Dr. M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY
(Decl. U/S 3 of the UGC Act 1956)
DEPARTMENT OF BIOTECHNOLOGY

B.Tech – Biotechnology (Full Time)
Curriculum and Syllabus
2013 Regulation

III SEMESTER						
S.No	**Sub. Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT13003	Biochemistry-I	3	1	0	4
2	BBT13004	Microbiology	3	1	0	4
3	BCT13031	Thermodynamics & Stoichiometry	3	0	0	3
4	BBT13005	Cell Biology	3	0	0	3
5	BBT13006	Molecular & Structural Biophysics	3	0	0	3
6	BBT13007	Genetics	3	0	0	3
7	BMG13005	Entrepreneurship	1	0	3	2
8	BBT13L01	Biochemistry Lab	0	0	3	1
9	BBT13L02	Microbiology Lab	0	0	3	1
		TOTAL	**19**	**2**	**9**	**24**

IV SEMESTER						
S.No	**Sub. Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT 13008	Biochemistry-II	3	1	0	4
2	BBT 13009	Microbial Biotechnology	3	0	0	3
3	BCT 13032	Principles Of Chemical Engineering	3	1	0	4
4	BBT 13010	Instrumentation And Analysis	3	0	0	3
5	BMA 13014	Advanced Mathematics For Biotechnology	3	1	0	4
6	BBT 13011	Molecular Biology	3	1	0	4
7	BEN13L01	Career and Confidence Building(Soft Skills -I)	1	0	3	2
8	BBT 13L03	Microbial Biotechnology Lab	0	0	3	1
9	BBT13L04	Instrumentation And Analysis Lab	0	0	3	1
		TOTAL	**19**	**4**	**9**	**26**

V SEMESTER						
S.No	**Sub Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT 13012	Recombinant DNA Technology	3	0	0	3
2	BBT 13013	Protein Science	3	1	0	4
3	BBT 13014	Plant Biotechnology	3	0	0	3
4	BCT 13033	Chemical Reaction Engineering	3	1	0	4
5	BBT 13015	Immunology	3	0	0	3
6	BBT13XXX	ELECTIVE –I	3	0	0	3
7	BEN13L02	Qualitative and Quantitative Skills (Soft skills –II)	1	0	3	2
8	BBT 13L05	RDNA Technology Lab	0	0	3	1
9	BBT13L06	Immunology Lab	0	0	3	1
		TOTAL	**19**	**2**	**9**	**24**

VI SEMESTER						
S.No	**Sub Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT 13016	Bioinformatics	3	0	0	3
2	BCS 13036	Computing for Biotechnologists	3	0	0	3
3	BBT 13017	Animal Biotechnology	3	0	0	3
4	BBT 13018	Bioprocess Engineering	3	1	0	4
5	BBT 13019	Pharmaceutical Technology	3	0	0	3
6	BBT13XXX	ELECTIVE -II	3	0	0	3
7	BBT13L07	Bioinformatics Lab	0	0	3	1
8	BBT 13L08	Bioprocess Lab	0	0	3	1
9	BBT13L09	Mini project (Industry attached)*	0	0	6	2
		TOTAL	**18**	**1**	**12**	**23**

***students have to undergo an training in an Industry or R & D lab for 15 full working days.**

		VII SEMESTER				
S.No	**Sub Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT 13020	Genomics	3	1	0	4
2	BBT 13021	Biomaterials and Tissue Engineering	3	0	0	3
3	BBT 13022	Food Biotechnology	3	0	0	3
4	BBT 13023	Downstream processing	3	1	0	4
5	BBT 13024	Bio fuels	3	0	0	3
6	BBT13XXX	ELECTIVE -III	3	0	0	3
7	BBT13L10	Tissue culture lab	0	0	3	1
8	BBT 13L11	Downstream processing lab	0	0	3	1
9	BBT13L12	Scientific Reading and Writing	0	0	3	1
		TOTAL	**18**	**2**	**9**	**23**

VIII SEMESTER						
S.No	**Sub Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT 13025	Legal aspects of biotechnology (IPR Bioethics, Biosafety)	3	0	0	3
2	BMG 13002	Total Quality Management	3	0	0	3
3	BBT 13L13	Project work	3	0	24	10
4	BBT13XXX	ELECTIVE -IV	3	0	0	3
			12	**0**	**24**	**19**

CREDIT DISTRIBUTION

I and II semester	45
III semester	24
IV semester	26
V semester	24
VI semester	23
VII semester	23
VIII semester	19
TOTAL	**184**

		ELECTIVES -I				
S.No	**Sub Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT13E01	Solid and Hazardous waste management	3	0	0	3
2	BBT13E02	Marine Biotechnology	3	0	0	3
3	BBT13E03	Stem cells and Developmental Biology	3	0	0	3

		ELECTIVES -II				
S.No	**Sub Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT13E 04	Design of Industrial waste water management	3	0	0	3
2	BBT13E 05	Phyto chemical Technology	3	0	0	3
3	BBT13E 06	Cancer Biology	3	0	0	3

		ELECTIVES-III				
S.No	**Sub Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
1	BBT13E 07	Environmental Impact Assessment	3	0	0	3
2	BBT13E 08	Molecular modeling and drug design	3	0	0	3
3	BBT13E 09	Biosensors and Biomedical devices in Diagnostics	3	0	0	3

		ELECTIVES-IV				
S.No	**Sub Code**	**Title of Subjects**	**L**	**T**	**P**	**C**
	BMG13E10	Management Concepts for Engineers and Technologist	3	0	0	3
	BBT13E10	Environmental Toxicology	3	0	0	3

BBT13003 **BIOCHEMISTRY –I** **3 1 0 4**

OBJECTIVES:

- To study the structure, organization and classification of biomolecules such as carbohydrates, proteins, lipids and nucleoproteins.
- To study the mechanism of enzymatic action including apo enzymes and co-enzymes and their kinetics in the presence of different inhibitors. To know the industrial applications of enzymes.

UNIT I: CHEMISTRY OF BIOMOLECULES **12 Hrs**

Carbohydrates- Introduction and classification, properties of mono, oligo and Polysaccharides and glycosidic bonds. Lipids- Structure and classification of lipids, Distribution and biological importance of fats and fatty acids.

UNIT II: PROTEINS **12 Hrs**

Structure and properties of amino acids, classification and properties of proteins, conformation and structure of proteins-primary, secondary, tertiary and quaternary structure, coagulation and denaturation of proteins. Macromolecules, structure of haemoglobin, Myoglobin and Immunoglobulin. Nucleic acids- Structure of purines, pyrimidines, nucleosides and nucleotides. Structure, types and biological role of RNA and DNA.

UNIT III: ENZYMES **12 Hrs**

General characteristics, nomenclature, IUB enzyme classification, enzyme specificity, factors affecting enzyme activity Enzyme catalysis- Transition and collision state theories, significance of activation energy, acid-base catalysis, covalent catalysis, proximity and orientation effects, strain and distortion theory, isoenzymes, coenzymes and cofactors. Enzyme inhibition - competitive, Non competitive, Uncompetitive (Concepts with example).

UNIT IV: ENZYME KINETICS **12 Hrs**

Derivation of Michaelis-Menten equation for Uni-substrate reactions, Km and its significance, Line-Weaver-Burk plot and its limitations, kinetics of zero and first order reactions, importance of kcat/Km, mechanisms, Determination of Km & Vmax in presence and absence of inhibitor and Ki determination. Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes, Symmetric and sequential modes for action of allosteric enzymes. Reversible and irreversible covalent modification of enzymes, cascade systems. Immobilized enzymes and their industrial applications.

UNIT V: DETOXIFICATION **12 Hrs**

Phase I and Phase II reactions, Enzymes of detoxification. Carcinogenesis, characteristics of cancerous cells, agents promoting carcinogenesis. Free radicals in biological system, Antioxidants.

Total No. of Hrs: 60

TEXT BOOKS

1. Nelson, L. D. and M. M Cox, (2002), *Lehninger's Principle of Biochemistry*: (3rd Ed) Macmillan, Worth Publication Inc.

REFERENCE BOOKS

1. Voet & Voet,:(1995) *Biochemistry* (2nd Ed)John Wiley and Sons.
2. Jeoffrery Zubay(1993) *Biochemistry:* (3rd Ed. Vol.1, 2, 3,), Wm C. Brown Publ.
3. Jeoffrery Zubay, (1995) *Principles of Biochemistry* Wm C. Brown Publ.
4. Nicholas C. Price and Lewis Stevens (1989), *Fundamentals of Enzymology* Oxford Univ.Press.
5. M. Dixon, E. C. Webb, CJR Thorne and K. F. Tipton(1979) *Enzymes***:**, Longmans,
6. Trevor Palmer. (1999) *Understanding Enzymes***:** Kindle publ

BBT 13004 **MICROBIOLOGY** **3 1 0 4**

OBJECTIVES:

- To understand the basic structure of microorganism such as bacteria, viruses, algae fungi and phage.
- To have a brief knowledge about the nutrition requirements and growth curve of bacteria.

UNIT I: HISTORY OF MICROBIOLOGY **12 Hrs**

Germ theory of disease –Spontaneous generation theory, Pasteur's contribution and Koch's contribution, Classification-systemic and numerical classification, 16Sr RNA classification Microscope and staining - Basic principles and application of light microscope, electron microscope, SEM TEM,STM, Confocal laser scanning microscope. Principle of different staining techniques –Simple staining, Gram's staining, acid fast and capsule staining.Structure of prokaryotic - Cell morphology and structure, synthesis of peptidoglycan layer,capsule, endospore formation, flagella. Marine microbial habitats - microbial life at surface, biofilm and microbial mats, hydrothermal vents and cold seeps, understanding of important marine bacteria can adapt to compete effectively in cold marine environments.

UNIT II: BACTERIAL GROWTH **12 Hrs**

Bacterial Growth- Growth curve, measuring the bacterial growth, factors effecting bacteria growth-physical and nutritional factors. Prevention of bacterial growth- Physical and chemical control of organisms,different mode of antibiotic action. Metabolism-Glycolytic pathway, alternative of glycolytic pathway, Fermentation, Kerb's cycle and electron transport and oxidative phosphorylation. Other metabolic pathway-Photoautotrophy, Photoheterotrophy and Chemoautotrophy.Microbes in extreme environment – Adaptation mechanism of Halophiles, alkaliphiles, psychrophiles, Piezophile and xerophile.

