Hazardous Waste – Sources and Nature of Hazardous Waste – Impact on Environment – Hazardous Waste Control – Minimization and Recycling -Assessment of Hazardous Waste Sites – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure, Remediaiton, risk assessment.

UNITV ENERGY GENERATION FROMWASTE

Thermal conversion Technologies – Pyrolysis systems, Combustion systems, Gasification systems, Environment control systems, Energy recovery systems. Biological& Chemical conversion technologies – Aerobic composting, low solids.Anaerobic digestion, high solids anaerobic digestion, Energy production from biological conversion products, other biological transformation processes. Chemical transformationprocesses.

Total: 4

Suggested Readings:

1. Dara.S.S,Mishra.D.D, A Text book of Environmental Chemistry and Pollution Control, S.Chand and Company Ltd., NewDelhi.2011.
2. Naomi B. Klinghoffer and Marco J. Castaldi,Waste to Energy Conversion Technology (Woodhead Publishing Series in Energy),Woodhead Publishing Ltd., Cambridge, UK,2013.
3. Frank Kreith,George Tchobanoglous,Hand Book of Solid Waste Management-2nd edition, McGraw Hill Publishing Ltd., Newyork,2002.
4. Shah, L Kanti, Basics of Solid & Hazardous Waste Management Technology, Prentice Hall (P) Ltd.,
5. NewDelhi.1999.
6. www.iitk.ac.in/3inetwork/html/reports/IIR2006/Solid_Waste.
7. http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/
8. www.alternative-energy-news.info/technology/garbage-energy/
9. nzic.org.nz/ChemProcesses/environment/

B.E/B.Tech **2018-2019**

18BESHOE02/18BTSHOE02 **3H-3C**

GREEN CHEMISTRY

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

End Semester Exam:3Hours

COURSE OBJECTIVES:

- To make the students conversant about the green chemistry
- To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
- To acquaint the student with concepts of green technology.
- To develop an understanding of the basic concepts of renewable energy resources.
- To acquaint the students with the basics information on catalysis.
- To apply the concepts of green catalysts in the synthesis

COURSE OUTCOMES:

1. Outline the basic principles of green chemistry (K)
2. Examine the different atom efficient process and synthesis elaborately (S)
3. Apply the concepts combustion of green technology (S)
4. Identify and apply the concepts of renewable energy(S)
5. Apply the concepts of green catalysts in the synthesis (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I INTRODUCTION TO GREEN CHEMICAL PRINCIPLES

Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNIT II ATOM EFFICIENT PROCESSES

Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis.

UNIT III BIOTECHNOLOGY AND GREEN CHEMISTRY

Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air.Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

UNIT IV RENEWABLE RESOURCES

Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion.

UNIT V CATALYSIS IN GREENCHEMISTRY

Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecularoxygen.

Total: 45

Suggested Readings:

1. Sanjay K. Sharma, Ackmez Mudhoo, Green Chemistry for Environmental Sustainability, CRC Press , London, 2010
2. AhluwaliaV.K.andM.Kidwai,NewTrendsinGreenChemistry2nd edition,Anamaya publishers., New Delhi,2007.
3. Dr. SunitaRatan, A Textbook of Engineering Chemistry, S.K. Kataria and Sons., New Delhi.,2012.
4. MukeshDoble.KenRollins,AnilKumar,GreenChemistryandEngineering,1st edition, Academic Press, Elesevier., New Delhi.2007.
5. Desai K. R., Green Chemistry, Himalaya Publishing House, Mumbai.,2005.
6. Matlack A. S., Introduction to Green Chemistry.,Marcel Dekker: NewYork,2001.
7. http://www.organic-chemistry.org/topics/green-chemistry.shtm
8. http://www.essentialchemicalindustry.org/processes/green-chemistry.html
9. http://www.chm.bris.ac.uk/webprojects2004/vickery/green_solvents.htm
10. http://www.epa.gov/research/greenchemistry/
11. http://www.amazon.in/Green-Chemistry-Catalysis

B.E/B.Tech **2018-2019**

18BESHOE03/18BTSHOE03 **3H-3C**

APPLIED ELECTROCHEMISTRY

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

End Semester Exam:3Hours

Objectives:

- To make the students conversant with the information on electrochemical material.
- To make the student acquire sound knowledge of conducting polymers.
- To acquaint the student with concepts of Energy storage devices.
- To develop energy storage devices.
- To impart knowledge on basic principles of solar cells and its applications
- To understand the chemical principles in the projects undertaken in field of engineering.

Course Outcomes:

1. Outline the basic principles of chemistry in electrochemical material (K)
2. Examine the properties of conducting polymers(S)
3. Apply the concepts of electrochemistry in storage devices.(S)
4. Identify the concepts of storage devices and its applications. (S)
5. Apply the suitable materials for the manufacturing of storage devices. (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNITI METAL FINISHING

Fundamental principles, surface preparation-Electroplating of copper, nickel, chromium, zinc and precious metals (gold & silver)- Electroplating for electronic industry- Alloy plating, brass plating- Electro less plating of nickel- anodizing – Electroforming – Electrowinning.

UNITII CONDUCTING POLYMERS ANDELECTROCHEMICALS

lectropolymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers- poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

UNITIII BATTERIES AND POWERSOURCES-I

Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

UNIT IV BATTERIES AND POWER SOURCES-II

Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

UNIT V ELECTROCHEMICAL MATERIAL SCIENCE

Solar cells- Preparation of CdS/Cu_2S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics

TOTAL :45

Suggested Readings:

1. Cynthia G. Zoski,Hand Book of Electrochemistry, Academic Press, Elesevier.,UK,2007.
2. D.Pletcher and F.C.Walsh, Industrial Electrochemistry, Chapman and Hall, London, 1990.
3. M. Barak, Electrochemical Power Sources, I.EEE series, Peter Peregrinius Ltd, Steverage,U.K.1997.
4. Bruno Scrosati, Applications of Electroactive Polymers, Chapman & Hall, London,1993.
5. K.L. Chopra and I. Kaur,Thin Film Devices and their Application,Plenum Press, New York.1983.
6. M.M.Baizer, Organic Electrochemistry, Dekker Inc. New York, 1983.
7. http://www.anoplate.com/finishes/
8. http://hyperphysics.phy-astr.gsu.edu/hbase/electric/battery.html
9. http://inventors.about.com/od/sstartinventions/a/solar_cell.htm

B.E/B.Tech **2018-2019**

18BESHOE04/18BTSHOE04 **3H-3C**

INDUSTRIAL CHEMISTRY

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

End Semester Exam:3Hours

Course Objectives:

- To make the students conversant with cement and lime and its uses.
- To make the student acquire sound knowledge of abrasives and refractories.
- To acquaint the student with concepts of inorganic chemicals.
- To develop an understanding of the basic concepts explosives.
- To acquaint the students with the basics of agriculture chemicals.
- To understand the chemical principles in the projects undertaken in field of engineering.

Course Outcomes:

1. Outline the basic chemistry of cement and lime (K)
2. Examine the uses of abrasives and refractories (S)
3. Identify the usage of the inorganic chemicals. (S)
4. Identify the concepts of explosives and smoke screens(S)
5. Identify the usage of the agriculture chemicals(S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNITI CEMENT ANDLIME

Manufacture of Portland cement – settling of hardening of portland cement – regauging cement – effect of fineness on setting and hardening – freezing – high early strength cement – high alumina cement Lime – raw materials- manufacture – slaking – lime mortar – types of lime – high – calcium or fat lime – calcium lime or lean lime – magnesian lime – dolomitic lime – hydrauliclime.

UNITII ABRASIVES ANDREFRACTORIES

Abrasives – hard abrasives – siliceous abrasives – soft abrasives – artificial abrasives – uses. Refractories – definition – classification – acid refractories – basic refractories – neutral refractories – properties – uses.

UNIT IIIINORGANIC CHEMICALS

Common salt and soda ash – manufacture – different grades – products – alkalis – Na_2CO_3, caustic soda and chlor-alkali industry – manufacture principles of electrolytic process – chlorine – storage. Hydrochloric acid – manufacture – absorption – uses, sulphur and sulphuric acid – extraction of sulphur – manufacture of H_2SO_4 – chamber – contact processes – industrial uses.

UNIT IV EXPLOSIVES

Explosives – uses – properties and tests – explosives for war – nitrocellulose – picric acid and T.N.T. – industrial explosives – nitroglycerin and dynamites – black powder – smoke screens – incendiaries – gas mask.

UNIT V AGRICULTURE CHEMICALS

Fertilizers – organic and inorganic – ammoniated superphosphates, sodium nitrate, solid pellets – potassium salts – pesticides – fungicides – herbicides – their preparations and characteristics – environmental impacts.

Total: 45

Suggested Readings:

1. Harikrishan, Industrial Chemistry, Goel Publishing House, Meerut.,2014.
2. B.K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut.,2000.
3. B.N.Chakrabarty, Industrial Chemistry, Oxford and IBH Publishing CO. New Delhi.1998.
4. JamesA.Kent,HandBookofIndustrialChemistry,9th edition,VanNostrandReinhold, New York.1992.
5. R.N. Sherve, Chemical Process Industries, McGraw-Hill, Kugakuisha Ltd.,Tokyo.1984.
6. S.D. Shukla and G.N. Pandy, A Text book of Chemical Technology, VikasPublishing
7. House (P) Ltd, NewDelhi.1979.
8. http://en.wikipedia.org/wiki/Cement
9. http://www.hon.ch/HONselect/Selection/D01.html
10. http://fas.org/man/dod-101/navy/docs/fun/part12.htm
11. http://toxics.usgs.gov/topics/agchemicals.html

B.E/B.Tech **2018-2019**

18BESHOE05/18BTSHOE05 **3H-3C**

TECHNICAL WRITING

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

End Semester Exam:3Hours

COURSE OBJECTIVES:

- Develop abilities to write technically and expressively,
- Recognize writing as a constructive, meaningful process,
- Practice using reading strategies for effective writing.
- Design effective technical documents for both print and digital media
- Identify the qualities of good technical writing
- To improve the ability of writing.

COURSE OUTCOMES:

Students undergoing this course are able to

1. Construct simple sentences, correct common grammatical errors in written English.
2. Develop confidence in English language by imbibing lexical and syntax rules.
3. Enrich their reading ability for effective writing.
4. Elevate them to minimize word, sentence, and paragraph length without sacrificing clarity or substance
5. Familiarize with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.
6. Demonstrate the basic components of definitions, descriptions, process explanations, and other common forms of technical writing.

UNIT– I BASICS OFWRITING

Introduction to Technical Writing – Importance of Writing – Characteristics of Writing– Audience Recognition/ Analysis – Appropriateness of language — Conciseness and Flow– Bias free and plain writing – Impersonal and Formal Language -Techniques of Technical Writing– Overcoming writer's block – Prioritizing for effective writing– Avoiding plagiarism.

UNIT– 2 PARAGRAPHS ANDESSAYS

Expressing Ideas – Paragraph construction – Cohesion and Coherence – Adequate development – Kinds of paragraphs – Writing drafts – Paragraph length and pattern – Types of Essays – Characteristics of Essays – Salient point of sentence constructions.

UNIT– 3 LETTERS, MEMOS AND EMAIL

Formal written correspondence – Types of messages – Business letters – Structure of letters – Language in letters – Tense in letters – Cover letters – Resumes – Curriculum vitae – Memos – Emails – Email Etiquette – Effectiveness and purpose.

UNIT – 4 THE ART OF CONDENSATION AND TECHNICAL PROPOSALS

Steps to Effective précis writing – Guidelines – Technical Proposals – Types of Proposals – Characteristics – Body of the Proposals – Style and appearance – Evaluation of proposals – Proof Reading – Book /Film Review – Travelogue – Dialogue Writing.

UNIT– 5 REPORTS AND RESEARCH ARTICLES

Discussion of newspaper articles -Objectives of Reports – Characteristics of Reports – Structure of Reports – Types of Reports – Writing an article – Writing research articles – Essential features of Dissertation – Organizing the structure of thesis and articles – Writing technical description.

SUGGESTED READINGS:

1. V.N. Arora&Lakshmi Chandra, Improve Your Writing: Revised First Edition, OUP, New Delhi.2014.
2. David Morley, The Cambridge Intro. to Creative Writing, CUP, NewDelhi.2010.
3. Graham King, Collins Improve Your Writing Collins; First edition, UK2009
4. Crème, P. and M. Lea.Writing at University: A guide for students.OUP, NewDelhi.2003
5. http://www.stevepavlina.com/blog/2006/08/10-ways-to-improve-your-technical-skills/http://www.nyu.edu/classes/keefer/brain/net2.html
6. https://www.udemy.com/technical-writing-and-editing/
7. http://techwhirl.com/what-is-technical-writing/

B.E/B.Tech **2018-2019**

18BESHOE06/18BTSHOE06 **3H-3C**

GEOPHYSICS

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

End Semester Exam:3Hours

Course Objective:

- To inculcate the basics of brief history of Earth sciences
- To divulge knowledge on the basics of structure of earth and earth's gravitational field.
- To disseminate the fundamentals of magnetic field and thermal distribution of earth
- To introduce the concepts of seismology and seismic waves.
- To impart the basic knowledge of oceans
- To understand the basics and properties of sea water.

Course Outcome:

Upon completion of this course, the students will be able to

1. Gain knowledge on the basics of history of Earth sciences.
2. Acquire knowledge on concepts of structure of earth and earth's gravitational field.
3. Have adequate knowledge on the concepts of magnetic field and thermal distribution of earth
4. Obtain knowledge on the basics of seismic waves.
5. Understand the basics of oceans and properties of sea water.
6. Apply the knowledge gained from this course to solve the relevant problems in engineering stream.

UNITI ORIGIN OFEARTH

A brief history of the development of Earth Sciences . An overview of Geophysical methods and their essential features, Problems of inversion and non-uniqueness in Geophysics, Origin & evolution of Solar system, Earth and Moon structure,.Kepler's law of planetary motion, A review of the Earth's structure and composition

UNITII STRUCTURE OFEARTH

Chemical composition of Earth, Rheological behavior of crust and upper mantle, viscoelasticity and rock failure criteria, Geochronology: Radiometric dating and their advantages, meaning of radiometric ages, Major features of the Earth's gravitational field and relationship with tectonic processes in the crust and upper mantle, concept of isostasy, mathematical concept of Airy and Pratt hypotheses ofisostasy

UNITIII MAGNETIC FIELD AND THERMAL DISTRUBUTION OFEARTH

Origin of geomagnetic field, polar wandering, secular variations and westward drift, reversals of geomagnetic field, sun spot, solar flares, geomagnetic storms, sea-floor spreading, Paleomagnetism and its uses, Thermal history of the Earth, sources of heat generation and temperature distribution inside the earth, convection in the mantle

UNITIV SEISMOLOGY

Earthquake seismology, Earthquakes and its classifications, Global seismicity and tectonics, Earth's internal structure derived from seismology, Earthquake mechanism and Anderson's theory of faulting, Continental drift and plate tectonics: its essential features, present day plate motions, Triple junctions, oceanic ridges, Benioff zones, arcs, hot spots, Mantle Plume, Mountain building, origin of Himalaya, Geodynamics of Indian subcontinent.