UNIT III: FUNGI **12 Hrs**

Classification of fungi, Oomycetes-water mould, Chytridiomycetes- anearobic rumenfungi , Zygomycetes- *Rhizopus stolonifer*, Ascomycetes- *Aspergillus* and Basidiomycetes-smuts and rusts and lichens. Prevention of fungal growth-antifungal and sterilization.Study of Yeasts – morphology and reproduction of yeasts, and application in industrial.

UNIT IV: VIRUS **12 Hrs**

Structure of virus, Classification of viruses on the basis of capsid symmetry enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Capsids complex (Bacteriophage, and Virion size), enveloped (Herpes), helical (TMV) and icosahedral (Polyoma) Phage - Specificity in phage infection, E. coli PhageT4, E.coli Phage T7, E.coli phage lambda, Immunity to infection, Prophage integration, Induction of prophage, Induction & Prophage excision, Repressor, Structure of the operator and binding of the repressor and the Cro product, assessment between the lytic and lysogenic Cycles. Principle of plaque assay.

UNIT V: MICROBIAL STRAIN IMPROVEMENT **12 Hrs**

Microbial strain improvement -Screening and isolation of microorganisms, primary and secondary metabolites, enrichment, specific screening for desired product. Modern trends in microbial production-Modern trends in microbial production of bioplastics (PHB, PHA), bioinsectides, biopolymer (dextran, alginate, xanthan). Biofuels-Microbial production of hydrogen gas, biodiesel from. Fungal enzymes of commercial importance and production of mammalian proteins from fungi. Case studies can be provided depending on any recent issue.

Total No. of Hrs: 60

TEXT BOOKS

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg,(2005), *Microbiology* (5thEd) TATA McGraw Hill,

REFERENCE BOOKS

1. Anantha Narayan, C.K. Jayaram Paniker, (2009), *Text Book of Microbiology* (7th Ed) Orient Blackswan,
2. Jacquelyn and G.Black (2000)*Microbiology :Principles and Explorations* (7th Ed) wiley
3. John Webster Roland Weber.(2007) *Introduction to fungi* Cambridge University Press,
4. Colin Munn.Marine(2011) *Microbiology –Ecology and application* (2nd Ed) **:** Kindle publ

BCT 13031 THERMODYNAMICS & STOICHIOMETRY 3 0 0 3

OBJECTIVES:

- To understand the basic principles of classical thermodynamics to the analysis of processes and cycles involving pure simple substances.
- To impart the advanced reactor design and stability including energy balance

UNIT I: BASIC CONCEPTS OF THERMODYNAMICS 9 Hrs

The Ideal Gas, Review of first and second laws of thermodynamics, PVT behaviour of Pure Substances, Application of the Viral Equations, Cubic Equations of State. The Vapour-Compression Cycle, the Choice of Refrigerant, Absorption, Refrigeration and liquefaction: Low temperature cycle: Linde and Claude.

UNIT II: THERMODYNAMICS AND ITS APPLICATIONS 9 Hrs

The Chemical Potential and Phase Equilibria Fugacity and Fugacity Coefficient: for pure species and solution; The Nature of Equilibrium, the Phase Rule, Duhem's Theorem, Simple model's for
Vapour/Liquid Equilibrium, Roult's Law, Henry's law.

UNIT III: BIOCHEMICAL THERMODYNAMICS 9 Hrs

Energetics of Metabolic Pathways; Energy Coupling (ATP & NADH); Stoichiometry and energetic analysis of Cell Growth and Product Formation - elemental Balances, Degree of reduction concepts; available-electron balances; yield coefficients; Oxygen consumption and heat evolution in aerobic cultures; thermodynamic efficiency of growth.

UNIT IV: SMALL UNITS AND DIMENSIONS 9 Hrs

Basic physical Laws & concepts of vapour pressure. Buckingham Pi-theorem. Dimensionless groups, Conversion of equations, Solution of simultaneous equations, use of log-log and semi-log graph paper, triangular diagram, Graphical differentiation and graphical integration, Treatment and Interpretation of data, Error analysis in connection with computation.

UNIT V: ENERGY BALANCE 9 Hrs

General energy balance equation for steady and unsteady state processes: Without Chemical Reaction, concept of humidification and psychometric chart. With Chemical Reaction, Enthalpy calculation procedures, Special cases e.g., spray dryer, Distillation Column, Enthalpy change due to reaction: Heat of combustion, Heat of reaction for processes with biomass production, Energy-balance equation for cell culture, for fermentation processes.

Total No. of Hours : 45

TEXT BOOKS

1. Smith & Vanness, *Thermodynamics for Chemical Engineers*, MGH
2. Hougen and Watson, *Chemical Process Principles* (Part one): 2nd ed, John Wiley.

REFERENCE BOOKS

1. Richardson, J.F., Peacock, D.G.Coulson & Richardson's(1998) *Chemical Engineering*- Volume 3 ed., First Indian ed. Asian Books Pvt. Ltd.
2. David Mautner Himmelblau(1996) *Basic Principles and Calculations in Chemical Engineering*
3. (6th Ed) Prentice Hall
4. Michael L. Shuler, Filkert Kargi(2001) *Bioprocess engineering*: *Basic concepts* (2nd Ed) Prentice Hall
5. Bhatt & Thakur(2012) *Stoichiometry* (1st Ed) Tata McGraw Hill

BBT 13005 **CELL BIOLOGY** **3 0 0 3**

OBJECTIVES:

- To recollect the knowledge on prokaryotic and eukaryotic cells, cell division and cell organelles. To understand transport mechanism across cell membrane.
- To learn the basics of cell signaling through binding of a ligand to its receptor.

UNIT I: BRIEF HISTORY OF THE CELL **9 Hrs**

Brief History of the cell, model organisms in research, Cells and organelles, organelles in human diseases, Cell cycle, and cell cycle regulation, apoptosis, ubiquitination, autophagy, stem cells.

UNIT II: MEMBRANES **9 Hrs**

Membranes: Functions of membranes, models of membrane structure, membrane lipids, membrane proteins, transport across membranes – simple diffusion, facilitated diffusion through carrier proteins and channel proteins, active transport. Energetics of transport.

UNIT III: ENDOMEMBRANE SYSTEMS AND PEROXISOMES **9 Hrs**

Endomembrane systems and peroxisomes: Structure of E R and glogi complex. Role of E R and golgi complex in protein glycosylation, secretary pathways, protein trafficking, exocytosis, endocytosis, coated vesicles in cellular transport processes. Lysosomes and cellular digestion. Role of plant vacuole and peroxisomes.

UNIT IV: SIGNALTRANSDUCTION **9 Hrs**

Signal Transduction: Electrical and synaptic signaling in neurons, membrane potential, action potential; signal transduction through messengers and receptors. Chemical signals and cellular receptors; G- Protein linked receptors, protein kinase associated receptors, hormonal signaling.

UNITV: CYTOSKELETONSYSTEMS **9 Hrs**

Cytoskeleton systems: Major structural elements of the cytoskeleton, microtubules, microfilament, intermediate filament, cell-cell recognition and adhesion, cell – cell junction, extracellular matrix of animal cells, and surface of plant cells

Total No. of Hours: 45

TEXT BOOKS

1. Jeff Hardin, Gregory Paul Bertoni, Lewis J. Kleinsmith(2011) Becker's World of the Cell (8th Ed) Pearson Publ.

BBT 13006 MOLECULAR & STRUCTURAL BIOPHYSICS 3 0 0 3

OBJECTIVES:

- To understand the basic biophysical structure of proteins and its interaction with other macromolecules.
- A broad understanding of nucleoprotein stability and structure is also studied.

UNITI: INTRODUCTION TO MACROMOLECULES 9 Hrs

Introduction to quantum mechanics, the electronic structure of atom, Molecular orbits and covalent bonds, molecular interaction, Stereo chemistry and chirality, Molecular mechanics, Bond stretching, angle bending improper torsions, Van der waals interactions, hydrogen bond interactions, water models, force fields, all atoms force field and united atom force field.

UNIT II: PRINCIPLES OF PROTEIN STRUCTURE AND CONFIRMATIONS 9 Hrs

Basics problems of protein structure, Polypeptide chain geometrics, estimates of potential energy, results of potential energy calculations, hydrogen bonding, hydrophobic interactions and water as universal solvent in biological systems, Disruption of hydrophobic interactions by urea, ionic interactions, hydrophobic versus ionic interactions, Disulfide bond, Ways of pairing N-half cystine, formation of specific disulfide link, prediction of protein structure.

UNIT III: PROTEIN STRUCTURE & STABILITY 9 Hrs

Two state model of protein stability, chemical denaturation and stabilization, surface denaturation. Principles of ionization equilibrium ionization of side chain, equilibria in proteins. Predicting properties from amino acid composition, Primary structure sequencing of polypeptide, hemoglobin, homologies in proteins, Secondary structure alpha and beta confirmation, collagen structure, stability of alpha helix, Ramachandran plot, Tertiary & Quaternary structures of Myoglobin and hemoglobin, symmetry consideration, Analysis of subunits and chain arrangement of subunits, stability of globular quaternary structure, Protein folding rules, pathways and kinetics.

UNIT IV: STRUCTURE OF NUCLEIC ACIDS 9 Hrs

Introduction of nucleic acids, definition of terms for nucleic acids, old nomenclature, IUPAC-IUB nomenclature. Basis of Watson Cricks original model Different, base- pairing schemes Unsatisfactory nature of Hoogsteen and other base pairing schemes, biological implication of Watson Crick base pairing, single crystal X-ray diffraction, and NMR studies on mono- and oligo- nucleotides, DNA polymorphism, parameters for A-, B-, C-, D- and Z-DNA, definitions of roll, tilt and propeller twist, spectroscopic study of DNA polymorphism, interaction of DNA with proteins, drugs, dyes and carcinogens, experimental and theoretical studies on base stacking, hydrogen bonding interactions, structure of RNA, basic differences between DNA and RNA structures.

UNIT V: STRUCTURAL ANALYSIS 9 Hrs

X-ray crystallography, determination of molecular structures, X-ray fiber diffraction, electron microscopy, neutron scattering - light scattering, NMR spectroscopy.

Total no of Hours: 45

TEXT BOOKS

1. Vasantha pattabhiraman and P. Gautham(2002)*Fundamentals of Biophysics* Narosa Publishing house

REFERENCE BOOKS

1. Charles Cantor &Paul R Schimmel. *Biophysical Chemistry (Parts I – III)*,(1st Ed) W.H. Freeman & Co Ltd
2. Lubert Stryer (2002) *Biochemistry* (5th Ed) W. H. Freeman and Company
3. C. Branden and J .Tooze (1991)*Introduction to Protein Structure*, (1st Ed) Garland publishing, New York
4. Arthur M. Lesk (2010*) Introduction to Protein Architecture, Function, and Genomics* (2nd Ed) Oxford University Press
5. GE Schulz, RH Schirmer (2004*), Principal of Protein Structure*, Springer

BBT 13007 **GENETICS** **3 0 0 3**

OBJECTIVES:

- To understand the basics of genetic inheritance and Mendelian laws of inheritance.
- To learn the organization of prokaryotic and eukaryotic chromosomes and functions.
- To know the mechanism involved in chromosome segregation and different genetic disorders

UNIT I: INTRODUCTION **9 Hrs**

Nature of genetic material, Mendelian laws of inheritance, law of segregation and laws of independent assortment. Dominance and lethal genes-Dominance relationships, lethal gene action, gene interactions and Epistasis –Types of gene interaction and molecular basis of gene interaction.

UNIT II: CHROMOSOME STRUCTURE AND ORGANIZATION **9 Hrs**

Chromosome morphology, composition of chromatin, Prokaryotic and Eukaryotic organization, heterochromatin. Different types of (polytene and lamp brush chromosome, giant chromosomes) Chromosomes. Human Chromosomes and Functions.

UNIT III: SEX CHROMOSOMES AND INHERITED DISEASES **9 Hrs**

Vehicles of heredity, sex determination in plants and animals, Autosomal dominant disorders sex linked inheritance, non-disjunction of X chromosomes, linkage and crossing over, interference, coincidence. molecular diseases-Hemoglobinopathies, disorders of coagulation, colour blindness, hemophilia. Multiple alleles ABO blood groups, Rh group system

UNIT IV: GENE TRANSFER &MAPPING **9 Hrs**

Mapping techniques-calculation of large map distances, mapping genes by mitotic segregation and recombination, mapping by in-situ hybridization. Gene transfer in bacteria-transformation, transduction, conjugation and their mapping

UNIT V: POPULATION GENETICS **9 Hrs**

Principles of Hardy Weinberg law-Gene frequency, genotype frequency, Hardy Weinberg equilibrium and application, factors affecting gene frequencies. Polymorphism and characteristic features, inbreeding.

Total no of Hours: 45

TEXT BOOKS

1. Monroe W. Stricberger (1985) *Genetics* (3th Ed) Macmillan Publishing Company
2. Gardner (2006) *Principles of Genetics* (8th Ed) Wiley edition,
3. B.D.Singh (1999) *Fundamentals of Genetics* (3th Ed) Kalyani Publishers, New Delhi.

REFERENCE BOOKS

1. Good enough (1984*) Genetics* Saunders College Pub.
2. Singer and P.Berg (1991) *Genes and Genomes* University Science Books
3. Griffith (2000) *Genetics* W. H. Freeman

BMG 13005 **ENTREPRENEURSHIP** **1 0 3 2**

OBJECTIVES:

- To impart the basic knowledge of Overview of Entrepreneurship.
- Also to provide a basic idea about Developing a Business model and Business Plan.
- To understand the Technical Product Development and team management skills.

UNIT I: **3 Hrs**

Overview of Entrepreneurship & the Venture Value Chain, What Does It Take to Be an Entrepreneur? Generating ideas for Business and evaluating them as opportunities – using Mullins Seven Domains Model.

UNIT II: **3 Hrs**

Developing a Business model and Business Plan. The Venture Communication Pyramid—Cohesive Communication for Startups, Examining Sample Business Plans and Executive Summaries

UNIT III: **3 Hrs**

Technical Product Development, making prototypes, patenting procedures.

UNIT IV: **3 Hrs**

Team Management Skills and marketing principles.

UNIT V: **3 Hrs**

An Overview of Startup Finances and Sources of Investment Capital, Developing Financial Projections—How to Forecast Expenses and Revenue accounting and valuation procedures; Sources of funds for entrepreneurs and their equity distribution.

The Internal Assessment to be done by Presentations and participation in the class lectures and tutorials. The End Semester Examination will be a theory examination.

Total no of Hours: 15

TEXT BOOKS

1. Rajeev Roy(2011) *Entrepreneurship* (2th Ed)*O*xford University Press
2. John Mullins (2013)*The New Business Road Test* (4th Ed) Financial Time series

BBT 13L01 **BIOCHEMISTRY LAB** **0 0 3 1**

OBJECTIVES:

- General biochemical reactions for the identification of biomolecules.
- To quantitatively estimate the primary and secondary metabolites present in plants

1. Laboratory Safety and Hygiene: Standard Operating Procedures, Units and Measurements, basic statistical concepts for biochemical analysis.
2. Use of Instruments, pH and Buffers
3. Qualitative analysis of Carbohydrates
4. Qualitative analysis of Proteins and Amino acids
5. Qualitative analysis of carbohydrates, lipids and steroids
6. Determination of pK and pI value of amino acid
7. Estimation of amino acids by ninhydrin method.
8. Measurement of enzyme activity: alpha-amylase, catalase
9. Biological Preparations: Isolation of caesin, lecithin and starch

TEXT BOOK

1. B.S. Rao and V.Deshpande (2005) *Experimental Biochemistry, A student companion* IK International Pvt. Ltd. (New Delhi)

BBT 13L02 **MICROBIOLOGY LAB** **0 0 3 1**

OBJECTIVES:

- To teach the basic concept involved in the sterilization, isolation and cultivation of microbes.
- To instruct the students about good laboratory practical, this will help them to handle the microorganisms.
- To be familiar with cultural and morphological characteristics of microorganisms grown in pure culture.
- To understand the practical knowledge of various biochemical phenomena by demonstrate the experiment, their applications and interpret the results.

1. Sterilization techniques- Autoclave, Hot air oven, Filter sterilization (lecture/demonstrations).
2. Preparation of culture media (a) broth type of media (b) Agar.
3. Culturing of Microorganisms: Pure culture techniques: Streak plate, pour plate, isolation and preservation of bacterial culture.
4. Differential media and selective media of bacteria.
5. Enumeration of micro-organisms- Serial dilution plating
6. Identification of microorganisms. (a) Staining techniques –Simple staining, Grams staining, Capsule staining, Endospore staining
7. Motility of bacteria by Hanging drop method.
8. Biochemical test -Gram negative –Indole test, Methyl red test, Voges Proskauer test, Cirtate test, Triple sugar iron test
9. Biochemical test -Gram positive – Catalase test, Coagulase test, Starch hydrolysis test.
10. Glucose fermentation test, nritate broth test
11. Exposing the Sabouraud's agar plate in different location -Fungal identification by LPCD mount.
12. Clinical microbiology –Antimicrobial susceptibility test, Minimum inhibitory concentration.

TEXT BOOKS

1. Monica Chessbrough(1999) *Laboratory Manual in Microbiology(Vol I & II)*Cambridge University Press

REFERENCE BOOKS

1. Cappucino (1999) *Microbiology - A laboratory Manual* Benjamin Cummings

BBT 13008 **BIOCHEMISTRY –II** **3 1 0 4**

OBJECTIVES:

- To study the various metabolic reactions undergone by the biomolecules to understand their synthetic and degradative pathways.
- To understand the process of Biological oxidation involved in the energy production by burning the food materials.
- To study the various diseases associated with the errors of metabolism of the biomolecules.

UNIT I: METABOLISM **12 Hrs**

- Basic Concepts and Design. Electron transport chain and oxidative phosphorylation: Structure of mitochondria, the mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization, sequence of electron carriers, sites of ATP production, ATP synthetase. Photosynthesis- Structure of organelles involved in photosynthesis in plants, proton gradients and electron transfer in chloroplasts of plants differences from mitochondria, light receptors**:** chlorophyll, light harvesting complexes,, photosystems I and II, their location, mechanism of quantum capture and energy transfer between photo systems, ferrdoxin, plastocyanin, plastoquinone and carotenoids, the Hill reaction, photophosphorylation, reduction of CO2, light and dark reactions, light activation of enzymes, regulation of photosynthesis.

UNIT II: CARBOHYDRATE METABOLISM **12 Hrs**

Uptake of carbohydrate in animals for catabolism, reactions, energetic and regulation of glycolysis, TCA cycle, its function in energy generation, reactions. Glucogenesis, glycogenolysis, Glyconeogenesis, and physiological significance of pentose phosphate pathway. Diseases associated with Carbohydrate metabolism Diabetes mellitus, Glycohemoglobins, Hypoglycemia, Ketone bodies, Glucose tolerance test.

UNIT III: PROTEIN METABOLISM **12 Hrs**

Degradation of proteins, Oxidative, Non- Oxidative deamination and decarboxylation of amino acids, Urea Cycle and Creatinine formation. Diseases of protein metabolism, inborn errors of amino acid metabolism

UNIT IV: LIPID METABOLISM **12 Hrs**

Uptake of lipids in animals**,** transport and hydrolysis of triglycerides, transport of fatty acids into mitochondria, Fatty acid oxidation**:** β-oxidation of saturated unsaturated fatty acids ,Ketone bodies formation and utilization, biosynthesis of fatty acids**:** saturated and Un saturated fatty acids, biosynthesis and degradation of cholesterol, Lipids, lipoproteins and apolipoproteins-role in diseases.

UNIT V: NUCLEIC ACID METABOLISM **12 Hrs**

Biosynthesis and degradation of purine and pyrimidines nucleotides, uricotelic and urotelic system, inhibitors of nucleotides biosynthesis. Diseases associated with purine and pyrimidine metabolism.