UNIT VOCEANS

Physical properties of seawater and methods of determination, distribution of salinity in the oceans, factors affecting salinity, water masses and water type, TS Diagram, Circulation of currents in major ocean waves. Tides: Dynamical and equilibrium theory of tides. Marine pollution, steps to control marine pollution, Laws of seas, Coastal zone management

Total: 45

Suggested Readings:

1. B.F. Howell, Introduction to Geophysics, McGraw-Hill,2007.
2. W. Lowrie, Fundamentals of Geophysics, Cambridge University Press,2007.
3. J.A. Jacobs, R.D. Russel, Physics and Geology,McGraw-Hill.2002.
4. www.ocw.mit.edu
5. www.physicsclassroom.com
6. www.nptel.ac.in
7. www.physics.org

B.E/B.Tech **2018-2019**

18BESHOE07/18BTSHOE07 **3H-3C**

ENGINEERING ACOUSTICS

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

End Semester Exam:3Hours

COURSE OBJECTIVES:

- To disseminate the fundamentals of acoustic waves.
- To inculcate the characteristics of radiation and reception of acoustic waves.
- To divulge knowledge on the basics of pipe resonators and filters.
- To introduce the features of architectural acoustics.
- To impart the basic knowledge of transducers and receivers.
- To apply the knowledge inputs of the course for engineering applications.

COURSE OUTCOME:

1. Develop the idea of the fundamentals of acoustic waves.
2. Apply the concepts of radiation and reception of acoustic waves.
3. Explain the basic ideas of pipe resonators and filters.
4. Illusrate the basics of architectural acoustics..
5. Illustrate the transducers and receivers and its applications in various electronic devices.
6. Apply the knowledge inputs of the course for engineering applications.

UNITI INTRODUCTION

Acoustics waves – Linear wave equation – sound in fluids – Harmonic plane waves - Acoustics intensity – Specific acoustic impedance – spherical waves – Describer scales.Reflection and Transmission: Transmission from one fluid to another normal and oblique incidence –method ofimages.

UNIT IIRADIATION AND RECEPTION OF ACOUSTIC WAVES

Radiation from a pulsating sphere – Acoustic reciprocity – continuous line sourceradiation impedance - Fundamental properties of transducers.Absorption and attenuation of sound. Absorption from viscosity – complex sound speed and absorption – classical absorptioncoefficient

UNITIII PIPES RESONATORS ANDFILTERS

Resonance in pipes - standing wave pattern absorption of sound in pipes – long wavelength limit – Helmoltz resonator - acoustic impedance - reflection and transmission of waves in pipe - acoustic filters – low pass, high pass and band pass. Noise, Signal detection, Hearing and speech. Noise, spectrum level and band level – combing band levels and tones –

detecting signals in noise – fundamental properties of hearing – loudness level and loudness – pitch and frequency – voice.

UNITIV ARCHITECTURAL ACOUSTICS

Sound in endosure – A simple model for the growth of sound in a room – reverberation time - Sabine, sound absorption materials – measurement of the acoustic output of sound sources in live rooms – acoustics factor in architectural design. Environmental Acoustics: Highway noise – noise induced hearing loss – noise and architectural design specification and measurement of some isolation design ofportions.

UNITV TRANSDUCTION

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

Total: 45

Suggested Readings:

1. LawerenceE.Kinsler, Austin R.Frey, Fundamentals of Acoustics, John Wiley &Sons, 4th edition2000.
2. F. Alton Everest &Ken Pohlmann, Master Handbook of Acoustics, McGraw Hill Professional, 6th edition2014.
3. www.acousticalsociety.org
4. www.acoustics-engineering.com
5. www.nptel.ac.in
6. www.ocw.mit.edu

18BESHOE08/18BTSHOE08 **3H-3C**

INDUSTRIAL MATHEMATICS – I

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

End Semester Exam:3Hours

OBJECTIVES:

- To develop analytical skills for solving engineeringproblems
- To teach the students the basic concepts ofLPP,
- To learn the techniques to solve transportation and Assignmentproblems
- To make the students to study about the Integer Programming and Network Analysis
- Analyse the results and propose recommendations to the decision-making processes in ManagementEngineering
- To formulate and solve problems as networks.

INTENDED OUTCOMES:

1. To define and formulate linear programming problems and appreciate their limitations.
2. To solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives foraction.
3. To be able to build and solve Transportation Models, AssignmentModels,
4. To construct linear integer programming models and discuss the solutiontechniques.
5. To formulate and solve problems as networks and graphs.
6. To be able to solve problems in different environments and develop critical thinking

UNITI LINEAR PROGRAMMING PROBLEM

Formulation of LPP - Graphical Method - Simplex Method - Artificial variable technique and two phase simplex method. Duality - Dual and simplex method - Dual Simplex Method.

UNITII TRANSPORTATIONPROBLEM

Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

UNITIII ASSIGNMENTPROBLEM

Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

UNITIV INTEGER PROGRAMMING

Integer Programming Problem – Gromory's fractional cut Method – Branch Bound Method

UNITV NETWORKANALYSIS

PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis.

Total : 45

Suggested Readings:

1. HamdyTaha. A., Operations Research, Prentice – Hall ofIndia Private Limited, New Delhi.2013.
2. KantiSwarup, Manmohan, Gupta, Operations Research, Sultan Chand & Sons, New Delhi.2010.
3. Natarajan A.M., Balasubramani P., Thamilarasi A, Operations Research, Pearson Education, New Delhi.2005.
4. Srinivasan G, Operations Research: Principles and Applications, PHI Private Limited, NewDelhi.2007.
5. Winston, Operations Research, Applications and Algorithms, Cengage Learning India Pvt. Ltd, NewDelhi,2004.
6. www.mathworld.
7. Wolfram.com
8. www.mit.edu
9. www.nptel.com

B.E/B.Tech **2018-2019**

18BESHOE09/18BTSHOE09 **3H-3C**

INDUSTRIAL MATHEMATICS – II

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

End Semester Exam:3Hours

OBJECTIVES:

- To kindle analytical skills for solving engineeringproblems
- To impact the knowledge about inventorymodels
- To learn replacement models and simulationmodels
- To provide techniques for effective methods to solve nonlinear programming and decisionmaking.
- To analyse the results and propose recommendations to the decision-making processes in ManagementEngineering
- To solve problems using non integer programming.

INTENDED OUTCOMES:

The students will

1. To be able to solve simple models in Inventory problems and Replacement problems.
2. To understand different queuing situations and find the optimal solutions using models for differentsituations.
3. Simulate different real life probabilistic situations using Monte Carlo simulationtechnique.
4. To be able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in eachtype.
5. Convert and solve the practical situations into replacementmodels.
6. To understand how to model and solve problems using non integer programming.

UNIT– I INVENTORYMODELS

Economic order quantity models-techniques in inventory management-ABC analysis.

UNIT– II NON LINEARPROGRAMMING

Khun-tucker conditions with non-negative constraints- Quadratic programming- Wolf's modified simplex method.

UNIT– III SIMULATION MODELS

Elements of simulation model -Monte Carlo technique – applications. Queuing model: problems involving (M\M\1): (∞\FIFO) , (M\M\c): (∞\FIFO) Models.

UNIT-IV DECISIONMODELS

Decision Analysis – Decision Making environment – Decisions under uncertainty – Decision under risk – Decision – TreeAnalysis.

UNIT-V REPLACEMENT MODELS

Models based on models that gradually detoriate with time-whose maintenance cost increase with time-Replacement of items that fail suddenly and completely.

Total : 45

Suggested Readings:

1. HamdyTaha. A., Operations Research, Prentice – Hall ofIndia Private Limited, New Delhi.2013.
2. KantiSwarup, Manmohan, Gupta, Operations Research, Sultan Chand & Sons, New Delhi.2010.
3. Natarajan A.M., Balasubramani P., Thamilarasi A, Operations Research, Pearson Education, New Delhi.2005.
4. Srinivasan G, Operations Research: Principles and Applications, PHI Private Limited, NewDelhi.2007.
5. Winston, Operations Research, Applications and Algorithms, Cengage Learning India Pvt. Ltd, NewDelhi,2004.
6. www.mathworld.
7. Wolfram.com
8. www.mit.edu
9. www.nptel.com

FUZZY MATHEMATICS

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

COURSE OBJECTIVES:

- Beabletounderstandbasicknowledgeoffuzzysetsand fuzzylogic
- Be able to apply basic knowledge of fuzzyoperations.
- To know the basic definitions of fuzzyrelations
- Be able to apply basic fuzzy inference and approximatereasoning
- To know the applications of fuzzyTechnology.
- To understand the concept of fuzziness involved in various systems.

COURSE OUTCOME:

1. To gain the main subject of fuzzysets.
2. To understand the concept of fuzziness involved in various systems and fuzzy settheory.
3. To gain the methods of fuzzylogic.
4. To comprehend the concepts of fuzzyrelations.
5. To analyze the application of fuzzy logic control to real timesystems.
6. The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzytechnology.

UNITI FUZZY SETS

Fuzzy Sets : Basics Classical sets vs Fuzzy Sets – Need for fuzzy sets – Definition and Mathematical representations – Level Sets – Fuzzy functions - Zadeh's Extension Principle

UNITII OPERATIONS ON FUZZY SETS

Operations on Fuzzy Sets Operations on [0,1] – Fuzzy negation, triangular norms, tconorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

UNITIII FUZZY RELATIONS

Fuzzy Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

UNITIV FUZZY MEASURES

Possibility Theory Fuzzy Measures – Evidence Theory – Necessity and Belief Measures – Probability Measures vs Possibility Measures

UNITV FUZZY INFERENCE

Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

Total : 45

Suggested Readings:

1. George J Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic : Theory and Applications, Prentice Hall of India, NewDelhi,2003.
2. Zimmermann H.J. Fuzzy Set Theory and its Applications, Kluwer Academic publishers, USA.2001.
3. Michal Baczynski and BalasubramaniamJayaram, Fuzzy Implications, Springer-Verlag publishers,Heidelberg,2008
4. Kevin M Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman publishers,USA,1998.

18BESHOE11/18BTSHOE11 **3H-3C**

MATHEMATICAL PHYSICS

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

End Semester Exam:3Hours

COURSE OBJECTIVES:

- To know the fundamentals ofTensors.
- To know the series solutions to differentialequations.
- To introduce the concepts of specialfunctions.
- To study about Calculus of variations and integralequations
- Be familiar with the main mathematical methods used inphysics.
- To learn different ways of solving second order differential equations.

COURSE OUTCOME:

1. Students will demonstrate proficiency in mathematics and the mathematical concepts needed for a proper understanding ofphysics.
2. Learn about special type of matrices that are relevant in physics and then learn about tensors.
3. Get introduced to Special functions like Bessel, Legendre , Hermite and Laguerre functions and their recurrencerelations
4. Learn different ways of solving second order differential equations and familiarized with singular points and Frobeniusmethod.
5. Students will master in calculus of variations and linear integralequations.
6. The students will have the knowledge on Mathematical Physics and that knowledge will be used by them in different engineering and technologyapplications.

UNITI TENSORS

Definition of tensor - rank, symmetric tensors, contraction, quotient rule - tensors with zero components, tensor equations, metric tensors and their determinants - pseudo tensors

UNITII DIFFERENTIAL EQUATIONS-SERIESSOLUTIONS

Series Solution : Classification of singularities of an ordinary differential equation - Series solution-Method of Frobenius - indicial equation - examples

UNITIII SPECIALFUNCTIONS

Basic properties (Recurrence and Orthogonality relations, series expansion) of Bessel, Legendre ,Hermite and Laguerre functions – Generating Function

UNIT IV CALCULUS OF VARIATIONS

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric Problems – Direct methods – Ritz and Kantorovich methods.

UNIT V LINEAR INTEGRAL EQUATIONS

Introduction – conversion of a linear differential equation to an integral equations and vice versa – conversion of boundary value problem to integral equations using Green's function – solution of aintegral equation – integral equations of the convolution type – Abel's integral equations – integro–differential equations – integral equations with separable kernels – solution of Fredholm equations with separable kernels.

Total : 45

Suggested Readings:

1. Dr. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, NewDelhi.2013.
2. Murray R Spiegel, Seymour Lipschutz, Dennis Spellman, Vector Analysis, TataMcGraw Hill Education Pvt. Ltd., New Delhi,2010
3. Stephenson, G, Radmore, P.M, Advanced Mathematical Methods for Engineering and Science students, Cambridge University Press India Pvt. Ltd., NewDelhi,1990.
4. Andrews, Larry C. Special Functions ofMathematicsfor Engineers, Oxford Science publishers, NewDelhi,1997.
5. www.mathcentre.ac.uk
6. www.mathworld.
7. wolfram.com
8. www.nptel.ac.in

LINEAR ALGEBRA

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

COURSE OBJECTIVES:

- To introduce the basic concepts of vectorspace
- To know the fundamentals of linearAlgebra
- To solve system of linear equations
- To study about the lineartransformations
- To introduce the concepts of inner productspaces
- To apply the basic concepts in their respective fields

COURSE OUTCOMES:

The student will be able to

1. To explain the fundamental concepts of advanced algebra and their role inmodern mathematics and appliedcontexts.
2. To describe the fundamental concepts of Eigen values and Eigen vectors by using Power method.
3. To apply the fundamental concepts in their respective engineeringfields
4. To visualize linear transformations as matrix form
5. To recognize the underlying theory of vector spaces over a field and innerproduct spaces over real or complexnumbers
6. To articulate the importance of Linear Algebra and its applications in branchesof Mathematics

UNITI VECTOR SPACES

General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space,

UNITII EIGEN VALUES AND EIGENVECTORS

Eigen values and Eigen vectors - Diagonalization - Power method - QR decomposition

UNITIII SYSTEM OF LINEAREQUATIONS

Direct methods, Gauss elimination method, Gauss Jordan method, Crout's method, iterative methods, Gauss-Jacobi method, Gauss–Seidel method, convergence criteria.

UNIT IV LINEAR TRANSFORMATIONS

Linear Transformations - The Null Space and Range - Isomorphisms - Matrix Representation of Linear Transformations – Similarity - Eigenvalues and Eigenvectors Eigen values and Eigen vectors -Diagonalization

UNIT V INNER PRODUCT SPACES

The Dot Product on R^n and Inner Product Spaces - Orthonormal Bases - Orthogonal Complements - Application : Least Squares Approximation - Diagonalization of Symmetric M - Application: Quadratic Forms

Total : 45

Suggested Readings:

1. Kreyszig,E, Advanced Engineering Mathematics, John Wiley & Sons, NewDelhi.,2014.
2. Anton and Rorres, Elementary Linear Algebra, Applications version, Wiley India Edition, NewDelhi,2012.
3. Jim Defranza, Daniel Gagliardi, Introduction to Linear Algebra with Application, Tata McGraw-Hill, NewDelhi.2008.
4. wolfram.com
5. www.sosmath.com
6. www.nptel.ac.in
7. www.mathworld.

		L	T	P	C
18BECSOE01	**INTERNET PROGRAMMING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study concepts of Internet, IP addresses and protocols
- To explain the concept of web page development through HTML
- To introduce the PERL and explore its current strengths and Weaknesses
- To write working Java code to demonstrate the use of applets for client side programming
- To study Internet telephony and various multimedia applications
- To Elaborate on the principles of web page development

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Learn the advanced concepts& techniques of Internet and Java.
- Analyze the requirements for and create and implement the principles of web page development
- Understand the concepts ofPERL
- Implement client side programming using java applets
- Generate internet telephony based upon advanced concepts
- Develop applications on internet programming based on java applets and scripts

UNITI Introduction (9)

Introduction - Network of Networks, Intranet, Extranet and Internet.World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing- Classful and Classless Addressing, Subnetting

UNITII HTML (9)

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps- map, area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.CGI Scripts- Introduction- Environment Variable, GET and POST Methods.

UNITIII PERL (9)

Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments, variable, comparison,condition,switch,loop,break.Object–string,array,Boolean,reg-ex.Function,Errors,

Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets- Container Class, Components, Applet Life Cycle, Update method, Applications.

UNIT IV Client-Serverprogramming (9)

Client-Server programming In Java - Java Socket, Java RMI. Threats - Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks- Network security techniques- Password and Authentication- VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall- Introduction, Packet filtering, Stateful, Application layer, Proxy.