Total no of Hours: 60

TEXT BOOKS

1. Voet & Voet,(1995) *Biochemistry:* (2nd Ed) John Wiley and Sons.

REFERENCE BOOKS

1. Stryer, L (1992) *Biochemistry* (4thEd.) W.H. Freeman & Co, NY.
2. Harpers (2003) *Biochemistry***:** (26th Ed.) Lange

BBT 13009 MICROBIAL BIOTECHNOLOGY 3 0 0 3

OBJECTIVES:

- The objective of this course is to introduce students to the exciting area of biology of microbes.
- To study about the sources, production and industrial application of enzymes.
- To understand the habitual and application of microbes in different products and process

UNIT I: HISTORY AND SCOPE 9 Hrs

History and scope of microbial biotechnology, Microbial biodiversity and its use, basic functions of CBD. Berge's manual of systemic bacteriology. Mass cultivation and preservation of microorganisms. Mycotechnology, Classification in microbial biomass.

UNIT II: MICROBIAL METABOLITES 9 Hrs

Production of microbial enzymes and its applications, microbial production of antibiotics, production of single cell proteins – Commercially available forms of single cell protein for food and feed. Strain improvement. Marine microbial metabolites and biopolymer.

UNIT III: ROLE OF MICROBES 9 Hrs

Role of microorganisms for industrial, agricultural and environmental use. Beer and wine defects in industries. Bio fertilizers and Biopesticides, Large-scale production of microbial inoculants for agriculture - microbial fertilizers, microbial pesticides and mycorrhiza. Strain improvement, maintenance and preservation of industrial microbes.

UNIT IV: MICROBES IN BIOREMEDIATION AND IN GENERATION OF ENERGY 9 Hrs

Bioremediation of Xenobiotic and natural compounds - microbes in mining, ore leaching, MEOR, waste - water treatment, biodegradation of non cellulose and cellulosic wastes for environmental conservation. Lignocellulosic waste degradation. Microbes as alternative energy sources by microbial fuel cells and biofuels. Treatment of urban (sewage) and industrial effluents. Biomass from carbohydrates.

UNIT V: CASE STUDIES AND CURRENT ISSUES 9 Hrs

Production of primary metabolites, organic acids (citric acid, itaconic acid, acetic acid, gluconic acid), Amino acids (glutamic acid, lysine, aspartic acid, phenylalanine), alcohols (Ethanol, 2,3-butanediol). Case studies on Industrial contamination (Only for discussion)

Total no of Hours: 45

TEXT BOOKS

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg(2005), "*Microbiology* (5th Ed).TATA McGraw Hill.

REFERENCE BOOKS

1. Anantha Narayan, C.K. Jayaram Paniker,(2009). *Text Book of Microbiology*" (7th Ed).Orient Blackswan,
2. Presscott and Dunn,(2006) *Industrial Microbiology*" CBS Publishers

BCT 13032 **PRINCIPLES OF CHEMICAL ENGINEERING** **3 1 0 4**
(WORKING PRINCIPLES ONLY TO BE STRESSED)

OBJECTIVES:

- To known the fundamentals of engineering calculations such as units and dimensions.
- To understand the behavior of fluids, mass balances, processes and process variables.
- To understand the principle of mass transfer and their application to separation and purification

UNIT I: BASIC CONCEPTS OF FLUID MECHANICS **12 Hrs**

Classification of fluids, Newtonian & non-Newtonian fluids, basic equation of fluid flow, Continuity equation, Momentum balance equation, Bernoulli equation, Incompressible laminar flow in pipes, Hagen-Poiseuille equation, Friction factor, Flow through packed-bed, Fundamentals of fluidization.

UNIT II: FLOW MEASUREMENTS AND MACHINERIES **12 Hrs**

Orifice and Venturi meters, Pitot Tube, Weirs, Roto meters and other types of meters, Transportation of fluids, Pipe Fittings and valves, Pumps – classification, centrifugal and positive displacement type - peristaltic. Blowers and Compressors (oil-free).

UNIT III: MECHANICAL OPERATIONS **12 Hrs**

Particulate solid**:** particle size shape, mixed particle size and size analysis. Screen analysis: Types of screens, ideal screen and real screen, differential and cumulative analysis, screen capacity, industrial screen. **Handling of solids:** Conveyors and storage of solids. Energy and power requirement, Crushers, Grinders, Mixing and Agitations, Power consumption in mixing, Mechanical separation, Screening, Types of screen, Filtration, Principle, Constant pressure and constant rate filtration, Settling classifiers, Floatation, Centrifugal Separations.

UNIT IV: HEAT TRANSFER **12 Hrs**

Classification of heat flow processes, basic law of conduction. One dimensional steady state heat conduction through plan wall-composite wall-radial systems. Concepts of convection. Heat flow in fluids by conduction and convection. Counter current and parallel flow. Heating and cooling of fluids, Heat transfer equipment. Evaporation and multistage evaporation, feeding methods.

UNIT V: MASS TRANSFER **12 Hrs**

Introduction to Mass Transfer: Molecular diffusion in fluids. Diffusivity, Mass Transfer Coefficients, Inter phase Mass Transfer, Gas Absorption, Packed Tower**. Distillation:** Flash and Differential distillation, continuous rectification **.Extraction, Drying and Crystallization**: Liquid–liquid equilibrium. Liquid extraction, Stage wise contact; Liquid-solid equilibria**,** Leaching; Batch drying and mechanism of batch drying, Principle and operation of a spray drier, Preliminary idea of Crystallization, **Advanced Separation Processes:** Dialysis, ultra filtration, reverse osmosis, electro dialysis and membrane separation.

Total no of Hours: 60

TEXT BOOK

1. McCabe, Smith & Harriot, TMH (1993),*Unit Operations of Chemical Engineering*:(5th Ed) Elsevier India

REFERENCE BOOK

1. Geankopolis (1993),*Transport Processes & Unit operations*: (3rd Ed) PHI.
2. Coulson & Richardson(1996), *Chemical Engineering, Vol-I & II*:, Butterworth Heinemann
3. Treybal, R.E.,(1988), *Mass-Transfer Operations*,(4th Ed) MGH
4. Perry, Chilton & Green, (1973)*Chemical Engineers' Handbook*, MGH

BBT 13010 INSTRUMENTATION AND ANALYSIS 3 0 0 3

OBJECTIVES:

- To impart adequate knowledge of scientific understanding of the basic concepts in instrumentation used in Biotechnology.
- To provide an understanding and skills in advanced methods of separation and analysis.
- To provide practical experience in selected instrumental methods of analysis.
- To develop skills of students in instrumentation and biological techniques

UNIT I: SPECTROSCOPY - I & THERMAL METHODS 9 Hrs

Introduction to principles and applications of spectroscopic methods - UV-Vis, IR, Fluorescence & Phosphorescence ORD, CD, DSC

UNIT II: SPECTROSCOPY - II & DIFFRACTION 9 Hrs

ESR, AAS, AFS, AES, Mass spectrometry, NMR, XRD

UNIT III: MICROSCOPY – TECHNIQUES 9Hrs

Polarized light microscopy, phase constrast microscopy, interference microscopy, Fluorescence microscopy, confocal microscopy, electron microscopy - TEM, SEM

UNIT IV: CHROMATOGRAPHY & CENTRIFUGATION - TECHNIQUES 9 Hrs

Chromatography - adsorption, affinity, partition - GLC, GC, HPLC, TLC, HPTLC, RPC.

UNIT V: ELECTROPHORETIC – TECHNIQUES 9 Hrs

Electrophoresis of proteins and nucleic acids - 1D & 2D gels, SDS-PAGE, Agarose gel electrophoresis, Western Blotting, Gel documentation

Total no of Hours : 45

TEXT **BOOKS**

1. Skoog DA, Thomspon Brooks and Cole(1998), *Principles of Instrumental Analysis*, (5th Ed) Harcourt Brace College Publisher

REFERENCE BOOKS

1. Chatwal GR (1998),*Instrumental Methods of Chemical Analysis*,(5th Ed) Himalaya Publishing House
2. Sharma BK (1994) *Instrumental Methods of Chemical Analysis*, (5th Ed)Krishna Prakashan Media Pvt Ltd
3. Willard, Merit Dean & Settle, (1986),*Instrumental methods of analysis* (6th Ed) CBS Publishers and Distributers,

BMA 13014 **ADVANCED MATHEMATICS FOR BIOTECHNOLOGY** **3 1 0 4**

OBJECTIVES:

- The explosion of data-rich information sets, due to the genomics revolution, which are difficult to understand without the use of analytical tools,
- To understand the recent development of mathematical tools such as chaos theory to help understand complex, non-linear mechanisms in biology,an increase in computing power which enables calculations and simulations to be performed that were not previously possible

UNIT I: ALGEBRA **12 Hrs**

Partial fraction-Binomial, Exponential and Logarithmic Series (without proof of theorems)-problems on Summation and Approximation (simple problems).

UNIT II: MATRICES II **12 Hrs**

Determinant-Symmetric & Skew symmetric matrices-Unitary matrix-Characteristic equation-Eigen values and Eigen vectors of a real matrix- Cayley-Hamilton theorem (without proof).

UNIT III: SEQUENCE AND SERIES **12 Hrs**

Basic definitions of Sequence and Series-Convergence & Divergence-Ratio test-Comparison test-Cauchy's root test -Raabe's test (simple problems).

UNIT IV: ORDINARY DIFFERENTIAL EQUATIONS **12 Hrs**

First order differential equations-Second and higher order linear differential equations with constant coefficients and with RHS of the form: e^{ax}, x^n, Sin ax, cos ax, e^{ax} f(x), xf(x) where f(x) is Sin bx or Cos bx-Differential equations with variable coefficients (Euler's form) (simple problems).

UNIT V: FUNCTIONS OF SEVERAL VARIABLES 12 **Hrs**

Partial derivatives- Total differential- Differentiation of implicit functions-Taylor's expansion –Maxima and Minima by Lagrange's Method of undetermined multipliers-Jacobians.

Total no of Hours: 60

Text Book :

1. Veerarajan T.,(2007)., *Engineering Mathematics (for first year*), Tata McGraw Hill Publishing Co

REFERENCE BOOKS

1. Kreyszig E., (2011). *Advanced Engineering mathematics* (9th Ed.), John Wiley & Sons,
2. Grewal B.S. (2012)., *Higher Engineering Mathematics*, Khanna Publishers,
3. John Bird, ,(2010). *Basic Engineering Mathematics* (5th Ed.), Elsevier Ltd
4. Vittal P.R., (2010).*Vector analysis, Analytical solid geometry, sequences and series* (3rd Ed.), Margham publications,
5. Arumugam et.al., Engineering Mathematics vol.1(VTU),Scitech Publications.
6. P.Kandasamy, K. Thilagavathy and K. Gunavathy (2000).*Engineering Mathematics* Vol. I (4th Revised Ed.), S. Chand & Co., Publishers, New Delhi
7. John Bird (2006)., *Higher Engineering Mathematics* (5th Ed.), Elsevier Ltd,

BBT 13011 **MOLECULAR BIOLOGY** **3 1 0 4**

OBJECTIVES:

- Understand the mechanism of replication, transcription and translation.
- To deeply learn the molecules involved in synthesis of DNA, RNA and proteins.

UNIT I: INTRODUCTION **12 Hrs**

DNAStructure, RNAstructure, organization of the bacterial chromosome, organization of eukaryotic chromosome, chromosome duplication and segregation, Mechanisms of DNApolymerase, types of DNApolymerases, replicon model, eukaryotic replication, role of telomerase.

UNIT II: MUTATION, REPAIR AND RECOMBINATION **12 Hrs**

replication errors and their repair, proofreading, mismatch repair, Mutagens, repair of DNA damage – photo reactivation, base excision repair, homologous recombination, hollidy model, recBCD pathway, role of rec A, homologous recombination in eukaryotes, site specific recombination, transposition- transposase – replicative transposition, non-replicative transposition.

UNIT III: TRANSCRIPTION AND SPLICING **12 Hrs**

Types of RNApolymerases, Bacterial promoters, sigma factor, transcription mechanism, rho dependent and independent termination , eukaryotic transcription, TATAelement, TBP, RNA processing, RNA polymerase I and III promoter, mechanism of splicing, spliceosome, self-splicing, alternative splicing, exon shuffling, RNAediting, mRNAtransport, inhibitors of transcription.

UNIT IV: TRANSLATION AND GENETIC CODE **12 Hrs**

mRNA, Open reading frame, Shine-Dalgarno sequence, 5', 3' modifications of eukaryotic mRNAs, role of tRNAs, tRNAcharging, tRNAsynthetases, structure of ribosome, mechanismof translation, eukaryotic translation factors, peptide bond formation, Degeneracy of the Genetic Code,Wobble, implication of mutations, suppressor mutations, Deviations from the universal genetic code.

UNIT V: GENE REGULATION **12 Hrs**

Prokaryotes – activators and repressors, DNAlooping, cooperative binding, antiterminations, eg. Lac operon, trp, phage lambda regulation of lytic andlysogenic lifecycle; Eukaryotes – Homeodomain proteins, Zn containing DNA-binding domains, leucind zipper motifs, helix – loop helix proteins, nuceosome modifiers, eg. Human interferon gene,gene silencing, histone modifications, DNAmethylation, RNAi, siRNA, microRNAs.

Total no of Hours : 60

TEXT BOOK

1. Watson et al (2004)*Molecular Biology of the Gene*, (5th Ed).,Pearson Education.
2. David freifelder (1987) *Molecular biology* Jones & Bartlett Publishers,

REFERENCE BOOKS

1. Baltimore (2000) *Molecular biology* (4th Ed): W. H. Freeman New York
2. Lodish (2000) *Molecular cell biology* (4th Ed): W. H. Freeman New York

BEN13L01 CAREER AND CONFIDENCE BUILDING (SOFT SKILLS -I) 1 0 3 2

OBJECTIVES

To Improve:

1. Behavioural Patterns and Basic Etiquette
2. Value System
3. Inter Personal Skills
4. Behaving in Corporate Culture
5. Self Awareness / Confidence
6. Managing Self and Personality Styles including Body Language
7. International Culture / Cross Cultural Etiquette

UNIT I **6 Hrs**

Creation of awareness of the top companies / different verticals / courses for improving skill set matrix, Industry expectations to enable them to prepare for their career - Development of positive frame of mind - Avoiding inhibitions - Creation of self awareness - Overcoming of inferiority/ superiority complex.

UNIT II **6 Hrs**

Selection of appropriate field vis-a-vis personality / interest to create awareness of existing industries, Preparation of Curriculum Vitae - Objectives, profiles vis-a-vis companies.

UNIT III **6 Hrs**

Group discussions: Do's and Don'ts - handling of Group discussions – What evaluators look for! Interpersonal relationships - with colleagues - clients - understanding one's own behaviour - perception by others, How to work with persons whose background, culture, language / work style different from one's, behaviour pattern in multi-national offices.

UNIT IV **6 Hrs**

Interview - awareness of facing questions - Do's and Don'ts of personal interview / group interview, Enabling students prepare for different procedures / levels to enter into any company - books / websites to help for further preparation, Technical interview - how to prepare to face it, Undergoing employability skills test.

UNIT V **6 Hrs**

Entrepreneurship development - preparation for tests prior to the interview - Qualities and pre-requisites for launching a firm.

Total No. of Hrs: 30Hrs

BBT 13L03 MICROBIAL BIOTECHNOLOGY LAB 0 0 3 1

OBJECTIVES:

- To understand the basic microbial systems and to know how does it help in the biodegradation and biotransformation process.

1. Pure culture techniques
   a. Selective screening mediums for industrially important microbes
2. Isolation of fungi from soil sample and identification through slide culture technique.
3. Determination of growth curve of the given organism
4. Screening of amylase producing microorganism
5. Screening of protease producing microorganism
6. Lyophilization of given industrially important microorganism
7. Determination of antibiotic producing microorganism from soil sample
8. Production single cell protein (Spirulina)
9. Determination of TDP (Thermal death point) and TDT (Thermal death time)
10. Production of ethanol using batch fermentation

REFERENCE BOOKS

1. Cappucino (1999) *Microbiology - A laboratory Manual* Benjamin Cummings
2. T.Sundarrajan(2005) *Microbiology laboratory Manual* (4th Ed) A. Sundarraj Perungudi.

BBT 13L04 INSTRUMENTATION AND ANALYSIS LAB 0 0 3 1

OBJECTIVES:

- To understand the standard operating procedures of various instruments. To analyze the different biomolecules present in the biological system using the analytical techniques.

1. Qualitative analysis: `
   Normal & Abnormal urine

2. Titrimetric analysis:
   Estimation of vitamin C in fruit juices
   Estimation of titrable acidity and ammonia content of urine.

3. Colorimetric analysis:
   Estimation of blood glucose by ortho toluedine method.
   Estimation of blood urea by dam method.

4 .Spectrophometric analysis:
   Estimation of protein by Biuret method.

5. Electrophoretic analysis:
   Separation of serum proteins by electrophoresis.

6. Centrifugation technique:
   Size determination of yeast cell by centrifugal method.

7. Chromatographic technique
   Separation of amino acids by paper chromatography
   Separation of lipids by TLC.

REFERENCE BOOK:

1. Harold Varley (1967) *Practical biochemistry* (4th Ed) Heinemann Medical,

BBT 13012 RECOMBINANT DNA TECHNOLOGY 3 0 0 3

OBJECTIVES:

- To gain knowledge on gene manipulation using genetic engineering methods and its importance in plant, animal and environmental biotechnology.
- To understand the principle behind of different enzymes and vectors used in recombinant DNA technology.

UNIT I: ENZYMES IN RECOMBINANT DNA TECHNOLOGY **9 Hrs**

Restriction Endonucleases, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Cohesive and blunt end ligation, linkers and adaptors, homopolymer tailing, alkaline phosphatase, double digestion, TA cloning. Hybridization techniques: Southern, Northern and colony hybridization, labeling of DNA probes: Nick translation, Random priming, Radioactive and non-radioactive probes.

UNIT II: PROPERTIES OF CLONING VECTORS **9 Hrs**

Plasmid Vectors : PBR 322, PUC19 vectors, Bacteriophage vectors : Insertion and replacement vectors, Cosmids, M13 Vectors, Methods for introducing DNA into cells, Transformation, Selection of recombinants, alpha complementation, replica plating. Expression vectors, Constitutive and Inducible Promoters, pMAL, GST, pET based vectors shuttle vectors, yeast vectors, artificial chromosome vectors: YAC and BAC.

UNIT III: CONSTRUCTION OF GENOMIC AND CDNA LIBRARIES **9 Hrs**

Construction of Genomic and cDNA Libraries, partial digests, preparation of mRNA, cDNA, Choice of vectors, Screening of libraries - gene probes, with antibodies, characterization of plasmid clones.

UNIT IV: PRINCIPLES OF DNA SEQUENCING **9 Hrs**

Principles of DNA Sequencing: Sanger's method, Maxam and Gilbert method. Automated DNA sequencing, shotgun sequencing, pyro sequencing, whole genome sequencing, PCR, Types of PCR: multiplex, RT-PCR, nested, touch-down, RACE. Applications of PCR, Gene silencing techniques: Introduction to SiRNA, SiRNA technology.

UNIT V: RECOMBINANT PROTEIN EXPRESSION **9 Hrs**

Recombinant Protein Expression, Insulin, Human Growth Hormone, Hepaptitis B viral vaccine, Use of Fusion Proteins to aid in Recombinant Protein Purification, Site specific Mutagenesis Methods.