UNIT V InternetTelephony (9)

Introduction, VoIP- Multimedia Applications- Multimedia over IP: RSVP, RTP, RTCP and RTSP- Streaming media, Codec and Plugins, IPTV- Search Engine and Web Crawler- Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

Total Hours: 45

TEXT BOOKS:

1. Paul Deitel, Harvey Deitel and Abby Deitel, “Internet and World Wide Web-How to Program”, 5th Edition,2011.

2. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi,2013.

REFERENCES:

1. Rahul Banerjee, Internetworking Technologies, An Engineering Perspective, PHI Learning, Delhi,2011.

2. Robert W. Sebesta, “Programming the World Wide Web”, Pearson Education,2016

		L	T	P	C
18BECSOE02	**MULTIMEDIA AND ANIMATION**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To impart the fundamental concepts of Computer Animation and Multimedia
- To study the graphic techniques and algorithms using flash
- Explain various concepts available in 3D animation
- Explain various devices available for animation
- To study the multimedia concepts and various I/O technologies for concept development
- To understand the three-dimensional graphics and their transformations

COURSE OUTCOMES:

Upon completion of this course, the student will be able to:

- Develop their creativity using animation and multimedia
- Understand the concepts of Flash and able to develop animation using it
- Understand about various latest interactive 3D animation concepts
- Know the various devices and software available in motion capture
- Understand the concept development process
- Develop an interactive multimedia presentation by using multimedia devices and identify theoretical and practical aspects in designing multimedia applications surrounding the emergence of multimedia technology.

UNITI Introduction (9)

What is mean by Animation – Why we need Animation – History of Animation– Uses of Animation – Types of Animation – Principles of Animation – Some Techniques of Animation – Animation on the WEB – 3D Animation – Special Effects -Creating Animation.

UNITII Creating Animationin Flash (9)

Introduction to Flash Animation – Introduction to Flash – Working with the Timeline and Frame-basedAnimation-WorkingwiththeTimelineandTween-basedAnimation–UnderstandingLayers - Action script.

UNITIII 3D Animation &itsConcepts (9)

Types of 3D Animation – Skeleton & Kinetic 3D Animation – Texturing & Lighting of 3D Animation – 3D Camera Tracking – Applications & Software of 3D Animation.

UNITIV Motion Caption (9)

Formats – Methods – Usages – Expression – Motion Capture Software's – Script Animation Usage – Different Language of Script Animation Among the Software.

UNITV Concept Development (9)

Story Developing – Audio & Video – Color Model – Device Independent Color Model – Gamma and Gamma Correction - Production Budgets- 3D Animated Movies.

Total Hours: 45

TEXT BOOK:

1. Computer Graphics, Multimedia and Animation-Malay K. Pakhira,PHI Learning PVT Ltd,2010

REFERENCES:

1. Principles of Multimedia – Ranjan Parekh, 2007, TMH. (Unit I, UnitV)

2. Multimedia Technologies – Ashok Banerji, Ananda Mohan Ghosh – McGraw Hill Publication.

3. Encyclopedia of Multimedia and Animations-Pankaj Dhaka, AnmolPublications-2011

18BECSOE03 **PC HARDWARE AND TROUBLE SHOOTING** **L T P C**

COURSE OBJECTIVES:

- To study the basic parts of computer in detail
- Introduce various peripheral devices available for computer and its detailed working concepts
- Overview of various interfaces and other hardware overview
- Assemble/setup and upgrade personal computer systems and discuss about power supplies and the skills to trouble-shoot various power-related problems.
- To study basic concepts and methods in troubleshooting
- To study the installation/connectionand maintenance of computer and its associated peripherals.

COURSE OUTCOME:

Upon completion of this course, the student will be able to:

- Identify the main components for the PC, familiarize themselves with PC memories such as RAM and ROM devices and so on.
- Identify various peripheral devices available and its working
- Understand various concepts of hardware and its interface and control
- Perform basic installation of PC. Importance of maintenance is understood
- Understand Various faults and failures are identified and troubleshooting in detail
- Understand overall PC hardware, interfacing, maintenance and troubleshooting

.

UNITI Introduction (9)

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

UNIT II PeripheralDevices (9)

Introduction – Keyboard – CRT Display Monitor – Printer – Magnetic Storage Devices – FDD – HDD – Special Types of Disk Drives – Mouse and Trackball – Modem – Fax-Modem – CD ROM Drive – Scanner – Digital Camera – DVD – Special Peripherals.

UNITIII PCHardwareOverview (9)

Introduction – Hardware BIOS DOS Interaction – The PC family – PC hardware – Inside the System Box – Motherboard Logic – Memory Space – Peripheral Interfaces and Controllers – Keyboard Interface – CRT Display interface – FDC – HDC.

UNITIV Installation andPreventiveMaintenance (9)

Introduction – system configuration – pre installation planning – Installation practice – routine checks – PC Assembling and integration – BIOS setup – Engineering versions and compatibility – preventive maintenance – DOS – Virus – Data Recovery.

UNITV Troubleshooting (9)

Introduction – computer faults – Nature of faults – Types of faults – Diagnostic programs and tools – Microprocessor and Firmware – Programmable LSI's – Bus Faults – Faults Elimination process – Systematic Troubleshooting – Symptoms observation and analysis – fault diagnosis – fault rectification – Troubleshooting levels – FDD, HDD, CD ROMProblems.

Total Hours: 45

TEXT BOOK:

1. B. Govindarajalu, "IBM PC Clones Hardware, Troubleshooting and Maintenance", 2/E, TMH, 2002.

REFERENCES:

1. Peter Abel, Niyaz Nizamuddin, "IMB PC Assembly Language and Programming",Pearson Education,2007
2. Scott Mueller, "Repairing PC's", PHI,1992

18BECSOE04	JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads, generics classes and swings
- To explain the need for generic programming
- To design and build simple Graphical User Interfaces

COURSE OUTCOMES:

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

- Develop Java programs using OOP principles
- Develop Java programs with the concepts inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with threads and generics classes and swings
- Understand various aspects for motivation of generic programming
- Develop various interactive Java programs using OOP concepts of Java

UNITI INTRODUCTION TOJAVA (9)

Object oriented programming concepts – objects – classes – methods and messages –abstraction andencapsulation–inheritance–abstractclasses–polymorphism.-ObjectsandclassesinJava – defining classes – methods - access specifiers – static members –constructors – finalizemethod

UNITII PACKAGES (9)

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – class hierarchy – polymorphism – dynamic binding – final keyword – abstract classes

UNITIII I/OSTREAMS (9)

The Object class – Reflection – interfaces – object cloning – inner classes – proxies - I/O Streams - Graphics programming – Frame – Components – working with 2Dshapes.

UNITIV EXCEPTION HANDLING (9)

Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy – introduction to Swing – Model-View-Controller design pattern –buttons – layout management – Swing Components – exception handling – exception hierarchy – throwing and catching exceptions.

UNITV MOTIVATION FORGENERICPROGRAMMING (9)

Motivation for generic programming – generic classes – generic methods – generic code and virtual machine – inheritance and generics – reflection and generics - Multi-threaded programming – interrupting threads – thread states – thread properties – thread synchronization – Executors – synchronizers.

TEXT BOOK:

1. Cay S. Horstmann and Gary Cornell Core Java: Volume I – Fundamentals Sun Microsystems Press 2008

REFERENCES:

1. K. Arnold and J. Gosling The JAVA programming languageThirdedition, Pearson Education,2009
2. Timothy Budd Understanding Object-oriented programming with Java Updated Edition, Pearson Education2002
3. C. Thomas Wu An introduction to Object-oriented programming with Java Fourth Edition, Tata McGraw-Hill Publishing company Ltd.,2008

WEBSITES:

1. http://elvis.rowan.edu/~kay/cpp/vc6_tutorial/
2. http://www.winprog.org/tutorial/msvc.html
3. http://www.tutorialized.com/tutorials/Visual-C/1
4. http://www.freeprogrammingresources.com/visualcpp.html

18BEEEOE01 **ELECTRIC HYBRID VEHICLE** **3H-3C**

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

Course Objectives

- To understand the basic concepts of electric hybrid vehicle.
- To gain the knowledge about electric propulsion unit.
- To gain the concept of Hybrid Electric Drive-Trains.
- To gain the different Energy Management Strategies.
- To study about the effciency manipulation in drives
- To understand and gain the knowledge about various energy storage devices

Course Outcomes:

- Summarize the basic concepts in bioprocess Engineering.
- Explain the concept of Hybrid Electric Vehicles.
- Understand the concept of Hybrid Electric Drive-Trains.
- Identify the different Energy Management Strategies.
- Understand the concept of different Energy Storage devices.
- Analyze the different motor drives used in Hybrid Electric Vehicles.

UNIT I INTRODUCTION

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II HYBRID ELECTRIC DRIVE-TRAINS

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III ELECTRIC PROPULSION UNIT

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV ENERGY STORAGE

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT V ENERGY MANAGEMENT STRATEGIES

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Suggested Readings

1. Iqbal Hussein Electric and Hybrid Vehicles: Design Fundamentals CRC Press – 2nd edition 2010.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design Standardsmedia – 2nd edition 2009.
3. James Larminie, John Lowry Electric Vehicle Technology Wiley – 2nd edition 2012

18BEEEOE02 ENERGY MANAGEMENT AND ENERGY AUDITING 3H-3C

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

Course Objectives:

- To gain the knowledge about energy management.
- To understand the basic concepts in economic analysis in energy management.
- To understand the basic principles of energy audit.
- To gain the knowledge about the basic concept of types of Energy Audit
- To gain and Evaluate the different energy efficient motors
- Understand the concept of Energy conservation.
- To study about the behaviour changes of PF requirement in motor currents

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the concept of Energy Management.
- Analyze the different methods for economic analysis
- Knowledge about the basic concept of Energy Audit and types.
- Evaluate the different energy efficient motors
- Understand the concept of Energy conservation.
- Investigate the different methods to improve power factor.

UNIT I ENERGY MANAGEMENT

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting –Energy Auditor and Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management.

UNIT II ECONOMIC ASPECTS AND ANALYSIS

Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.

UNIT III BASIC PRINCIPLES OF ENERGY AUDIT

Energy audit – definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT IV ENERGY EFFICIENT MOTORS

Electric Motors: Factors affecting efficiency - Energy efficient motors - constructional details, characteristics - voltage variation –over motoring – motor energy audit-

Energy conservation: Importance-energy saving measures in DG set-fans and blowers pumps- air conditioning system- energy efficient transformers.

UNIT V POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS

Power factor - methods of improvement, location of capacitors, p.f with non linear loads, effect of harmonics on p.f,- p.f motor controllers –Energy efficient lighting system design and practice-lighting control– Measuring Instruments – wattmeter, data loggers, thermocouples, pyrometers, lux meters, tong testers, application of PLCs.

Suggested Readings

1. Murphy W.R. and G.Mckay Butter worth Energy Management Heinemann Publications 2007.
2. John.C. Andreas Energy Efficient Electric Motors Marcel Dekker Inc Ltd – 3rd edition 2005.
3. W.C.Turner Steve Doty Energy Management Handbook Lulu Enterprises, Inc. - 8th Edition Volume II 2013.

18BEEEOE03 PROGRAMMABLE LOGIC CONTROLLER 3H-3C

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

Course Objectives

- To understand the basic principles of PLC systems.
- To gain the knowledge about data handling functions.
- To gain the knowlege of storage techniques in PLC
- To acquire the knowledge about how to handle the data and functions
- To study about flo charts of ladder and spray process system
- To understand the principles of PID.

Course Outcome

- At the end of the course the student will be able to understand the registers and functions in PLC and they are able to do the program.
- To acquire the knowlege of storage techniques in PLC
- Students know how to handle the data and functions
- Students known about advanced controller in PLC applications
- Students gather real time industrail application of PLC
- Students gathered and evaluate the flow charts of ladder and spray process system

UNIT I INTRODUCTION

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment Programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT II PLC PROGRAMMING

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT III REGISTERS AND PLC FUNCTIONS

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT IV DATA HANDLING FUNCTIONS

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT V PID PRINCIPLES

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

Suggested Readings

1. JR Hackworth and F.D Hackworth – Jr Programmable Logic Controllers – Programming Method and Applications Pearson 2006
2. John Webb and Ronald A Reiss Programmable Logic Controllers – Principle and Applications Fifth edition, PHI 2004
3. W.Bolton Programmable Logic controller Elsevier Newnes Publications, 5th Edition 2009

18BEEEOE04 RENEWABLE ENERGY RESOURCES 3H-3C

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

Course Objectives

- To gain the knowledge about environmental aspects of energy utilization.
- To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
- To study about solar energy collectors and its storages
- To study about the inter connected system in wind power
- To understand the basic principles fuel cell, Geo thermal power plants.
- To gain the knowledge about hydro energy.

Course Outcomes

At the end of this course, students will demonstrate the ability to

- Analyze the Energy Scenario in india
- Understand the concept of Solar Energy
- Understand the concept of Wind Energy
- Understand the concept of Hydro Energy
- Analyze the different energy sources
- Students gathered the real time inter connected system modelling in wind power

UNIT I INTRODUCTION

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2003.

UNIT II SOLAR ENERGY

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

UNIT III WIND ENERGY

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNIT IV HYDRO ENERGY

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNIT V OTHER SOURCES

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

Suggested Readings

1. Rai.G.D Non-conventional sources of energy Khanna publishers 2011
2. Khan.B.H Non-Conventional Energy Resources The McGraw Hills, Second edition 2009
3. Rao.S. & Parulekar Energy Technology Khanna publishers, Eleventh Reprint 2013
4. Godfrey Boyl Renewable Energy: Power sustainable future Oxford University Press, Third edition 2012.
5. John W Twidell and Anthony D Weir Renewable Energy Resources Taylor and Francis – 3rd edition 2015.

LIST OF OPEN ELECTIVES OFFERED BY ELECTRONICS AND COMMUNICATION ENGINEERING TO OTHER DEPARTMENTS

B.E Electronics and Communication Engineering **2018-2019**

Semester-__

18BEECOE01 Real Time Embedded Systems 3H-3C

Instruction Hours/week: L: 3 T:1P:0 **Marks:** Internal**:40**External**:60**Total**:100**

End Semester Exam:3Hours

Course Objectives

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

Course Outcomes

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

- Understand overview of embedded systems architecture
- Acquire knowledge on embedded system, its hardware and software.
- Gain knowledge on overview of Operating system
- Discuss about task Management
- Gain knowledge about semaphore management and message passing.
- Gain knowledge about memory management.

UNIT-I INTRODUCTION TO EMBEDDED SYSTEM

Introduction- Embedded systems description, definition, design considerations & requirements- Overview of Embedded System Architecture (CISC and RISC)-Categories of Embedded Systems- embedded processor selection & tradeoffs- Embedded design life cycle -Product specifications- hardware / software partitioning- iterations and implementation- hardware software integration – product testing techniques–ARM7.

UNIT-II OPERATING SYSTEM OVERVIEW

Introduction–Advantage and Disadvantage of Using RTOS–Multitasking–Tasks-Real Time Kernels – Scheduler- Non-Preemptive Kernels – Preemptive Kernels – Reentrancy- Reentrant Functions– Round Robin Scheduling- Task Priorities- Static Priorities– Mutual Exclusion– Deadlock– Inter task Communication–Message Mailboxes–Message Queues- Interrupts- Task Management–Memory Management-Time Management–Clock Ticks.