Total no of Hours : 45

TEXT BOOK:

1. Jeremy W. Dale, Malcolm von Schantz, Nick Plant (2011) *From Genes to Genomes- Concepts and Applications of DNA Technology* (Illustrated) John Wiley & Sons

REFERENCE BOOK

1. J.D. Watson, A.A. Caudy, R.M. Myers and J.A. Witkowski(2007), *Recombinant DNA,* (3rd Edition),W.H. Freeman and Company

BBT 13013 **PROTEIN SCIENCE** **3 1 0 4**

OBJECTIVES:

- To recapitulate the knowledge on protein structure and its properties.
- To learn different methods in characterizing proteins and protein structure determination.
- To learn protein structure prediction and modeling and mechanism of protein folding and misfolding

UNIT I: PROTEIN STRUCTURE AND CLASSIFICATION **12 Hrs**

Protein Structure and Classification: Amino acids classification, primary, secondary, tertiary and quaternary structure of proteins, protein stability and denaturation. General classes of protein structures and function. Protein folding patterns. Protein databases, Molecular Viewers to display protein structures.

UNIT II: METHODS OF CHARACTERIZING PROTEINS IN SOLUTION **12 Hrs**

Methods of Characterizing Proteins in solution, Absorbance and fluorescence of proteins, Fluoresence resonance energy transfer, circular dichroism, Protein structure determination – X-ray crystallogaphy, Nuclear magnetic resonance spectroscopy, Low temperature electron microscopy, Mass spectrometry, Protein Sequencing, Catalysis by enzymes- serine proteases; protein conformational changes, control of protein activity.

UNIT III: MOTIFS **12 Hrs**

MOTIFS, helix turn helix motifs, BETA structures, folding and flexibility , signal transduction, Membrane proteins fibrous proteins.

UNIT IV: PROTEIN ENGINEERING **12 Hrs**

Protein Engineering, folding, prediction and design-Protein folding, effect of denaturants on rate of folding and unfolding, chaperones, folding funnels, protein misfolding and GroEL – GroES chaperone protein. Protein structure prediction and modelling – CASP, homology modeling, threading, prediction of novel folds, prediction of protein function. evolution of NAD-binding domain of dehydrogenases; mechanisms of protein evolution – divergence, recruitment and mixing and matching of domains.

UNITV:PROTEIN INTERACTIONS AND PROTEINS IN DISEASE **12 Hrs**

Protein Interactions and Proteins in disease – General properties of protein-protein interfaces, protein-DNA interaction& transcription factors eg. – Lambda cro, leucine zippers, zinc fingers, membrane proteins. Diseases due to Absent or dysfunctional proteins and protein aggregation.

Total no of Hours : 60

TEXT BOOK:

1. Arthur M. Lesk, (2004) *Introduction to Protein Science: Architecture, Function and Genomics*. Oxford University Press

REFERENCE BOOK

1. Carl Barnden and Tooze, (1999) *Introduction to Protein Structure* , (2nd Ed) Garland publishing Inc.

BBT 13014 **PLANT BIOTECHNOLOGY** **3 0 0 3**

OBJECTIVES:

- To gain knowledge on organelle DNA in plants and its importance.
- To understand the principle of nitrogen fixation in plants and genes involved.
- To understand the role of Agrobacterium and its pathogenesis in crown gall formation.To enlighten the knowledge about Ti plasmid and gene transfer mechanisms; different types of plant viral vectors used in genetic engineering

UNIT I: PLANT GENOME **9 Hrs**

Plant Genome : Gene structure, expression, and regulation in plants - an overview of nuclear and organelle gene structure, function, and expression, with emphasis on aspects that are unique to plant genes. Development of *Arabidopsis* as a model for molecular genetic studies in plant biology, an introduction to systems approaches.

UNIT II: GENETIC TRANSFORMATION **9 Hrs**

Genetic Transformation : Direct gene Transfer Techniques, Agrobacterium mediated gene transfer- Biology and molecular basis of Agrobacterium mediated plant transformation and its application, Plant vectors, Ri and Ti Plasmids, Opines and their significance. Viral vectors : Gemini virus, cauliflower mosaic virus and their uses. Reverse Genetics.

UNIT III: PLANT DISEASE RESISTANCE **9 Hrs**

Plant Disease Resistance : Types of pathogen and their mode of action, Plant defence system, Constitutive and inducible defence, Genetic basis of plant pathogen interaction, R genes and R gene mediated resistance, Biochemistry and Molecular biology of defence reactions, Systemic acquired resistance, Role of Salicylic, Jasmonic acid and ethylene in plant defence. Plant Stress Response : Abiotic and biotic stress, Pathogen stress, Osmotic adjustment and its role in drought and salinity tolerance, ABA in stress tolerance, Strategies for genetic engineering of stress tolerance

UNIT IV: USE OF KNOCKOUT MUTANT PLANTS **9 Hrs**

Use of knockout mutant plants in understanding the significance of plant hormones, genetically modified plants - Golden rice, vitamin E enhancement, Bt. Cotton, pesticide resistance, cytoplasmic male sterility.Plant genetic resources, Crop gene bank, Plant breeders right and farmers right, patenting of biological materials.

UNIT V: PLANT TISSUE CULTURE **9 Hrs**

Plant tissue culture : Plasticity and Totipotency, The culture environment, Plant Cell culture media, Plant growth regulators and function, Culture types- Callus, Cell-suspension culture, Protoplast culture, Root culture, Shoot tip and Meristem culture, Embryo culture, Microspore culture, Somaclonal variation, Somatic Embryogenesis, Polyploidy, Androgenesis, Artificial Seed, Germplasm Conservation and Cryopreservation.

Total no of Hours : 45

TEXT BOOKS

1. Westhoff et al.(1998). *Molecular Plant Development: From gene to plant.* Oxford University Press, Oxford. Selected parts available for purchase at the UBC Bookstore.

REFERENCE BOOK

1. Buchanan et al.(2000). *Biochemistry & Molecular Biology of Plants.* American Society of Plant Physiologists, Rockville MD
2. Heldt HW. (1997) *Plant Biochemisty and Molecular Biology*. Oxford University Press.

BCT 13033 CHEMICAL REACTION ENGINEERING 3 1 0 4

OBJECTIVES:

- To learn about the basic concept of reaction kinetics and reactor types.
- To known various aspects of design for single, multiple reactions and Effects of temperature and pressure on conversion.
- To understand the Kinetics of Biochemical reaction systems.

UNIT I: BASIC KINETICS 12 Hrs

Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrhenius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method, Fractional order reactions

UNIT II: APPLICATIONS OF KINETICS 12 Hrs

Applications of Kinetics: Interpretation of batch reactor data for simple and complex reactions. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes.– derivation of Michaelis-Menten equation, Briggs-Haldane relationship, the determination and significance of kinetic constants, Lineweaver-burk and Eadie-Hofstee plot, principles of enzyme inhibition – Competitive, non-competitive and uncompetitive.

UNIT III: IDEAL REACTORS 12 Hrs

Design for homogeneous systems, batch, stirred tank and tubular flow reactor, design of reactors for multiple reactions, combination reactor system, and size comparison of reactors.

UNIT IV: DESIGN OF MULTIPLE REACTORS 12 Hrs

Kinetics of series and parallel reaction, yield and selectivity of multiple reactions, Contacting patterns for series and parallel reactions, quantitative treatment of product distribution and reactor size, best operating conditions for parallel and series reactions. Series-parallel reactions. Numerical problems.

UNIT V: NON-IDEAL REACTORS 12 Hrs

Analysis of non- ideal behaviour in bioreactors- reasons for non ideality-importance of RTD studies- stimulus-response experiment-circulation time distribution, exit age distribution, F-curve and C-curve- mean and variance of residence time-diagnosis of ills of flow reactors- models for non-ideal reactors- zero, one and two parameter models (with emphasis on the tanks in series model and dispersion model) - estimation of conversion using these models.

Total no of Hours: 60

TEXT BOOKS

1. Levenspiel O.(1999) *Chemical Reaction Engineering*,(3rd Ed) John Wiley.
2. Fogler H.S. (1999) *Elements Of Chemical Reaction Engineering*,(3rd Ed) Prentice Hall India**.**

REFERENCE BOOKS

1. Missen R.W, Mims C.A and Saville B.A, (1999)*Introduction to Chemical Reaction Engineering and Kinetics*,(3rd Ed) John Wiley.
2. D.G.Rao,(2009) *Introduction to Biochemical Engineering*, Tata McGraw Hill.
3. Syed Tanveer Ahmed Inamdar, (2012) *Biochemical Engineering*, (3rd Ed) Prentice Hall of India

BBT 13015 **IMMUNOLOGY** **3 0 0 3**

OBJECTIVES:

- To understand the role of immune system, to gain knowledge on different lymphoid organs and types of immunity and immune responses produced.
- To acquire knowledge on development, maturation, activation and differentiation of T-cells and B-cells

UNIT I: INTRODUCTION **9 Hrs**

Components of innate and acquired immunity; Organs and cells of the immune system - primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; theory of clonal selection.

UNIT II: CELLULAR RESPONSES **9 Hrs**

Development, maturation, activation and differentiation of T-cells and B-cells; T-Cell receptors; Functional T-cell subsets; Immunoglobulins: basic structure, classes, subclasses and functions; Generation of antibody diversity; antigen-antibody reactions; antigen presenting cells : Major Histocompatibility Complex; Antigen processing and presentation: regulation of T-cell and B-cell responses; Monoclonal antibodies: Principle and Applications.

UNIT III: INFECTION AND IMMUNITY **9 Hrs**

Injury and inflammation; Immune responses to infections: Immune response to infectious agents: Viruses, bacteria, fungi and parasites; Cytokines secreted by Th1 and Th2 subsets; Complement; Immunosuppression, tolerance; Immune dysfunction and its consequence: Allergy and Asthma; Hypersensitivity (Type I to IV); AIDS and Immunodeficiencies; Immunisation; Vaccines and types: Common vaccines for humans.

UNIT IV: TRANSPLANTATION AND TUMOR IMMUNOLOGY **9 Hrs**

Transplantation: Different types of transplants; Mechanism of graft rejection;Tumor immunology : Tumor antigens, Immune response to tumors and tumor evasion; Autoimmunity, Autoimmune disorders and diagnosis.

UNIT V: IMMUNOLOGICAL TECHNIQUES **9 Hrs**

Antigen-antibody interactions : Precipitation, agglutination and complement mediated immune reactions; Blood grouping; Advanced immunological techniques - RIA, ELISA, ELISPOT assay, Western blotting, Immunohistochemistry, Immunofluorescence, Flow cytometry and Immunoelectron microscopy; Cell Cytotoxicity assays.

Total no of Hours : 45

REFERENCE BOOKS

1. Roitt's (2011) *Essential of Immunology*,(12th Ed),Wiley-Blackwell.,.

TEXT BOOKS

1. Kuby J, (2003). *Immunology*, (5th Ed), WH Freeman & Co., New York.,
2. Janeway CA, Travers P, Walport M, and Shlomchik M. (2001) *Immunobiology*, (6th Ed), Garland Science.,
3. Animated pictures & Videos : www.roitt.com

BEN13L02 QUALITATIVE AND QUANTITATIVE SKILLS (SOFTSKILLS-II) 1 0 3 2

PURPOSE

The purpose of this course is to build confidence and inculcate various Soft skills and to help Students to identify and achieve their personal potential at the end of this training program the participant will be able to, explain the concept of problem solving

- Outline the basic steps in problem solving
- List out the key elements
- Explain the use of tools and techniques in problem solving
- Discuss the personality types and problem solving techniques.
- By adapting different thinking styles in group and lean environment.
- Recognizing and removing barriers to thinking in challenging situations.
- Make better decision through critical thinking and creative problem solving.

METHODOLOGY

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities
2. Collaborative learning
3. Interactive sessions
4. Ensure Participation
5. Empirical Learning

UNIT – I

Self Introduction- Narration – Current News Update – Numbers – Height & Distance – Square & Cube Roots.

UNIT – II

Current Tech Update – Verbal Aptitude Test 1 – GD – 1 Odd man out series – Permutation & Combination – Problems on ages.

UNIT – III

GD –II – Resume Writing – Mock Interview I / reading comprehension

UNIT – IV

Mock Interview II / reading comprehension – Mock Interview III / reading comprehension – GD – III – Ratio & Proportion – Clocks – H.C.F. &L.C.M

UNIT – V

GD – IV – Verbal Aptitude Test II – Review – Partnership – Puzzles – Test

Total No of Hrs: 30

REFERENCES:

1. Pushplata and Sanjay Kumar (2007) *Communicate or Collapse: A Handbook of Effective Public Speaking, Group Discussions and Interviews*, Prentice – Hall, Delhi
2. Thorpe, Edgar (2003) *Course in Mental Ability and Quantitative Aptitude*, TMHl,
3. Thorpe, Edgar (2003) *Test of Reasoning* , Tata McGraw-Hill
4. Prasad, H.M (2001) *How to prepare for Group Discussion and Interview*, TMH
5. *Career Press Editors. 101 Great Resumes* (2003) Jaico Publishing House
6. Agarwal, R. S.(2004) *A Modern Approach to Verbal and Non- Verbal Reasoning*, S. Chand & Co.
7. Mishra Sunita and Muralikrishna (2004) *Communication Skills for Engineers*,(1st ed.), Pearson

BBT 13L05 RECOMBINANT DNA TECHNOLOGY LAB 0 0 3 1

OBJECTIVES:

- To apply the knowledge gained in Recombinant DNA technology and Molecular biology subjects regarding DNA, RNA and gene manipulation.

1. Isolation of Plasmid DNA
2. Competent Cell preparation and transformation
3. Quantitation of DNA by agarose gel electrophoresis and spectroscopy
4. Isolation of Plant cell and / or genomic DNA
5. Restriction Enzyme Digestion
6. Principles of Colony hycridization
7. PCR
8. Principles of RNA isolation and northern hybridization

REFERENCE BOOKS:

1. Sambrook, Frisch and Maniatis, Vol I, II and III (1989) *Molecular Cloning* (2nd Ed) Cold Spring Harbor Laboratory,

BBT 13L06 **IMMUNOLOGY LAB** **0 0 3 1**

OBJECTIVES:

- To learn the structure and functions of antibodies and mechanism of antibody diversity

1. Identification of cells in a blood smear
2. Identification of blood group
3. Immuno diffusion SRID
4. Immunoelectrophoresis Serum, CIE
5. Testing for typhoid antigens by Widal test
6. Enzyme Linked ImmunoSorbent Assay (ELISA)
7. Isolation of monocytes from blood

VI SEMESTER

BBT 13016 BIOINFORMATICS 3 0 0 3

OBJECTIVES:

- To learn nucleotide, protein and genome databases and know about the file formats .
- To understand pairwise and multiple sequence alignment and the principle.
- To gain knowledge on approaches for gene prediction methods in prokaryotes and eukaryotes

UNIT I: BIOLOGICAL DATABASES AND DATA RETRIEVAL 9 Hrs

Nucleotide databases (Genbank, EMBL, DDBJ), Sequence submission Methods and tools (Sequin, Sakura, Bankit), Sequence retrieval systems (Entrez & SRS), Sequence File Formats and Conversion tools, Protein (Swiss-Prot, Tr-EMBL, PIR_PSD, Expasy), Genome (NCBI, EBI, TIGR, SANGER), Derived Databases (Prosite, PRODOM, Pfam, PRINTS), Metabolic Pathway DB (KEGG, EMP, EcoCyc, BioCyc and MetaCyc), Specialized DB (IMGT, Rebase, COG, LIGAND, BRENDA)

UNIT II: PAIRWISE SEQUENCE ALIGNMENT 9 Hrs

Similarity, Identity and Homology, Global Alignment, Local Alignment, Visual Alignment, Dynamic Programming, Heuristic approach, Database Search methods & tools, Scoring Matrices and Affine Gap costs, Detailed method of derivation of the PAM & BLOSUM Matrices, Differences between Distance & Similarity Matrix, Assessing the Significance of Sequence Alignments

UNIT III: MULTIPLE SEQUENCE ALIGNMENT 9 Hrs

Significance of MSA, Various approaches for MSA (Progressive & Iterative), Profile analysis, Block analysis, Pattern searching, Motif analysis. Statistical methods for aiding alignment – Expectation Maximization, MEME, Gibbs Sampling, Markov Chains, Hidden Markov Models, Algorithm of HMM-based approaches, BaliBase-Scoring of MSA, PSI/PHI-BLAST

UNIT IV: GENE PREDICTION 9 Hrs

Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods, Neural Networks, Pattern Discrimination methods, Signal sites Predictions (Promoter, Splice, UTR, CpG-islands), Evaluation of Gene Prediction methods

UNIT V: RNA SECONDARY STRUCTURE PREDICTION 9 Hrs

RNA secondary structure prediction methods and its limitations, mfold method of Zuker, RNAfold program, Tertiary structures of rRNA, Applications of RNA structure modeling Phylogenetic Analysis: Concept of dendrograms, Strings and Evolutionary trees, Ultrametric trees and Ultrametric distances, Additive - Distance trees, Methods of Construction of Phylogenetic trees- Maximum Parsimony Method, Maximum likelihood method and Distance Methods, Reliability of trees

Total no of Hours : 45

TEXT BOOKS

1. A. Lesk (2002) *Introduction to Bioinformatics* (3rd Ed), Oxford University Press

REFERENCE BOOKS

1. D.E. Krane and M.L Raymer (2003)*Fundamental concepts of Bioinformatics* Pearson Education ISBN 81-297-0044-1
2. A.D. Baxevanis et. al., (2005) *Current Protocols in Bioinformatics* Wiley Publishers
3. Carlos Setubal, Joao Meidanis ,(1997) *Introduction to Computational Molecular Biology* PWS Pub.

BCS 13036 COMPUTING FOR BIOTECHNOLOGISTS 3 0 0 3

OBJECTIVES:

- Primary objective of this course is to prepare students on how to use C and Unix to manage development projects.
- To understand the usage of PERL in biological databases.

UNIT I: UNIX **9 Hrs**

Fundamentals of Unix- Architecture-Features-Basic Commands-Utilities-V1 Editor.

UNIT II: UNIX **9 Hrs**

The shell-Unix File System-Directories-Ownership and Permissions-Changing File Permissions-File Handling.

UNIT III: DBMS **9 Hrs**

Introduction to DBMS-Purpose of DBMS-Applications-Advantages and disadvantages of DBMS-Database Languages-DDL,DML- Relational algebra-Structural Query Language(SQL).

UNIT IV: C **9 Hrs**

Control Structure-String Handling-Arrays Structure and Union-File Handling.

UNIT V: PERL **9 Hrs**

Fundamentals of scripting with Perl-Scalars-Arrays, Variable interpolation, Operators (Mathematics, Condition & Logic)-File IP/output, Printing, Loops (if-then-else, for, while), list operation- Functions/subroutines, hash arrays and regular expressions.

Total no of Hours : 45

TEXT BOOKS

1. M.J. Bach, (2007) "*The Design of Unix Os*"(1st Ed), Prentice Hall
2. Abraham Siberschatz, Henry F.Korth, S.Sudharshan (1997) "*Database System Concepts*",(4th Ed), Tata McGraw-Hill.

REFERENCE BOOKS

1. Dennis, M. Ritchie, Brian W. Kernighan (1988) *C Programming Language* (2nd Ed) AT&T Bell Laboratories. Murray Hill.
2. James Lee (2010) *Beginning Perl* (3rd Ed) Apress.

BBT 13017 **ANIMAL BIOTECHNOLOGY** **3 0 0 3**

OBJECTIVES:

- To learn the basic of animal tissue culture and the composition of different types of medium and the role of serum used in cell culture.
- To gain knowledge about different types of cell culture methods and applications of cell culture

UNIT I: ANIMAL CELL CULTURE **9 Hrs**

Introduction to basic tissue culture techniques; role of serum in cell culture, chemically defined media and serum free media; various types of cultures: Primary culture, cell line, suspension cultures, continuous flow cultures, immobilized cultures, Tissue and organ culture. Cryopreservation and thawing of cells, Somatic cell fusion; cell cultures as a source of valuable products.

UNIT II: ASSISTED REPRODUCTIVE TECHNOLOGY (ART) **9 Hrs**

Causes of male and female infertility; hormonal regulation of sexual differentiation; Embryo transfer technology, Techniques used in Assisted Reproductive Technology: ICSI, ZIFT, GIFT; artificial insemination, Steps involved in In-vitro fertilization (IVF) and embryo transfer; embryo sexing and embryo splitting; cryopreservation of embryos, enrichment of x and y bearing sperms from semen samples of animals using flowcytometer; micromanipulation technology and breeding of farm animals.