UNIT-III TASK MANAGEMENT

Introduction-µ C/OS-II Features-Goals ofµ C/OS-II-Hardware and Software Architecture– Kernel Structures: Tasks–Task States–Task Scheduling–IdleTask–Statistics Task–Interrupts

Under µC/OS-II –Clock Tick-µ C/OS- II Initialization. Task Management: Creating Tasks– Task Stacks–StackChecking–Task'sPriority–SuspendingTask– esumingTask.TimeManagement: Delaying a Task–Resuming a Delayed Task–System Time. Event Control Blocks-Placing a Task in the ECB Wait List–Removing a Task from an ECB waitList.

UNIT-IV SEMAPHORE MANAGEMENT AND MESSAGE PASSING

Semaphore Management: Semaphore Management Overview– Signaling a Semaphore. Message Mailbox Management: Creating a Mailbox –Deleting Mailbox–Waiting for a Message box– Sending Message to a Mailbox- Status of Mailbox. Message Queue Management: Creating Message Queue– Deleting a Message Queue–Waiting for a Message Queue–Sending Message to a Queue– Flushing a Queue.

UNIT-V MEMORY MANAGEMENT

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

SUGGESTED READINGS

1. Floyd JeanJ. Labrosse Micro C/OS–II The Real Time Kernel CMPBOOKS2009
2. David Seal ARM Architecture Reference Manual.Addison-Wesley2008
3. Steve Furbe, ARM System-on-Chip Architecture, Addison-Wesley Professional, California2000.
4. K.V.K.K.Prasad Embedded Real-Time Systems: Concepts, Design & Programming Dream Tech Press 2005.
5. Sriram V Iyer, Pankaj Gupta Embedded Real Time Systems Programming Tata Mc Graw Hill2004

Semester-__

18BEECOE02 **Consumer Electronics** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- To study about various speakers and microphone
- To learn the fundamental of television systems and standards
- To learn the process of audio recording and reproduction
- To study various telephone networks
- To discuss about the working of home appliances
- To familiarize with TV services like ISDN.

Course Outcomes

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

- Understand working of various type of loud speakers
- Acquire knowledge on various types of picture tubes
- Demonstrate the working of various optical recording systems
- Distinguish various standards for color TV system
- Acquire knowledge on various telecommunication networks
- Demonstrate the working of various home appliances

UNIT-I LOUDSPEAKERS AND MICROPHONES

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters – Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones.

UNIT-II TELEVISION STANDARDS AND SYSTEMS

Components of a TV system–interlacing–composite video signal. Colour TV– Luminance and Chrominance signal; Monochrome and Colour Picture Tubes- Color TV systems– NTSC, PAL, SECAM-Components of a Remote Control.

UNIT-III OPTICAL RECORDING ANDREPRODUCTION

Audio Disc– Processing of the Audio signal–readout from the Disc –Reconstruction of the audio signal–Video Disc–Video disc formats- recording systems–Playback Systems.

UNIT-IV TELECOMMUNICATIONSYSTEMS

Telephone services-telephone networks–switching system principles–PAPX switching–Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network.Wireless Local Loop.VHF/UHF radio systems, Limited range Cordless Phones; cellular modems.

UNIT-V HOME APPLIANCES

Basic principle and block diagram of microwave oven; washing machine hardware and

software; Components of air conditioning and refrigeration systems.

SUGGESTED READINGS

1. S.P. Bali Consumer Electronics Pearson Education 2007
2. J.S.Chitode Consumer Electronics Technical Publications 2007
3. Philip Hoff, Philip Herbert Hoff Consumer Electronics for Engineers Cambridge University Press1998

Semester-__

18BEECOE03 **Neural Networks and its Applications** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- To introduce the basic concepts of neural networks and its applications in various domain
- To educate how to use Soft Computing to solve real-world problems
- To have a solid understanding of Basic Neural Network.
- To provide students with a sound and comprehensive understanding of artificial neural networks and machine learning.
- To gain exposure in the field of neural networks and relate the human neural system into the digital world
- To provide knowledge of computation and dynamical systems using neural networks

Course Outcomes

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

- Understand the basic concepts of neural networks and its applications in various domains
- Gain knowledge about learning process in Neural Networks
- Apply perception concept in design
- Design using ART phenomena
- Gain knowledge on SOM concepts
- Ability to develop the use of Soft Computing to solve real-world problems

UNIT-I INTRODUCTION TO NEURAL NETWORKS

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules-types of neural networks-single layer, multiple layer-feed forward, feedback networks

UNIT-II LEARNING PROCESS

Error– correction learning– memory based learning- hebbian learning-competitive learning-Boltzmann learning-supervised and unsupervised learning-adaptation-statistical learning theory.

UNIT-III PERCEPTION

Single layer Perception-Adaptive filtering-unconstrained Optimization-Least-mean square algorithm- Leaning Curve-Annealing Technique-perception convergence Theorem-Relationship between perception and Baye's Classifier-Back propagation algorithm

UNIT-IV ATTRACT OR NEURAL NETWORK AND ART

Hopfield model-BAM model -BAM Stability-Adaptive BAM -Lyapunov function-effect of gain- Hopfield Design-Application to TSP problem-ART-layer 1-layer 2-orienting subsystem- ART algorithm-ARTMAP.

UNIT-V SELF ORGANIZATION

Self-organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical Vector Quantization. Applications of self-organizing maps: The Neural Phonetic Type Writer Learning Ballistic Arm Movements.

SUGGESTED READINGS

1. SimonHaykin Neural Networks and Learning Machines 3rd Edition Pearson/Prentice Hall 2009
2. SatishKumar Neural Networks: A Classroom Approach TMH2008
3. Rajasekaran.S, Vijayalakshmi Pai.G.A Neural Networks, Fuzzy Logic andGenetic Algorithms, Synthesis and Applications PHI, New Delhi2003.
4. LaureneFausett Fundamentals of Neural Networks: Architectures, Algorithms, and Applications Pearson/Prentice Hall1994
5. Wasserman P.D Neural Computing Theory & Practice Van Nortrand Reinhold1989.
6. Freeman J.A, S kapura D.M Neural networks, algorithms, applications, and programming techniques AdditionWesley2005.

Semester-___

18BEECOE04 **Fuzzy Logic and its Applications** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- To introduce the basic concepts of Fuzzy logic and its applications in various domain
- To educate how to use Fuzzy computation to solve real-world problems
- To have a solid understanding of Basic fuzzy models.
- Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
- To learn about applications on Fuzzy based systems
- To familiarize with fuzzy fiction and de fuzzy fiction procedures

Course Outcomes

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

- Understand the basic concepts of Fuzzy logic and its applications in various domain
- Gain knowledge on theory of Reasoning
- Develop fuzzy controllers
- Understand concepts of adaptive fuzzy control
- Ability to develop how to use Fuzzy computation to solve real- world problems
- Design fuzzy based model for any application

UNIT-I BASICS OF FUZZYLOGIC

Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, the extension principle

UNIT-II THEORY OF APPROXIMATEREASONING

Linguistic variables, Fuzzy proportions, Fuzzy if-then statements, inference rules, compositional rule of inference-fuzzy models

UNIT-III FUZZY KNOWLEDGE BASED CONTROLLERS

Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, fuzzy fiction and de fuzzy fiction procedures–Design of Fuzzy Logic Controller

UNIT-IV ADAPTIVE FUZZYCONTROL

Process performance monitoring, adaption mechanisms, membership functions, tuning using gradient descent and performance criteria. Set organizing controller model based controller.

UNIT-V FUZZY BASEDSYSTEMS

Simple applications of FKBC-washing machines-traffic regulations-lift control-fuzzy in medical Applications-Introduction to ANFIS.

SUGGESTED READINGS

1. D .Diankar ,H. Hellendoom and M .Rein frank An Introduction to Fuzzy Control Narosa Publishers India 1996
2. G.J. KlirandT.A. Folger Fuzzy Sets Uncertainty and Information PHI IEEE1995
3. Timothy J. Ross Fuzzy Logic with Engineering Applications McGrawHill1997
4. George. J Klir and Bo Yuan Fuzzy Sets and Fuzzy Logic Prentice Hall, USA1995.

Semester-___

18BEECOE05 Principles of Modern Communication System 3H-3C

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

End Semester Exam:3 Hours

Course Objectives

- To provide students with an overview of communication systems
- To provide an overview on mobile communication
- To make students to have a better understanding on satellite and radar communication
- To understand the basic communication techniques which in turn are used as the building blocks of the larger and more complex communication systems.
- To acquire the basic engineering understanding to the modern communication systems and; the relevant theory and technique.
- Design simple systems for landing and navigation.

Course Outcomes

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

- Understand past, present and future trends in mobile communication.
- Gain knowledge about mobile cellular communication
- Understand various standards in use for wireless communication and its application.
- Demonstrate some basic application of GPS.
- Gain knowledge about RADAR working and its applications
- Demonstrate how a simple radar system works and its applications.

UNITI THE EVOLUTION OF ELECTRONICCOMMUNICATION

From smoke signals to smart phones - History of communications: Theoretical Foundations, Development & Applications - Frequencies for communication - Frequency regulations - Overview of communication transmitter and receiver.

UNITII MOBILE CELLULARCOMMUNICATIONS

Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G,4G - Cellular network components - Components of a mobile phone - setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role ofTRAI.

UNITIII WIRELESS COMMUNICATION

Introduction - Bluetooth - Infrared communication - IEEE Wireless LANs (Wi-Fi) - IEEE 802.16 (WiMaX) - Future mobile and wireless networks: Introduction to 5G- device to device communication-IoT.

UNITIV SATELLITECOMMUNICATION

History of Satellite communication, Basics of Satellites, Types of Satellites, Capacity Allocation - Launch Vehicles and Orbits: Introduction to launching vehicles, Important Orbits, working of rocket, Three Pioneers of Rocketry - Basics of Global Positioning System (GPS) - Applications of GPS.

UNIT V RADAR & NAVIGATION

Introduction, Radar Block diagram and Operation, Radar Frequencies, Applications of Radar. Navigation Systems: Introduction & methods of navigation, Instrument Landing System, Microwave landing system- Modern Navigation systems.

SUGGESTED READINGS

1. S.Haykin, —Communication Systems, 4/e, John Wiley2007
2. B.P.Lathi, —Modern Digital and Analog Communication Systems, 3/e, Oxford UniversityPress,2007
3. Rappaport Theodore S - Wireless Communications: Principles and Practice, 2/E, Pearson Education India,2010
4. Vijay. K. Garg, —Wireless Communication and Networking, Morgan Kaufmann Publishers, 2007.
5. T.Pratt, C. Bostian and J.Allnutt; —Satellite Communications, John Wiley and Sons, Second Edition.,2003
6. M. I .Skolnik —Introduction to Radar Systems, Tata McGraw Hill2006.
7. Myron Kyton and W.R.Fried —Avionics Navigation Systems, John Wiley & Sons 1997.

18BEAEOE01	**AUTOMOBILE ENGINEERING**	**3H-3C**

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

End Semester Exam:3Hours

Course Objectives:

- To impart knowledge on the constructional details and principle of operation of various automobile components.
- To learn the function and working of various components in transmission and drive lines.
- To study the concept and working of steering and suspension systems in an automobile.
- To give knowledge on the wheels, tyres and brakes of automobiles.
- To provide information on the current and future trends in automobiles.
- Explain the function and working of components in transmission and drive lines.

Course Outcomes:

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

- Demonstrate the operating principles and constructional details of various automobile components.
- Explain the function and working of components in transmission and drive lines.
- Identify and explain the types of steering system.
- Identify and explain the types of suspension system.
- Classify and describe the types of wheels, tyres and brakes of automobiles.
- Discuss the current and future trends in the automobiles.

UNITI ENGINE AND AUXILIARYSYSTEMS

Classification of engines – construction and working of four-stroke spark ignition (SI) engine and compression ignition (CI) engine – construction and working of two-stroke SI and CI engine – firing order – carburettor – fuel injection systems – battery – dynamo – alternator – starting motor – lighting system – ignitionsystem.

UNITII TRANSMISSIONSYSTEMS

Requirements of transmission system – flywheel – clutch – types of clutch – construction of single and multi-plate clutches – need, types and construction of transmission gear box – universal joint – propeller shaft – need, types and construction of differential – four wheel drive.

UNITIII STEERING AND SUSPENSIONSYSTEMS

Principle of steering – steering linkages – types of steering gear box –power steering – suspension systems – need and types – independent suspension – coil spring, leaf spring, torsion bar and air suspension – shock absorbers.

UNITIV WHEELS ANDBRAKES

Wheels and tyres – construction – types and specifications – tyre wear and causes – brakes – need – braking distance – types – mechanical, hydraulic and pneumatic brakes – power brake – parking brake – redundant braking system.

UNITV CURRENT AND FUTURETRENDS

Anti-lock Braking System (ABS) – brake assist – Electronic Brakeforce Distribution (EBD) – airbags – automatic high-beam control – backup cameras – defogger – electric vehicles – hybrid vehicles – autonomous vehicles – vehicle-to-vehicle communication – vehicle tracking – alternative fuels.

Suggested Readings:

1. Kirpal Singh, *Automobile Engineering Volume 1*, Standard Publishers, New Delhi,2018.
2. Sethi H M, *Automobile Technology*, Tata McGraw-Hill, New Delhi,2003.
3. William H Crouse and Donald L Anglin, *Automotive Mechanics*, Tata McGraw-Hill, New Delhi,2006.
4. Srinivasan S, *Automotive Mechanics*, Tata McGraw-Hill, New Delhi,2003.
5. Ganesan V, *Internal Combustion Engines*, McGraw-Hill Education, New Delhi,2012.

18BEAEOE02 TWO AND THREE WHEELER TECHNOLOGY 3H-3C

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

End Semester Exam:3Hours

Course Objectives:

- To impart technical knowledge on construction and working of the power train and drive train of two and three wheeler vehicles.
- To familiarise with maintenance procedures of the engine and subsystems of two and three wheelers.
- To impart knowledge on types of transmission systems
- To impart knowledge on types of steering and suspension systems
- To impart knowledge on types of wheels, tyres and brakes for two and three wheelers
- To make the students conversant on servicing of two and three wheelers.

Course Outcomes:

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

- Construct the frames of two and three wheelers of different layouts.
- Demonstrate the constructional details and principle of operation of various engine components.
- Identify and explain the types of transmission systems.
- Identify and explain the types of steering and suspension systems.
- Classify and describe the types of wheels, tyres and brakes for two and three wheelers.
- Explain the servicing of two and three wheelers.

UNITI INTRODUCTION

History of two and three wheelers – classification and layouts of two wheelers – classification and layouts of three wheelers – main frame for two wheelers and types – main frame for three wheelers and types.

UNITII INTERNAL COMBUSTIONENGINES

Classification of engines – selection criteria of engine for two and three wheelers – design considerations for two and three wheeler engines – construction and working of two-stroke and four-stroke engines – fuel feed system – lubricating system – cooling system – scavenging system – cranking system – kick start and auto-start mechanisms.

UNITIII TRANSMISSION, STEERING AND SUSPENSIONSYSTEMS

Clutch – single plate, multiple plate and centrifugal clutches – primary reduction – gear box – gear shifting mechanisms – automatic transmission – final drive and differential for three wheelers – steering geometry – steering column construction – steering system for three wheelers – front and rear suspension systems – spring and shock absorber assembly.

UNITIV WHEELS, TYRES ANDBRAKES

Spoked wheels, pressed steel wheels and alloy wheel – tyre construction – tyre with tube and tubeless tyre – theory of brake action – drum and disc brakes – brake links layout for front and rear wheels – mechanical and hydraulic brake control systems – anti-lock braking system.

UNITV TWO AND THREE WHEELERS CASESTUDY

Case study of mopeds, scooters, motor cycles, sports bikes, auto rickshaws, pickup vans, delivery vans and trailers – servicing – factors affecting fuel economy and emission.

Suggested Readings:

1. Dhruv U Panchal, *Two and Three Wheeler Technology*, PHI Learning, New Delhi,2015.
2. Ramalingam K K, *Two Wheelers and Three Wheelers: Theory, Operation and Maintenance*, Scitech Publications, Chennai,2017.
3. Irving P E, *Motorcycle Engineering*, Veloce Enterprises, USA,2017.
4. D ennis Bailey and Keith Gates, *Bike Repair and Maintenance for Dummies*, John Wiley & Sons, USA, 2009.

18BEAEOE03 VEHICLE MAINTENANCE 3H-3C

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

End Semester Exam:3Hours

Course Objectives:

- To understand the need for vehicle maintenance and its importance.
- To familiarise the maintenance procedure for various components of an automobile.
- To familiarize the students to understand servicing of transmission and driveline components.
- To make the students conversant on the procedure for steering and suspension
- To make the students conversant on the procedure for wheel and brake maintenance.
- To Study and acquire knowledge on the fault diagnosis in the electrical and air conditioner systems.

Course Outcomes:

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

- Describe and differentiate the types of maintenance.
- List the procedure for dismantling, servicing and assembling of engine components.
- Demonstrate the servicing of transmission and driveline components.
- Discuss the procedure for steering and suspension
- Discuss the procedure for wheel and brake maintenance.
- Explain the fault diagnosis in the electrical and air conditioner systems.

UNITI MAINTENANCE OF RECORDS ANDSCHEDULES

Need for maintenance – preventive and breakdown maintenance – requirements of maintenance – preparation of check lists – inspection schedule – maintenance of records, log sheets and other forms – safety precautions in maintenance – workshop layout, tools andequipment.

UNITII ENGINE AND ENGINE SUBSYSTEMMAINTENANCE

General engine service – dismantling of engine components – engine repair – service of basic engine parts, cooling and lubricating system, fuel system, intake and exhaust system – engine tune-up.

UNITIII TRANSMISSION AND DRIVELINEMAINTENANCE

General checks, adjustment and service of clutch – dismantling, identifying, checking and reassembling transmission, transaxle – road testing – removing and replacing propeller shaft – servicing of cross and yoke joint, and constant velocity joint – rear axle service points – removing axle shaft and bearings – servicing differential assemblies – fault diagnosis.

UNITIV STEERING, SUSPENSION, WHEEL AND BRAKEMAINTENANCE

Inspection, maintenance and service of steering linkage, steering column, rack and pinion steering, recirculating ball steering, worm type steering, power steering system – inspection, maintenance and service of MacPherson strut, coil spring, leaf spring, shock absorbers – wheel alignment and balance – removing and fitting of tyres – tyre wear and tyre rotation – inspection, maintenance and service of hydraulic brake, drum brake, disc brake,

parking brake – bleeding ofbrakes.

UNITV ELECTRICAL AND AIR CONDITIONERMAINTENANCE

Maintenance of batteries, starting system, charging system and body electrical – fault diagnosis using scan tools – maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator – replacement of hoses – leak detection – air conditioner charging – fault diagnosis – vehicle body repair like panel beating, tinkering, soldering, polishing,painting.

Suggested Readings:

1. Tim Gilles, *Automotive Service: Inspection, Maintenance, Repair*, Cengage Learning, USA, 2015.
2. Philip Knott and Adam Roylance, *An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles*, EMS Publishing, UK,2010.
3. James D Halderman and Curt Ward,*Advanced Engine Performance Diagnosis*, Pearson, USA, 2016.
4. Ed May and Les Simpson, *Automotive Mechanics Volume 1*, McGraw-Hill Australia,2006.
5. James E Duffy, *Modern Automotive Technology*, Goodheart-Willcox, USA,2017.
6. Service manuals of variousOEMs.

18BEAEOE04 **MODERN VEHICLE TECHNOLOGY** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives:

- To impart knowledge on trends in the vehicle power plants.
- To learn the various advanced driver assistance systems.
- To study the working of advanced suspension and braking systems in an automobile.
- To give information about motor vehicle emission and noise pollution control.
- To provide knowledge of the vehicle telematics.
- To give information about the noise control techniques

Course Outcomes:

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

- Distinguish and describe the various modern vehicle power plant systems.
- List and explain the various driver assistant mechanisms.
- Identify and describe the working of advanced suspension and braking systems.
- Apply the knowledge of motor vehicle emission and noise pollution control.
- Describe the noise control techniques
- Describe the vehicle telematics and its applications.

UNITI TRENDS IN POWER PLANTS

Hybrid vehicles – stratified charged / learn burn engines – hydrogen engines – battery vehicles – electric propulsion with cables – magnetic track vehicles.

UNITII DRIVER ASSISTANCE SYSTEMS

Adaptive cruise control – intelligent speed adaptation – lane departure warning systems – traction control systems – driver drowsiness detection system – collision avoidance systems – hill descent control – anti spin regulation – parking assistance systems – night-vision systems – pedestrian detection.

UNITIII SUSPENSION, BRAKES ANDSAFETY

Interconnected air and liquid suspensions – hydrolastic suspension system – hydragas suspension – closed loop suspension – indirect floating calliper disc brake – self energising disc brake – anti-skid braking system – retarders – regenerative braking – auto emergency braking – crumple zone – safety cage – airbags – seat belts – headrests.

UNITIV EMISSION AND NOISE POLLUTION CONTROL

Engine emissions – types of catalytic converters – open loop and closed loop operation to the oxidizing catalytic converter – evaporative emission – internal and external noise – identification of noise sources – noise control techniques – adaptive noise control.

UNITV VEHICLE TELEMATICS

Building blocks of vehicle telematics system – Global Positioning System (GPS) and Geographic Information System (GIS) for vehicle tracking – automotive navigation system – road recognition system – wireless vehicle safety communications – Usage Based Insurance (UBI).

Suggested Readings:

1. Ljubo Vlacic, Michael Parent and Fumio Harashima, *Intelligent Vehicle Technologies*, Butterworth-Heinemann, UK,2001.
2. Ronald K Jurgen, *Navigation and Intelligent Transportation Systems*, SAE International, USA,1898.
3. Heinz Heisler,*Advanced Vehicle Technology*, Butterworth-Heinemann, UK,2002.
4. James E Duffy, *Modern Automotive Technology*, Goodheart-Willcox, USA,2017.
5. William B Ribbens, *Understanding Automotive Electronics*, Butterworth-Heinemann, UK, 2017.
6. *Bosch Automotive Handbook*, Robert Bosch, Germany,2018.

18BEAEOE05 **FLEET MANAGEMENT** **3H-3C**

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

End Semester Exam:3Hours

Course Objectives:

- To impart knowledge on the personnel management, selection process, training methods and motor vehicle act.
- To plan the vehicle routes, scheduling of vehicles and fare structure.
- To design the vehicle maintenance systems.
- To Study and acquire knowledge on fare structure and analyse the methods of fare collection
- To introduce the concepts of vehicle parts, supply management and data processing
- To Study and acquire knowledge on electronically controlled vehicle maintenance system

Course Outcomes:

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

- Apply the knowledge of personnel management and analyse the selection process and training methods.
- Apply the motor vehicle act in terms of registration and describe the various vehicles and conduct the test of competence to drive.
- Construct a fare structure and analyse the methods of fare collection.
- Analyse the vehicle parts, supply management and data processing.
- Describe the scheduled and unscheduled maintenance
- Demonstrate an electronically controlled vehicle maintenance system and analyse the work schedule.

UNITI INTRODUCTION

Personnel management – objectives and functions of personnel management – psychology, sociology and their relevance to an organization – selection process: job description, employment tests, interviewing, introduction to training objectives, methods of training, training procedure and psychological tests.

UNITII MOTOR VEHICLEACT

Schedules and sections of the motor vehicle act – traffic signs, fitness certificate, registration requirements, permit, insurance and constructional regulations – description of vehicle: goods carrier, tankers, tippers, delivery vans, recovery vans, power wagons and fire fighting vehicles – spread over, running time, test of competence to drive.

UNITIII SCHEDULING AND FARE STRUCTURE

Route planning – scheduling of transport vehicles – preparation of timetable – preparation of vehicle and crew schedule – principal features of operating costs for transport vehicles – fare

structure and method of drawing up of a fare table – methods of farecollection.

UNITIV VEHICLE PARTS, SUPPLY MANAGEMENT ANDBUDGET

Cost of inventory – balancing inventory cost against downtime – parts control – bin tag systems – time management – time record keeping – budget activity and capital expenditures – classification of vehicle expenses – fleet management and data processing – data processing systems – computer controlling of fleetactivity.

UNITV MAINTENANCE

Scheduled and unscheduled maintenance – preventive maintenance – evaluation of Preventive Maintenance Inspection (PMI) programme – work scheduling – overtime – breakdown analysis – control of repair backlogs – cost of options – electronically controlled vehicle maintenance system.

Suggested Readings:

1. Robert P Currie, Michelle B Currie and George M Keen, *Fleet Management*, Wandering Brothers Publishing, USA,2006.
2. John Dolce, *Fleet Management*, McGraw-Hill,1884.
3. SCC Editorial, *Motor Vehicles Act, 1888*, Eastern Book Company, New Delhi,2018.
4. Rex W Faulks, *Bus and Coach Operation*, Butterworth-Heinemann, UK,1887.
5. John E Dolce, *Analytical Fleet Maintenance Management*, SAE International, USA,2009.

18BECEOE01 HOUSING PLAN AND MANAGEMENT 3 0 0 3 100

COURSE OBJECTIVES

1. To examine the role and tasks of basic housing policies and building bye laws
2. Understand the process of integrated service delivery in the context of economic, social, environmental and institutional factors
3. Analyze the Innovative construction methods and Materials
4. Analyze city management strategies and strengthen the urban governance through a problem solving approach
5. To know the Importance of basic housing policies and building bye laws
6. To use Housing Programmes and Schemes

COURSE OUTCOME

The students will be able to

1. Know the Importance of basic housing policies and building bye laws
2. Use Housing Programmes and Schemes
3. Plan and Design of Housing projects
4. Examine Innovative construction methods and Materials
5. Know Housing finance and loan approval procedures
6. Understand Construction as well as managing techniques

UNITI INTRODUCTION TO HOUSING 9

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNITII HOUSING PROGRAMMES 9

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-GovernmentOrganizations.

UNITIII PLANNING AND DESIGN OFHOUSING PROJECTS 9

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV CONSTRUCTION TECHNIQUES ANDCOST-EFFECTIVE MATERIALS 9

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNITV HOUSING FINANCE ANDPROJECTAPPRAISAL 9

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy

and Cross Subsidy, Pricing o f Housing Units, Rents, Recovery Pattern (Problems).

TOTAL HRS : 45

TEXT BOOKS

1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd., New Delhi,2002.
2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House, Bombay,2001.

REFERENCES

1. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai,2002.
2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi,2000.

COURSE OBJECTIVES

1. Defining and identifying of eng. services systems in buildings.
2. The role of eng. services systems in providing comfort and facilitating life of users of the building.
3. The basic principles of asset management in a building & facilities maintenance environment
4. Importance of Fire safety and its installation techniques
5. To Know the principle of Refrigeration and application
6. To Understand Electrical system and its selection criteria

COURSE OUTCOME

The students will be able to

1. Machineries involved in building construction
2. Understand Electrical system and its selection criteria
3. Use the Principles of illumination & design
4. Know the principle of Refrigeration and application
5. Importance of Fire safety and its installation techniques
6. Know the principle behind the installation of building services and to ensure safety in buildings

UNITI MACHINERIES 9

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

UNIT II ELECTRICAL SYSTEMS IN BUILDINGS 9

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

UNIT III PRINCIPLES OF ILLUMINATION & DESIGN 9

Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angleillumination – Utilization factor – Depreciation factor – MSCP – MHCP –Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination requiredfor physically handicapped and elderly in buildingtypes.

UNIT IV REFRIGERATION PRINCIPLES & APPLICATIONS 9

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Sub cooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilled waterplant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

UNITV FIRE SAFETY INSTALLATION 9

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

TOTAL HRS : 45

TEXT BOOKS

1. E.R.Ambrose, “Heat Pumps and Electric Heating”, John and Wiley and Sons, Inc., New York,2002.
2. Handbook for Building Engineers in Metric systems, NBC, New Delhi,2005.

REFERENCES

1. Philips Lighting in Architectural Design, McGraw-Hill, New York,2000.
2 A.F.C. Sherratt, “Air-conditioning and Energy Conservation”, The Architectural Press, London,2005.
3 National BuildingCode.

18BECEOE03 REPAIR AND REHABILITATION OF STRUCTURES 3 0 0 3 100

COURSE OBJECTIVES

1. To learn various distress and damages to concrete and masonry structures
2. To know the influence of corrosion in durability of structures
3. To understand the importance of maintenance of structures
4. To study the various types and properties of repair materials
5. To learn various techniques involved in demolition of structures
6. To Assessing damage of structures and various repair techniques

COURSE OUTCOME

By the end of this course students will have the capability/knowledge of

1. Various distress and damages to concrete and masonry structures
2. Durability of structures and corrosion mechanism
3. The importance of maintenance of structures, types and properties of repair materials etc
4. Assessing damage of structures and various repair techniques
5. Modern technique and equipment being adopted for the demolition of structures
6. Influence of corrosion in durability of structures

UNIT– I INTRODUCTION 9

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors.

UNIT– II DURABILITY OF STRUCTURES 9

Corrosion mechanism – diagnosis- causes and effects - cover thickness and cracking, measurements for corrosion - methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

UNIT-III MAINTENANCE AND REPAIR STRATEGIES 9

Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

UNIT-IV MATERIALS FOR REPAIR 9

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete. eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete.

UNIT-V TECHNIQUES FOR REPAIR AND REPAIR OF STRUCTURES 9

Non-destructive Testing Techniques, Corrosion protection techniques , Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure Engineered demolition techniques for dilapidated structures - case studies

TOTAL : 45 HRS

TEXT BOOK

Sl.No	Title of Book	Author of Book	Publisher	Year of Publishing
1	Repair of Concrete Structures	R.T.Allen and S.C.Edwards	Blakie and Sons, UK,	2011

REFERENCES:

Sl.No	Title of Book	Author of Book	Publisher	Year of Publishing
1	Rehabilitation of concrete structures	Dr.B.Vidivelli	Standard publishers, Chennai.	2011

WEBSITES:

- http://www.icivilengineer.com
- http://www.engineeringcivil.com/
- http://www.aboutcivil.com/
- http://www.engineersdaily.com
- http://www.asce.org/
- http://www.cif.org/
- http://icevirtuallibrary.com/
- http://www.ice.org.uk/
- http://www.engineering-software.com/ce/

18BECE0E04 COMPUTER-AIDED CIVILENGINEERING DRAWING 3 0 0 3100

COURSE OBJECTIVES

1. Develop Parametric design and the conventions of formal engineeringdrawing
2. Produce and interpret 2D & 3Ddrawings
3. Communicate a design idea/concept graphically/visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings
5. to produce designs using a combination of 2D and 3D software.
6. Get a Detailed study of an engineeringartifact

COURSE OUTCOME

The students will be able to

1. Develop Parametric design and the conventions of formal engineeringdrawing
2. Produce and interpret 2D & 3Ddrawings
3. Communicate a design idea/concept graphically/visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineeringartifact
6. Planning and designing of structures

UNIT 1:*INTRODUCTION*; Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co- ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards. **9**

UNIT 2: *SYMBOLS AND SIGN CONVENTIONS*: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

9

UNIT 3: *MASONRY BONDS:* English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

9

UNIT 4: *BUILDING DRAWING*: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing

of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

9

UNIT 5: *PICTORIAL VIEW*: Principles of isometrics and perspective drawing. Perspective view of building.

9

List of Drawing Experiments:

1. Buildings with load bearing walls including details of doors andwindows.
2. Single storey RCCbuilding
3. Multistorey RCCbuilding

Text/Reference Books:

1. Subhash C Sharma & Gurucharan Singh (2005), " Civil Engineering Drawing" , StandardPublishers
2. Ajeet Singh (2002), " Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, NewDelhi
3. Sham Tickoo Swapna D (2009), " AUTOCAD for Engineersand Designers" , PearsonEducation,
4. Venugopal (2007), "Engineering Drawing and Graphics +AUTOCAD", New Age International Pvt.Ltd.,
5. Balagopal and Prabhu (1987), " Building Drawing and Detailing",Spades publishing KDR building,Calicut

COURSES OFFERED TO OTHER DEPARTMENTS

18BEMEOE01 COMPUTER AIDED DESIGN 3 H – 3 C

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

End Semester Exam :3Hours

Course Objective

1. To apply basic concepts to develop construction (drawing) techniques.
2. To ability to manipulate drawings through editing and plotting techniques.
3. To understand geometric construction and Produce template drawings.
4. To understand and demonstrate dimensioning concepts and techniques.
5. To understand Section and Auxiliary Views.
6. To become familiar with Solid Modelling concepts and techniques.

Course Outcome

1. Apply basic concepts to develop construction (drawing) techniques.
2. Ability to manipulate drawings through editing and plotting techniques.
3. Understand geometric construction and Produce template drawings.
4. Understand and demonstrate dimensioning concepts and techniques
5. Understand Section and Auxiliary Views
6. Become familiar with Solid Modelling concepts and techniques.

UNITI OVERVIEW OF CAD SYSTEMS

Conventional and computer aided design processes-advantages and disadvantages.Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations.Networking of CAD systems.

UNITII INTERACTIVE COMPUTER GRAPHICS AND GRAPHICSTRANSFORMATIONS

Generative, cognitive and image processing graphics.Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives - display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transformations, Visual Realism, Computer animation, customizing graphics software.

UNITIII GEOMETRIC MODELING

Wireframe, surface, NURBS and solid modeling-applications and advantages.Creating primitive solids, sweeping solids, Boolean operations.Extracting entities from a solid.Filleting of edges of solids. Boundary representation (B-rep) Constructive Solid Geometry(CSG) and Analytical SolidModeling(ASM)

UNITIV PARAMETRIC DESIGN AND OBJECTREPRESENTATION

Types of co-ordinate systems.Parametric design - definition and advantages.Parametric representation of analytic and synthetic curves.Parametric representation of surfaces and solids - manipulations.

UNITV PRODUCT DESIGN ANDDEVELOPMENT

Automated 2D drafting - basics, mechanical assembly - bill of materials generation.Mass property calculations.

SUGGESTED READINGS

1. Vera B Anand, Computer Graphics and Geometric Modeling for Engineers,1st edition, John Wiley & Sons, New York,2000
2. Radhakrishnan P and Subramanyan S, CAD/CAM/CIM, 2nd edition, New Age International Pvt. Ltd,2008
3. Ibrahim Zeid, CAD/CAM Theory and Practice,2nd edition, McGraw Hill Inc., New York,2009

4. Barry Hawhes, The CAD/CAM Process,1st edition, Pitman Publishing, London,2007(digital)
5. William M Newman and Robert Sproul, Principles of Interactive Computer Graphics,1st edition, McGraw Hill Inc., New York,2001
6. Sadhu Singh, Computer-Aided Design and Manufacturing,1st edition, Khanna Publishers, New Delhi,1998

18BEMEOE02 INDUSTRIAL SAFETY AND ENVIRONMENT 3 H – 3 C

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

End Semester Exam :3Hours

Course Objective

1. To recognize and evaluate occupational safety and health hazards in the workplace.
2. To determine appropriate hazard controls following the hierarchy of controls.
3. To analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. To prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. To teach studentthe conceptof Industrial Safety & provide useful practical knowledge for workplace safety.
6. Toprevent or mitigate harm or damage to people, property, orthe environment.

Course Outcome

1. Recognize and evaluate occupational safety and health hazards in the workplace.
2. Determine appropriate hazard controls following the hierarchy of controls.
3. Analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. Understand the conceptof Industrial Safety & provide useful practical knowledge forworkplace safety.
6. Prevent or mitigate harm or damage to people, property, orthe environment.

UNITI CONCEPTS

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNITII TECHNIQUES

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNITIII ACCIDENT INVESTIGATION ANDREPORTING

Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNITIV SAFETY PERFORMANCEMONITORING

Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities -Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems.

UNITV SAFETY EDUCATION ANDTRAINING

Importance of training-identification of training needs-training methods – programme, seminars, conferences,

competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

SUGGESTED READINGS

1. Accident Prevention Manual for Industrial Operations, 3rd edition, N.S.C. Chicago,2010(digital).
2. Heinrich H.W. “Industrial Accident Prevention”, 2nd edition, Tata McGraw-Hill Company, New York, 1941.
3. Krishnan N.V, Safety Management in Industry, 1st edition, Jaico Publishing House, Bombay,1997.
4. John R Ridley, Safety at Work,3rd edition,Elsevier,2014
5. Roland P. Blake ,Industrial Safety, 2ndedition,Prentice Hall, Inc., New Jersey,1973
6. L M Deshmukh, Industrial safety management,1stedition, TATA McGraw Hill,2005

18BEMEOE03 **TRANSPORT PHENOMENA** **3 H – 3 C**

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

End Semester Exam :3Hours

Course Objective

1. To generalized equations for mass, momentum and heat.
2. To understand the concepts of Reynolds and Gauss theorems.
3. To learn combined diffusive and convective transport.
4. To apply Film- and penetration models for mass and heat transfer.
5. To apply Stefan-Maxwells equations for multi-component diffusion.
6. To Solve the given set of equations either analytically or numerically.

Course Outcome

1. Generalized equations for mass, momentum and heat.
2. Understand the concepts of Reynolds and Gauss theorems.
3. Learn combined diffusive and convective transport.
4. Apply Film- and penetration models for mass and heat transfer.
5. Apply Stefan-Maxwells equations for multi-component diffusion.
6. Solve the given set of equations either analytically or numerically.

UNITI INTRODUCTION AND BASICCONCEPTS

General overview of transport phenomena including various applications, Transport of momentum, heat and mass , Transport mechanism, Level of transport, Driving forces, Molecular transport (diffusion), convective transport (microscopic)

UNITII PROPERTIES, UNITS AND OTHER PHYSICALPARAMETERS

Unit systems, temperature, mole, concentration, pressure, Gas laws, laws of conservation, energy and heat units

UNITIII MOMENTUM TRANSPORT

Basic concepts in fluid mechanics, Force, unit and dimensions, pressure in fluid, head of fluid, Molecular transport for momentum, heat and mass transfer, Viscosity of fluids, Newton's law, Momentum transfer, Newtonian and non- Newtonian fluids, Fluid flow and Reynolds number, Overall mass balance, Control volume and Continuity equation, Overall energy balance, Bernoulli's equation, Overall momentum balance, Drag coefficient, Stokes law, Flow in packed beds, Flow in fluidizedbed

UNITIV ENERGYTRANSPORT

Basic concepts in heat transfer, Heat transfer mechanisms, Fourier's law of heat conduction, thermal conductivity, convective heat transfer coefficient, Conduction heat transfer - through flat slab/wall and through hollow cylinder, Conduction through solids in series, Forced convection heat transfer inside pipes, Heat transfer outside various geometrics in forced convection, General discussion on natural convection heat transfer, Heat exchangers, General discussion on radiation heattransfer

UNITV MASS TRANSPORT

Basic concepts in mass transport, Some application examples, Modes of mass transfer, Molecular diffusion- Fick's law, Analogy between mass, heat and momentum transfer, Dispersion, Hydraulic or Darcy's flow in porous

media, Chemical kinetics and activation energy, Film theory, Convective mass transfer, Liquid-solid mass transfer, Liquid-liquid mass transport, Gas-liquid mass transfer, Aeration and oxygen transport, Airstripping

SUGGESTED READINGS

1. Geankoplis, C. J, Transport Processes and Separation Processes Principles, 4th edition, Prentice Hall,2013
2. R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, Transport Phenomena, 1st edition, John Wiley & Sons, 2007.
3. Edwin N. Lightfoot, Transport phenomena and living systems: biomedical aspects of momentum and mass transport, 1st edition, Wiley, 1973, 2007(digital)

18BEMEOE04 INTRODUCTION TO BIOMECHANICS 3 H – 3 C

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

End Semester Exam :3Hours

Course Objective

1. To describe the principles of the study of human movement.
2. To describe the range of factors that influence the initiation,production and control of human movement.
3. To identify the body's lever systems and their relationship to basicjoint movement and classification.
4. To distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
5. To explain joint and muscle function and the forces acting upon the human body during various sporting activities.
6. To relate the different body systems necessary for human movement to occur.

Course Outcome

1. Describe the principles of the study of human movement.
2. Describe the range of factors that influence the initiation, production and control of human movement.
3. Identify the body's lever systems and their relationship to basic joint movement and classification.
4. Distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
5. Explain joint and muscle function and the forces acting upon the human body during various sporting activities.
6. Relate the different body systems necessary for human movement to occur.

UNITI INTRODUCTION

Biomechanics - Improving Performance – Applications - Preventing And Treating Injury - Qualitative And Quantitative Analysis - Scholarly Societies - Computer Searches – Biomechanical Knowledge versus Information - Kinds of Sources - EvaluatingSources

UNITII KEY MECHANICALCONCEPTS

Mechanics - Basic Units - Nine Fundamentals of Biomechanics - Principles and Laws - Nine Principles for Application of Biomechanics

UNITIII HUMAN ANATOMY AND SOME BASICTERMINOLOGY

Gross (Whole-Body) Modeling - Position and Direction Terminology - Terminology for Common Movements - Skeletal Anatomy - Major Joints - Major Muscle Groups - AnthropometricData

UNITIV ANATOMICALDESCRIPTION

Key Anatomical Concepts - Directional Terms - Joint Motions - Muscle Actions - Active and Passive Tension of Muscle - Limitations of Functional Anatomical Analysis - Mechanical Method of Muscle Action Analysis - The Need for Biomechanics to Understand Muscle Actions - Sports Medicine and Rehabilitation Applications

UNITV MECHANICS OF THE MUSCULOSKELETALSYSTEM

Tissue Loads - Response of Tissues To Forces - Biomechanics of The Passive Muscle–Tendon Unit - Biomechanics of Bone - Biomechanics of Ligaments - Three Mechanical Characteristics of Muscle - Stretch-

Shortening Cycle (SSC) - Force–Time Principle - Neuromuscular Control

SUGGESTED READINGS

1. Duane Knudson, Fundamentals of Biomechanics, 1st edition,Springer Science+ Business Media, LLC,2013
2. C. Ross Ethier Craig A. Simmons, Introductory Biomechanics,1st edition, Cambridge University Press,2008

18BTCEOE01 ENERGY MANAGEMENT IN CHEMICAL INDUSTRIES 3 0 0 3100

COURSE OBJECTIVE:

- To provide students with a general awareness on the importance of energy
- To provide awareness about conservation, its impact on society, various energy sources, energy conversion processes, energy management, energy audit and energy conservation measures.
- To introduce the energy and water management principles related to process Chemical plants.
- To introduce various forms of energy and its forms.
- To introduce the growth, need and necessity of the consumption energy.

COURSE OUTCOMES:

After completion of the course, students are able to

- Plan to optimize energy using systems and procedures to meet energy demand
- Describe the movement of substances in the entire globe
- Examine the relationship between energy systems and society
- Use optimization techniques for conservation of energy in chemical industries
- Evaluate the production rate and analyze the cost from economic balance for energy consumption.
- Understand the concepts of conservation of the resources available.

PLANNING FOR ENERGY NEEDS

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modelling and optimal mix of energy sources.

(9)

ENERGY AND ENVIRONMENT

Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society, environment population and technology.

(9)

ENERGY AND SOCIETY

Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit.

(9)

MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES

Chemical industries; classification; conservation in unit operations such as separation; cooling tower; drying; conservation applied to refineries, petrochemical, fertilisers, cement, pulp and paper, food and chlor-alkali industries; conservation usingoptimization techniques. (9)

ECONOMIC BALANCE IN ENERGY CONSUMPTION

Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and production using fuel inventories; input-output analysis; economics; tariffs (9)

TOTAL :45

SUGGESTED READINGS

- Jerrold H Kertz, Energy Conservation and Utilization, Allyn and BacurInc,1976.
- Gemand M Gramlay, Energy, Macmillion publishing Co, Newyork,1975
- Krentz J. H., Energy Conservation and Utilization, Allyn and Bacur Inc.,1976.
- Gramlay G. M., Energy, Macmillan Publishing Co., New York,1975.
- Rused C. K., Elements of Energy Conservation, McGraw-Hill Book Co.,1985

18BTCEOE02 FERTILIZER TECHNOLOGY 3 0 0 3 100

COURSE OBJECTIVES:

- To introduce the concepts of fertilizers and manures.
- Justify the need for synthetic fertilizer.
- To understand the process and flow in manufacture of fertilizers.
- To analyze how the nitrogenous fertilizers are useful for the agriculture purpose.
- To categories the storage and handling of the fertilizers.

COURSE OUTCOMES:

After completion of the course, students are able to

- Illustrate chemical, organic fertilizers and nutrients
- Develop the flow chart for manufacture of nitrogenous fertilizers
- Analyze the various processes and develop the flow chart for the manufacture of phosphatic fertilizers.
- Develop the flow chart for the manufacture of potassic fertilizer and analyze the unit operations involved in the process.
- Illustrate the quality and pollution standards permissible in fertilizer industry.
- Application of fertilizers based on various characteristics

INTRODUCTION

Chemical Fertilizers and Organic Manures - Types of chemical Fertilizers.Secondary nutrients, micronutrients. (9)

NITROGEN FERTILIZERS

Nitrogenous Fertilizers - Methods of production of Ammonia and Urea. Nitric acid, Ammonium sulphate, Ammonium Nitrate, Calcium Ammonium Nitrate, Ammonium Chloride - Their methods of production, characteristics, storage and handling specifications.

(9)

PHOSPHATIC FERTILIZERS

Raw materials, phosphate rock, Sulphur pyrites -Process for the production of Sulphuric and Phosphoric acids. Ground phosphate rock, bone meal.Single Super Phosphate, Triple Super phosphate -Methods of production, characteristics and specifications.

(9)

POTASSIC FERTILIZERS

Potassium chloride, Potassium sulphate, Potassium schoenite - Methods of production, specification, characteristics.Complex Fertilizers, NPK Fertilizers, Mono ammonium phosphate, Diammonium phosphate, Nitro phosphate Methods of production.

(9)

FERTILIZERS IMPACTS AND STANDARDS

Fluid fertilizers.Controlled Release of fertilizers. Solid, Liquid and Gaseous pollution from ammonia urea and NPK fertilizer industries and standards laid down for them. Fertilizer productionin India. (9)

TOTAL : 45

SUGGESTED READINGS

- GopalaRao M., Marshall Sittig, Dryden's Outlines of Chemical Technology, ThirdEdition, WEP East-West Press, New Delhi,2010.
- George T. Austin., Shreve's Chemical Process Industries, Fifth Edition, McGrawHill Professional,2012
- Vincent Sauchelli., The Chemistry and Technology of Fertilizers, Reinhold Pub. Corp.,1960
- Editorial Committee - FAI Seminar on Fertilizer in India in the Seventies (Proceedings),The Fertilizer Association of India,New Delhi,1973.
- Editorial Committee - Seminar on Recent Advances in Fertilizer Technology, TheFertilizer Association of India, New Delhi,1972.
- Sauchelli V., Manual on Fertilizer Manufacture, Industry Publication Inc, New Jersy,1963.
- CHEMTECH - II - (Chapter on Fertilizers by Chari, K.S.), Chemical EngineeringEducation Development Centre, I.I.T.,Madras,1977.
- Menon M.G., Fertilizer Industry - Introductory Survey, Higginbothams, Madras,1973

18BTCEOE03 INDUSTRIAL WASTEWATER TREATMENT 3 0 0 3 100

COURSE OBJECTIVES:

- To impart knowledge on composition treatment and effective disposal of industrial effluents.
- To understand the basic characteristics of wastewater.
- Understanding the kinetics of biological system.
- Understand the design and working principle of various treatment methods.
- Understand magnitude and influence of hazardous content

COURSE OUTCOMES:

After completion of the course, students are able to

- Examine the constituents of waste water and its effects.
- Separate the contaminants from the effluent for treatability.
- Determine the biomass yield and substrate utilization rate for biological treatment process and design of activated sludge process.
- Develop a flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textile and pharmaceutical industries.
- Develop process flow diagram for water reuse and sludge disposal.
- Perform efficient treatment on industrial waste water.

INTRODUCTION TO WASTE WATER ENGINEERING

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical andbiologicalCharacteristics. (7)

UNIT OPERATIONS AND UNIT PROCESS

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, OxidationandNeutralization (11)

FUNDAMENTALS OF BIOLOGICAL TREATMENT

Introduction, Microbial growth kinetics, types of biological process for wastewater treatment - aerobic and anaerobic oxidation,Biological Nitrification and De-nitrification, biological phosphorous removal, activated sludge process (with design Considerations), trickling filters and lagoons. (9)

WASTE WATER TREATMENT IN SPECIFIC INDUSTRIES

Dairy, Sugar, Pulp and Paper, Textile andPharmaceutical Industries. (9)

WATER REUSE

Wastewater reclamation technologies and reuse, Solid processing flow diagrams, sludge and scum pumping, grinding, screening,degritting, blending, anaerobic digestion, composting, conditioning, dewateringandincineration. (9)

TOTAL :45

SUGGESTED READINGS

- Metcalf Eddy, Wastewater Engineering -Treatment and Reuse, Fourth Edition, TataMcGraw Hill, New Delhi,2002.
- Mark J. Hammer, Water and Wastewater Technology, Seventh Edition, Prentice Hall ofIndia Pvt Limited, New Delhi,2012.
- James M. Montgomery, Water Treatment Principles and Design, First Edition, A Wiley Interscience publication, New York,1985

18BTCEOE04 SOLID AND HAZARDOUS WASTE MANAGEMENT 3 0 0 3 100

COURSE OBJECTIVES:

- Provides an overview of municipal solid waste (MSW), industrial waste and hazardous waste management, including design and economic analysis
- In planning and engineering principles needed to address the growing and increasingly intricate problem of controlling and processing the refuse (solid waste) created by urban societies.
- To understand the landfilling, composting and incineration from engineering, social, and regulatory perspectives
- To understand about the physical, chemical, and biological treatment of hazardous waste.
- To analyze and understand the situations dealing with real world settings are covered through worked examples and field trips to solid waste management facilities.

COURSE OUTCOMES:

- After successful completion of the course, student will be able to
- Outline the salient features of solid waste management and handling.
- Deduce the source reduction, recycling and reuse techniques of solid waste.
- Analyze the collection systems and method of transfer of solid waste.
- Describe the processing techniques for solid and hazardous waste.
- Select the suitable methods for disposal of solid and hazardous waste.
- Interpret the legislation for management, handling and disposal of solid and hazardous waste.

CHARACTERISTICS AND SOURCE REDUCTION OF SOLID WASTE

Definition, sources, and types of solid waste - Composition, physical, chemical and biological properties of solid wastes - Percapita generation rates - Sampling and characterization of solid waste - Source reduction of wastes -Waste exchange - Recyclingand reuses - Salient features of Indian legislations on management and handling of municipal solid wastes.

(9)

COLLECTION AND TRANSPORT OF SOLID WASTE

Estimation of solid waste and factors affecting generation rates - On-site handling, storage, and processing- Collection services:municipal and commercial - Industrial services - Collection systems: Hauled-container system (HCS) and stationary containersystem (SCS) - Vehicle and labour assessment - Assessment of collection route - Transfer and transport - Transfer stationlocation- Means and methodsoftransfer. (9)

PROCESSING AND DISPOSAL OF SOLID WASTE

Objective of processing - material separation and processing technologies- biological, chemical and thermal conversiontechnologies- disposal in Landfills: site selection methods and operations, leachate and gas generations and movement andcontrol of gas and leachate techniques - Composting: aerobic and anaerobic - Resource and energy recovery schemes.

(9)

HAZARDOUS WASTE CHARACTERIZATION AND MANAGEMENT

Definitions and Identifications of hazardous waste - Origin and characterization of hazardous solid waste- Typical hazardouswastes in MSW - Hazardous waste management: minimization, collection, storage, handling, transport, and disposal - design ofhazardous waste landfills - TCLP tests - National and International legislation for hazardous waste management – AtomicEnergy Regulatory Board -International Atomic Energy Agency - Department of Atomic Energy - Nuclear Power Corporation -Nuclear power plants inIndia.

(9)

NUCLEAR WASTE AND e-WASTE

Sources - classification - effects of nuclear waste- initial treatment of nuclear wastevitrification, ion exchange, synroc – long term management - above ground disposal, geological disposal, ocean dumping, transmutation, space disposal - reuse ofwaste - nuclear safety and waste regulation - case study on nuclear disaster - source of e-waste - material composition ofe-waste - recycling and recovery - integrated approaches to e-waste recycling - socio economic factors - treatment option -disposal option - e-waste legislation.

(9)

TOTAL :45

TEXT BOOKS

- Tchobanoglous, G. et al., "Integrated Solid Waste Management", McGraw-Hill Publication., New York,1993.
- Ronald E. Hester, Roy M. Harrison "Electronic Waste Management", Royal Societyof Chemistry,2009.
- Peavy, SH, Rowe, RD and Tchobanoglous, G, "Environmental Engineering", McGraw-Hill Inter Edition,1985.
- Charles, A.W., "Hazardous Waste Management", McGraw-Hill Publication,2002

18BTFTOE01 PROCESSING OF FOOD MATERIALS 3H-3C

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

End Semester Exam:3Hours

Course Objectives:

- Explain the milling, extraction and manufacture of tremendous products from cereals, pulses and oilseeds
- Summarize the production and processing methods of fruits andvegetables
- Discuss the chemical composition, processing, production, spoilage and quality of milk and milkproducts
- Outline the overall processes involved in the production of meat, poultry and fishproducts
- Review the production and processing methods of plantation and spiceproducts

Course Outcomes:

1. Discuss the various processing technologies involved in cereal, pulses and oilseedtechnology
2. Demonstrate the major operations applied in fruits and vegetableprocessing
3. Illustrate the techniques involved in the processing of dairyproducts
4. Infer the production of different types ofmilk
5. List the overall processing of meat, poultry and fishprocessing
6. Outline the processing of spices and plantationproducts

Unit I - CEREAL, PULSES AND OIL SEEDSTECHNOLOGY

Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies -Pasta products -Tortilla - Method ofmanufacture.

Unit II - FRUITS AND VEGETABLE PROCESSING

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

Unit III - DAIRY PROCESSING

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milk powder - Equipments - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products - Icecream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage ofmilk.

Unit IV - MEAT, POULTRY AND FISH PROCESSING

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing .

Unit V - PLANTATION PRODUCT TECHNOLOGY

Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric

SUGGESTED READINGS

1. Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow. 3rd Edition.2010.
2. Chakraverty A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press. USA. 1st Edition.2003.
3. Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression.2016.

18BTFTOE02 **Nutrition and Dietetics** **3H-3C**

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

End Semester Exam:3Hours

Course objectives

- Explain the basic concepts of food and nutrition
- Define the overall classification, function, and source of carbohydrates, lipids andproteins
- Discuss the overall aspects ofvitamins
- Outline the role of health and nutritional importance of micro and macrominerals
- Summarize the recent trends innutrition

Course outcomes

1. Discuss the basics in the area of nutritional assessment in health anddisease
2. Categorize the recommended dietary allowances for different agegroups
3. Express the classifications, functions and sources of carbohydrates, lipids andproteins
4. List the various attributes of fat and water solublevitamins
5. Report the role, bioavailability, sources and deficiency diseases of macro and microminerals
6. Recognize the diets and concepts of foods suggested for nutrional, chronic and acutedisorders

UNIT I - HUMAN NUTRITION

Historical perspective of nutrient requirements – Assessment of nutritional status - recommended dietary allowances of macronutrients for all age groups - Assessment of protein quality – Malnutrition and related disorders – Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health andwellbeing.

UNIT II - BIOMOLECULES

Carbohydrates- Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Refined & Hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins.

UNIT III - VITAMINS

Physiological role, bio-availability, requirements, sources and deficiency of Fat Soluble Vitamins: Vitamin A, Vitamin D, E & K. Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6.

UNIT IV - MINERALS

Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride.

UNIT V - RECENT TRENDS IN NUTRITION

Principles of dietary management in gout, rheumatism, AIDS/HIV - Cancer-risk factors,

symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods, health foods and novel foods, organically grown foods, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

SUGGESTED READINGS

1. Gordon M. Wardlaw. Perspectives in Nutrition. WCB McGraw-Hill Publishers, Boston, 9th Edition. 2013.
2. Shubhangini A. Joshi. Nutrition and Dietetics. Tata Mc Grow- Hill publishing Company Ltd, New Delhi. 4th Edition.2016.
3. Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6th Edition. 2017.
4. Ronald Ross Watson. Functional foods and Nutraceuticals in Cancer Prevention. Ed. Wiley – Blackwell.2003.
5. Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rd edition2018.

18BTFTOE03 **Ready to Eat Foods** **3H-3C**

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

Course Objectives

- Outline the current status of snack foodIndustry
- Describe the production, processing and marketing trends of potato and tortillachips
- Outline the overall processing ofpopcorn
- Explain the production and processing of fruits involved in snack foodpreparation
- Summarize the sensory analysis methods and packaging techniques of snackfoods

Course Outcomes (COs)

1. Review the overall aspects of snack foodindustry
2. Develop ready to eat foods from potato and maizeflour
3. Demonstrate the various unit operations involved in the production of potato and tortillachips
4. Illustrate the overall aspects of popcornproduction
5. List the production, processing and manufacturing of fruit basedsnacks
6. Recognize the sensory analysis and packaging methods of snackfoods

UNIT I SNACK FOOD INDUSTRY

Introduction-History-Past innovations- Outline of snack food industry- Nutrition-Total Quality Management of Technology-Domestic Snack Food Market-Global Market-Snack Food Association Future Considerations

UNIT II POTATO AND TORTILLA CHIPS PROCESSING

Potato Production- Potato snack Ingredients- Potato Analysis and Composition-Potato chip manufacturing process-Unit Operations-Other value added products from Potato.

Tortilla chips - Raw Materials- Processing steps-Equipment involved-Reconstitution of Dry Maize Flour-Unit operations.

UNIT III POPCORN PROCESSING

Introduction- Raw popcorn selection and preparation-Popping Methods-Home preparation of Popcorn-Equipments-Industrial manufacturing process- Flavorings and Applicators-Popcorn Packaging- Relative Nutrition- Marketing.

UNIT IV FRUIT BASED SNACKS

Introduction-production and processing of fruit crops – fruit purees – fruit powders – canned fruit snacks – alcoholic preservation of fruit snacks – fruit candies – fruit bars – exotic fruits.

UNIT V SENSORY EVALUATION AND PACKAGING

Introduction- Analytical methods-Sensory methods- Sensory Aspect of Processing- Quality properties of Snack Foods and Packaging Materials-Automated Bag- Pouch Packaging- Cartoning Case Packing-Current Issues in Snack Foods Packaging

SUGGESTED READING

1. Lusas, E. W and Rooney, L. W. Snack Foods Processing. CRC Press,1st Edition2001.
2. Panda, H. The Complete Technology Book on Snack Foods, National Institute of Industrial Research, Delhi. 2nd Edition2013.
3. Sergio O Serna-Saldivar, Industrial Manufacture of Snack Foods, Kennedys Books Ltd.2008.

18BTFTOE04 **Agricultural Waste and Byproducts Utilization** **3H-3C**

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

Course Objectives

- Categorize the types of agriculturalwastes
- Outline the production and utilization ofbiomass
- Explain the various parameters considered to be important in the designing of biogasunits
- Review the various methods employed in the production of alcohol from the byproducts of agriculturalwastes
- Summarize the overall aspects involved in the production of paperboards and particleboards from agriculturalwastes

Course Outcomes

1. List and group the types of agriculturalwastes
2. Develop a number of value added products from agriculturewastes
3. Discuss the techniques and production involved in the utilization ofbiomass
4. Assess the various parameters considered to be important in the designing of biogasunits
5. Illustrate the various methods employed in the production of alcohol from the byproducts of agriculturalwastes
6. Choose the appropriate materials to produce paperboards and particle boards from agricultural wastes

UNIT 1-TYPES OF AGRICULTURAL WASTES

Introduction and Background Agricultural Waste, Crop Waste, Agricultural Residues (annual crops), Technical terms, rice by-products utilization-rice bran and germ, rice bran oil, economic products from agriculture waste/by-products.

UNIT 2-BIOMASS PRODUCTION AND UTILIZATION

Biomass Gasifier, Technology used for the utilization of agricultural wastes: Biomass Gasifier, Nimbkar Agricultural Research Institute (NARI) Gasifier, Rice-Husk Based Gasifier, Heat and Steam from Sugarcane Leaf and Bagasse.

UNIT 3-BIOGAS DESIGN AND PRODUCTION

Biogas: Definition, composition, history of biogas, Production of biogas; types of biogas plant (floating drum type and fixed dome type) and their components (inlet, outlet, stirrer, slanting pipe, digester, gas holder and gas outer pipe), Selection and Design of biogas plant.

UNIT 4-PRODUCTION OF ALCOHOL FROM WASTE MATERIALS

Production of Alcohol from waste materials: Introduction, Production methods, Cellulolysis (biological approach): Pretreatment, Cellulolytic processes (Chemical and Enzymatic hydrolysis), Microbial fermentation, Gasification process (thermochemical approach).

UNIT 5-PRODUCTION OF PAPER BOARDS AND PARTICLE BOARDS FROM AGRICULTURAL WASTE

Production and testing of Paperboards and Particleboards from Agricultural Waste: Introduction, History, Terminology and classification, Raw materials, Production steps- Pulping, Classifications of pulp, Bleaching, Plies, Coating, Grades.

SUGGESTED READINGS

1. K M Sahay and K K Singh. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt Ltd, Noida, Uttar Pradesh. 2nd Edition2013.
2. Beggs C. Energy Management and Conservation. Elsevier Pulication. 2nd Edition2009.
3. Chaturvedi P. 2009. Energy Management: Challenges for the Next Millennium. Concept Publishing Co. 1st Edition2000.
4. Fardo SW, Patrick DR, Richardson RE and Fardo BW. Energy Conservation Guidebook. The Fairmont Press. 3rd Edition2014.
5. Wulfinghoff DR. Energy Efficiency Manual. Energy Institute Press.2000.

18BEBMEOE01 ROBOTICS IN MEDICINE 3 0 0 3 100

OBJECTIVES

The goal of this course is for students

- To understand the basics of Robotics, Kinematics.
- To understand the basics of Inverse Kinematics.
- To explore various kinematic motion planning solutions for various Robotic configurations.
- To study the trajectory planning for robot.
- To understand the task level programming
- To explore various applications of Robots in Medicine

OUTCOMES

Upon completion of this course, students will be able to:

- Explain various kinds robotics techniques, vision, planning and applications.
- Outline the basic concept of robotics
- Identify and discuss the Robot Vision
- Describe about manipulators and kinematics.
- Demonstrate Task level programming
- Discuss the applications of robotic systems in medical field.

UNITI INTRODUCTION

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

UNITII KINEMATICS

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three-Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNITIII ROBOT VISION

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNITIV PLANNING

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNITV APPLICATIONS

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopaedics, Neurosurgery

TEXT BOOKS:

S.NO.	Author(s)Name	Title of the book	Publisher	Year of publication
1	Robert Schilling	Fundamentals of Robotics-Analysis and control‖	Prentice Hall	2003
2	J.J.Craig	Introduction to Robotics‖,	Pearson Education	2005

REFERENCES:

S.NO.	Author(s)Name	Title of the book	Publisher	Year of publication
1	Staugaard, Andrew C	Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning‖	Prentice Hall Of India	1987
2	Grover, Wiess, Nagel, Oderey	Industrial Robotics: Technology, Programming and Applications‖	McGraw Hill	1986.
3	Wolfram Stadler	Analytical Robotics and Mechatronics‖	McGraw Hill,	1995
4	Saeed B. Niku,	Introduction to Robotics: Analysis, Systems, Applications‖	Prentice Hall	2001
5	K. S. Fu, R. C. Gonzales and C. S. G. Lee	Robotics‖	McGraw Hill	2008

18BEBMEOE02 VIRTUAL REALITY AND AUGMENTED REALITY 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To impart the fundamental aspects, principles of virtual reality technology.
- To gain knowledge about applications of virtual reality.
- To introduce the relevance of this course to the existing technology through demonstrations and applications.
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality
- To choose Virtual Reality application areas

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Understand the basic concepts of Virtual reality
- Infer the importance of virtual reality
- Comprehend the significance Virtual reality in present scenario
- Analyse VR on the mobile and VR on the web.
- Design of various modeling concepts.
- Develop the Virtual Reality applications in different areas

UNITI INTRODUCTION

The three I‘s of virtual reality-commercial VR technology and the five classic components of a VR system- InputDevices:(Trackers, Navigation, and Gesture Interfaces):Three-dimensionalposition trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays &haptic feedback..

UNITII VR DEVELOPMENTPROCESS

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNITIII CONTENT CREATION CONSIDERATIONS FOR VR

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNITIV VR ON THE WEB & VR ON THEMOBILE

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

UNITV APPLICATIONS

Medical applications-military applications-roboticsapplications- AdvancedReal time Trackingother applications- games, movies, simulations, therapy.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	C. Burdea & Philippe Coiffet	Virtual Reality Technology‖	Second Edition, Gregory,	2008
2	Jason Jerald	. The VR Book:Human-Centred Design for VirtualReality. Association for Computing Machinery and Morgan & Claypool	New York, NY, US	-

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Dieter Schmalstieg & Tobias Hollerer	Augmented Reality: Principles and Practice (Usability)	Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United	2016
2	Steve Aukstakalnis,	Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)	Addison-Wesley Professional 1 edition,	2016
3	Robert Scoble & Shel Israel	The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything	, Patrick Brewster Press	2016
4	Tony Parisi,	Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile	O'Reilly Media; 1 edition	2015
5	Tony Parisi	Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for	O'Reilly Media; 1 edition	2014
6	Jos Dirksen	Learning Three.js: The JavaScript 3D Library for WebGL	Packt Publishing - ebooks Account; 2nd Revised ed.	2015

18BEBMEOE03 ARTIFICIAL ORGANS AND IMPLANTS 3 003 100

OBJECTIVES

The goal of this course is for students:

- To discuss the overview of artificial organs &transplants
- To extend the principles of implant design with a casestudy
- To explain the implant design parameters and solution inuse
- To simplify about various blood interfacingimplants
- To know the biocompatibility of artificial organs
- To learn about the implantable medical devices

OUTCOMES

Upon completion of this course, students will be able to:

- Explain the implant design parameters and solution inuse
- Analyze about various blood interfacing implants
- Evaluate response of biomaterials in living system
- Perceive knowledge about artificial organs &transplants
- Demonstrate different types of soft tissue replacement and hard tissuereplacement
- Assess biocompatibility of artificial organs

UNITI ARTIFICIAL ORGANS &TRANSPLANTS

ARTIFICIAL ORGANS:-Introduction, outlook for organ replacements, design consideration, evaluation process.

TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNITII PRINCIPLES OF IMPLANTDESIGN

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNITIII IMPLANT DESIGN PARAMETERS AND ITSSOLUTION

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNITIV BLOOD INTERFACINGIMPLANTS

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNITV IMPLANTABLE MEDICAL DEVICES ANDORGANS

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Kopff W.J	Artificial Organs	John Wiley and sons, New York, 1st edition	1976
2	Park J.B.,	Biomaterials Science and Engineering‖	Plenum Press	1984

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	J D Bronzino	Biomedical Engineering handbook Volume II	CRC Press / IEEE Press	2000
2	R S Khandpur	Handbook of Biomedical Instrumentation	Tata McGraw Hill	2003
3	Joon B Park	Biomaterials – An Introduction	Plenum press, New York	1992
4	Yannas, I. V	Tissue and Organ Regeneration in Adults‖	New York, NY: Springer	2001
5	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D,Bronzino	ClinicalEngineering‖	CRC Press, 1st edition	2010
6	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	McGraw- Hill	2003

18BTBTOE01 **BIOREACTOR DESIGN** **3H-3C**

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

Course Objectives:

- To impart basic knowledge in bioprocess Engineering
- To design the bioreactors for various operations.
- To understand the principle and working of heat transfer equipments.
- To extend the knowledge in principle of heat transfer inside a bioreactor
- To construct the equipments used in mass transfer operations.
- To learn the equipments used in separation process.

Course Outcomes:

- Summarize the basic concepts in bioprocess Engineering.
- Design the bioreactors for various operations.
- Develop the heat transfer equipments for Bioprocess Engineering.
- Elaborate the principle of heat transfer in bioreactor.
- Construct the equipments used in mass transfer operations.
- Categorize the equipments used in separation process.

UNIT I –INRODUCTION TO BIOPROCESS ENGINEERING

Introduction – Biotechnology and Bioprocess Engineering- Biologists and Engineers Differ in their approach to research-How Biologists and Engineers work Together- Bioprocesses: Regulatory constraints.

UNIT II - REACTOR DESIGN

Design of Airlift fermentor, Bubble column reactor and Continuous stirred tank reactor.

UNIT III - HEAT TRANSFER EQUIPMENTS

Design of Shell and tube Heat exchanger, Double pipe heat exchanger, long tube vertical evaporator and forced circulation evaporator.

UNIT IV - MASS TRANSFER EQUIPMENTS

Design of Bollmann extractor, fractionating column, packed tower and spray tray absorber

UNIT V - SEPARATION EQUIPMENTS

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

SUGGESTED READINGS:

1. James Edwin Bailey, David F. Ollis (2015) Biochemical Engineering Fundamentals, Second Edition. McGraw-Hill Education (India) privatelimited.
2. Don W. Green, Robert H.Perry (2008). Chemical Engineer Hand book. The McGraw-Hill Companies,Inc.
3. Pauline. M. Doran (2015). Bioprocess Engineering Principles Second Edition . Academic Press.

18BTBTOE02 FOOD PROCESSING AND PRESERVATION 3H-3C

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

Course Objectives

- To learn the scope and importance of food processing.
- To impart basic knowledge in different food processing methods carried out in the food tech companies.
- To extend the brief knowledge in food conservation operations.
- To study the methods of food preservation by cooling.
- To familiarize the students on the concepts of preservation methods for fruits.
- To create deeper understanding on preservation methods for vegetables.

Course Outcomes

- Describe the scope and importance of food processing.
- Outline the various processing methods for foods.
- Extend the knowledge in food conservation operations.
- Describe the methods of food preservation by cooling.
- Summarize the preservation methods for fruits.
- Demonstrate the preservation methods for vegetables.

UNIT I - SCOPE AND IMPORTANCE OF FOOD PROCESSING

Properties of food - Physical, thermal, mechanical, sensory.Raw material Preparation - Cleaning, sorting, grading, peeling.

UNIT II - PROCESSING METHODS

Heating- Blanching and Pasteurization. Freezing- Dehydration- canning-additives- fermentation- extrusion cooking- hydrostatic pressure cooking- dielectric heating- micro wave processing and aseptic processing – Infra red radiation processing-Concepts and equipment used.

UNIT III - FOOD CONVERSION OPERATIONS

Size reduction – Fibrous foods, dry foods and liquid theory and foods – equipments - membrane separation- filtration- equipment and application.

UNIT IV - FOOD PRESERVATION BY COOLING

Refrigeration, Freezing-Theory, freezing time calculation, methods freezing of freezing equipments, freeze drying, freeze concentration, thawing, effect of low temperature on food. Water activity, methods to control water activity.

UNIT V - PRESERVATION METHODS FOR FRUITS AND VEGETABLES

Pre processing operations - preservation by reduction of water content: drying / dehydration and concentration – chemical preservation – preservation of vegetables by acidification, preservation with sugar - Heat preservation– Food irradiation- Combined preservation techniques.

SUGGESTED READINGS:

1. R. Paul Singh, Dennis R.Heldman (2014).Introduction to food engineering. Academicpress.
2. P.Fellows.(2017). Food processing technology principles and practice, Fourth Edition. Wood head publishingLtd.
3. Mircea Enachescu Dauthy. (1995). Food and vegetable processing.FAO agriculturalservices bulletin.
4. M.A. Rao, Syed S.H.Rizvi, Ashim K. Datta. (2014). Engineering properties of foods.CRC press.
5. B. Sivasankar. (2002). Food processing and preservation.PHI learningPvt.Ltd.

18BTBTOE03 **BASIC BIOINFORMATICS** **3H-3C**

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

Course Objectives

- To understand the available tools and databases for performing research in bioinformatics.
- To expose students to sequence alignment tool in bioinformatics.
- To construct the phylogenetic trees for evolution.
- To get familiar with the 3D structure of protein and classification.
- To acquire basic knowledge in protein secondary structure prediction.
- To extend the brief knowledge in Micro array data analysis.

Course Outcomes

- Summarize the basic concepts and importance of Bioinformatics in various sectors.
- Demonstrate the sequence alignment tool in bioinformatics.
- Construct the phylogenetic trees for evolution.
- Analyze the three dimensional protein structure and classification using various tools.
- Illustrate the protein secondary structure prediction by comparative modeling.
- Extend the knowledge in micro array technology and applications of bioinformatics in various sectors.

UNIT I - OVERVIEW OF BIOINFORMATICS

The scope of bioinformatics; bioinformatics & the internet; useful bioinformatics sites. Data acquisition: sequencing DNA, RNA & proteins; determination of protein structure; gene & protein expression data; protein interaction data. Databases – contents, structure & annotation: file formats; annotated sequence databases; miscellaneous databases.

UNIT II - RETRIEVAL OF BIOLOGICAL DATA

Data retrieval with Entrez & DBGET/ LinkDB; data retrieval with SRS (sequence retrieval system).Searching sequence databases by sequence similarity criteria: sequence similarity searches; amino acid substitution matrices; database searches, FASTA & BLAST; sequence filters; iterative database searches & PSI-BLAST. Multiple-sequence alignment, gene & protein families: multiple-sequence alignment & family relationships; protein families & pattern databases; protein domain families.

UNIT III - PHYLOGENETICS

Phylogenetics, cladistics & ontology; building phylogenetic trees; evolution of macromolecular sequences. Sequence annotation: principles of genome annotation; annotation tools & resources.

UNIT IV - STRUCTURAL BIOINFORMATICS

Conceptual models of protein structure; the relationship of protein three-dimensional structure to protein function; the evolution of protein structure & function; obtaining, viewing & analyzing structural data; structural alignment; classification of proteins of known three-dimensional structure: CATH & SCOP; introduction to protein structure prediction; structure prediction by comparative modeling; secondary structure prediction; advanced protein structure prediction & predictionstrategies.

UNIT V - MICROARRAY DATA ANALYSIS

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling & SAGE. Bioinformatics in pharmaceutical industry: informatics & drug discovery; pharma informatics resources. Basic principles of computing in bioinformatics: running computer software; computer operating systems; software downloading & installation; databasemanagement.

SUGGESTED READINGS:

1. Dan E krane Michael L Rayme. (2004). Fundamental concepts of Bioinformatics. Pearson Education.
2. Andreas D Baxevanis B.F. Franchis Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins.Wiley-Interscience.
3. David W. Mount. (2004). Sequence and Genome Analysis. Cold Spring HarborLaboratory.
4. Jonathan Pevsner.(2015). Bioinformatics and functional genomics.wiley-Liss.
5. Michael J Koernberg. (2016).Microarray Data Analysis: Methods and applications. Humana Press

18BTBTOE04 FUNDAMENTALS OF NANOBIOTECHNOLOGY 3H-3C

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

Course Objectives

- To impart the skills in the field of nano biotechnology and its applications.
- To acquire knowledge in the nano particles and its significance in various fields.
- To extend the knowledge in types and application of nano particles in sensors.
- To define the concepts of biomaterials through molecular self assembly.
- To equip students with clinical applications of nano devices.
- To describe deeper understanding of the socio-economic issues in nanobiotechnology.

Course Outcomes

- Develop skills in the field of nano biotechnology and its applications.
- Summarize the nanoparticles and its significance in various fields.
- Extend the knowledge in types and application of nano particles in sensors.
- Define the concepts of biomaterials through molecular self assembly.
- Outline the clinical applications of nano devices.
- Describe the socio-economic issues in nanobiotechnology.

UNIT I - INTRODUCTION

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Nanotechnology in Different, Fields: Nanobiotechnology, Materials, Medicine, Dental care.

UNIT II - NANO PARTICLES

Introduction, Types of Nanoparticles, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrications- MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

UNIT III – MEDICAL NANOTECHNOLOGY

Nanomedicine, Nanobiosensor and Nanofludics.Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems.Nano-Biodevices and Systems.Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for in vivo drug delivery- Future nanomachine.

UNIT IV - NANOBIOTECHNOLOGY

Clinical applications of nanodevices.Artificial neurons. Real-time nanosensors- Applications in cancer biology. Nanomedicine.Synthetic retinyl chips based on bacteriorhodopsins.High throughput DNA sequencing with nano carbontubules.Nanosurgicaldevices.

UNIT V - ETHICAL ISSUES IN NANOTECHNOLOGY

Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Nanomedicine Applied in Nonmedical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economicchallenges.

SUGGESTED READINGS:

1. Niemeyer, C.M. and Mirkin, C.A (2005). Nanobiotechnology: Concepts, Applications and Perspectives.Wiley-VCH.
2. Goodsell, D.S. (2004). Bionanotechnology. John Wiley and Sons,Inc.
3. Shoseyov, O.and Levy, I (2008).Nanobiotechnology: Bioinspired Devices and Materials of the Future. HumanaPress.
4. Bhushan, B.(2017). Springer Handbook of Nanotechnology. Springer-Verlag Berlin Heidelberg.
5. FreitasJr R.A (2006) Nanomedicine. LandesBiosciences.
6. Kohler, M. and Fritzsche, W. (2008). Nanotechnology – An Introduction to Nanostructuring Techniques.Wiley-VCH.