UNIT III: MICROMANIPULATION TECHNOLOGY **9 Hrs**

Concepts of transgenic animal technology; strategies for the production of transgenic animals using DNA microinjection, Production of transgenic animals using embryonic stem cells, Nuclear transfer, Applications of transgenic livestock, Production of pharmaceutical products and human proteins in transgenic live stock (biopharming), gene pharming.

UNIT IV: DIAGNOSIS OF ANIMAL DISEASES **9 Hrs**

Diagnosis of bacterial and viral diseases in animals using PCR, RFLP, Northern and Southern blotting, Fluorescent In-situ hybridization (FISH); Steps involved in the production of Monoclonal antibodies and their use in immunodiagnostics.

UNIT V: THERAPY FOR ANIMAL DISEASES **9 Hrs**

Recombinant cytokines and their use in the treatment; Types of vaccines : Recombinant subunit vaccines, Peptide vaccines, DNA vaccines and their applications in treatment of animal diseases; Principle and types of gene therapy, Advantages and disadvantages of viral vectors used in gene transfer; Non viral vector systems for gene therapy.

Total no of Hours : 45

TEXT BOOKS

1. Ramadass P. (2008) *Animal Biotechnology. Recent Concepts and Developments*. MJP Publishers.
2. Ranga M.M.(2002) *Animal Biotechnology*. Agrobios India Limited.
3. Sudha Gangal.(2007) *Principle and Practice of Animal Tissue Culture*, Universities Press.
4. Wilson Aruni A and Ramadass P,(2011).*Animal Tissue Culture*, MJP Publishers.

REFERENCE BOOKS

1. Ian Freshney R, (2005) *Culture of Animal Cells: A manual of basic Technique*. WILEY-LISS Publication.

BBT13018 **BIOPROCESS ENGINEERING** **3 1 0 4**

OBJECTIVES:

- To get an overview of industrial fermentation process and process flow sheet.
- To study Media requirement, formulation and optimization for fermentation.
- To learn functions of a fermentor and various types of bioreactors
- .To recap different types of sterilization techniques and studying sterilization kinetics.

UNIT I: OVERVIEW OF BIOPROCESS ENGINEERING **12 Hrs**

Engineering perspective of fermentation processes – role of bioprocess engineers- Kinetics of microbial growth and product formation: Key determinants of cell population kinetics- growth patterns and kinetics in batch cultures- batch growth curve- kinetics of exponential growth- classification of microbial products. Medium optimization techniques **Design Of Novel Bioreactors**- packed bed bioreactors, Bubble-column bioreactors, fluidized bed bioreactors, trickle bed bioreactors, airlift loop bioreactors, photo bioreactors,- Batch, fed-batch and continuous fermentations- ideal reactors for kinetics measurements- Ideal batch reactor, fed-batch reactors Thermal death kinetics of cells and spores: Survival curve- decimal reduction factor.

UNIT II: STERILIZATION KINETICS **12 Hrs**

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilizationequipment - batch and continuous. **Kinetic modelling of cell growth**: Model structure and complexity- different perspectives for kinetic representations using models- prediction of specific growth rate using unstructured un-segregated models-Monod equation- Monod chemostat model- Models with growth inhibitors (substrate inhibition, product inhibition and inhibition by toxic compounds)- logistic equation- growth models for filamentous organisms-structured kinetic models- compartment models

UNIT III: MASS TRANSFER **12 Hrs**

Gas liquid mass transfer- theories of diffusion -volumetric oxygen transfer coefficient correlations – oxygen transfer mechanism- Measurement K_La merits and demerits of each method. **Scale up and scale down of bioprocess systems**: operating boundaries for aerated and agitated fermenters- scale up criteria for microbial cell processes.

UNIT IV: MONITORING AND CONTROL OF BIOPROCESSES **12 Hrs**

Fermentation monitoring: Various physical, chemical and biological parameters measured or controlled in bioreactors-Physical and chemical sensors for fermentation medium and gases- online sensors for cell properties- offline analytical methods- measurement of medium properties and cell population composition- flow cytometry. Analysis by Microfluidics: Basic principles of flow based analytical techniques, flow injection, sequential injection, Bead injection and Sequential injection chromatography-
Measurement analysis: Use of digital computers for data acquisition, interpretation and analysis- software systems data smoothing and interpolation –Fault analysis- state and parameter estimation methods- use of observers or estimators.

UNIT V: APPLICATION OF BIOPROCESS ENGINEERING IN INDUSTRIES **12 Hrs**

Food Industry-(Lactic Acid Production, Citric Acid Production, Hfcs Production,Baker Yeast Production)Chemical & Pharmaceutical Industry(Ethanol,Acetone-Butanol Production, Penicillin Production)Environmental Industry(Biological Waste Water Treatment)- Medical Applications Of Bioprocess Engineering(Tissue Engineering, Gene Theraphy)

Total no of Hours : 60

TEXT BOOKS

1. Michael L. Shuler, Filkert Kargi(2001) *Bioprocess engineering*: *Basic concepts* (2nd Ed) Prentice Hall
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker(1995) ,*Principles of Fermentation Technology*, (2nd Ed) Butterworth-Heinemann .

REFERENCE BOOKS

1. Pauline. M. Doran,(1995) *Bioprocess engineering principles*, Academic press..
2. James. E.Bailey, David.F. Ollis (2002) *Biochemical engineering fundamentals*, (2nd Ed), McGraw Hill ,Prentice Hall of India.
3. Mukesh Doble, Sathyanarayana and Gummadi N (2007), *Biochemical Engineering*, Prentice Hall of India.
4. Mukhopadhyay S.N (2008) *Advanced Process Biotechnology*, (1st Ed) Viva Books.

BBT 13019 PHARMACEUTICAL TECHNOLOGY 3 0 0 3

OBJECTIVES:

- General introduction about the pharmaceutical industries and process of new drug discovery.
- To understand the pharmacokinetic and pharmacodynamic aspects of drugs.
- To acquire basic knowledge about the preparations of various therapeutic agents.
- To study in detail about several biopharmaceuticals.

UNIT I: INTRODUCTION 9 Hrs

Pharmaceutical industry & development of drugs; types of therapeutic agents and their uses; economics and regulatory aspects.

UNIT II: DRUG ACTION, METABOLISM AND PHARMACOKINETICS 9 Hrs

Mechanism of drug action; physico-chemical principles of drug metabolism, radioactivity; pharmacokinetics.

UNIT III: CHEMOTHERAPEUTICS 9 Hrs

Chemotherapy for bacterial, fungal, viral infections, drugs acting on protozoal infection, malarial infection and helminth parasites. Cancer chemotherapy, Drug interactions

UNIT IV: PRINCIPLES OF DRUG MANUFACTURE 9 Hrs

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oral liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; gmp.

UNIT V: BIOPHARMACEUTICALS 9 Hrs

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, hormones and biological.

Total no of Hours : 45

TEXT BOOKS

1. B.Sathoskar (2005) *Pharmacology and pharmacotherapeutics*(19th Ed) popular Prakasam

REFERENCE BOOKS

1. Gareth Thomas (2000). *Medicinal Chemistry. An introduction*.(2nd Ed) John Wiley.
2. Katzung B.G.(1995), *Basic and Clinical Pharmacology*,(6th Ed) Prentice Hall of Intl.

BBT13L07 **BIOINFORMATICS LAB** **0 0 3 1**

OBJECTIVES:

- To demonstrate the protein/DNA sequence search methods and sequence alignment databases.
- To understand and hands-on-training on the genome sequence analysis and annotation.
- To analyze the comparative genomics.
- To use various computational tools for expression analysis to identify open reading frames, mutations, conserved region

Lecture 1: Demonstration of Entrez and SRS
Lecture 2 : Database Searches with BLAST and FASTA
Practical 1: Simple Sequence Formats- Sequin
Practical 2: Protein secondary structure prediction and tour of protein structure database
Practical 3: Pairwise Sequence Alignment
Practical 4**:** Database Searches : BLAST, FASTA
Practical 5: Genome analysis and Annotation
Practical 6: Applications of comparative genomics
Practical 7: computational tools for expression analysis
Practical 8: cluster analysis.

REFERENCE BOOKS

1. Claverie and Notredame, (2003) *Bioinformatics for Dummies*, Wiley Publishing
2. David W. Mount (2004) *Bioinformatics – Sequence and Genome Analysis* (2nd Ed) Cold Spring Harbor Laboratory Press.
3. Andreas E.Baxevanis, B.F.Francis Oullette.(2001) *Bioinformatics - A practical guide to the analysis of genes and proteins* – (2nd Ed), Wiley online library

BBT13L08 BIOPROCESS LABORATORY 0 0 3 1

OBJECTIVES:

- To evaluate the results of hand-on up streaming process experiment.
- To know the selection, preparation and operation of bioreactors.
- To analyze how to interpret the data collected from the bioreactor**.**

1. Thermal death kinetics
2. Batch sterilization design
3. Batch cultivation, estimation of kla – dynamic gassing method, exhaust gas analysis – carbon balancing, gas balancing
4. Residence time distribution
5. SSF
6. Continuous cultivation – x-d diagram, pulse and shift method, evaluation of kinetic parameters, exhaust gas analysis – carbon balancing, gas balancing. Statistical plan in the analysis of data in cell growth
7. Bacterial cell size determination by dye adsorption technique
8. Immobilization technique
9. Amylase production
10. Protease production

11 Bio ethanol productions

REFERENCE BOOK

1. Ponmurugan *Experimental Procedures In Bioprocess Technology & Downstream Processing* (1st Ed) Anjanaa Publishing

BBT13L09 MINI PROJECT (INDUSTRY ATTACHED)* 0 0 6 2

Students have to undergo an training in an industry or in a R&D lab for 15 full working days. Marks will be given based on the report they are submitting.

BBT 13020 **GENOMICS** **3 1 0 4**

OBJECTIVES:

- To study the Structure and organization of prokaryotic and eukaryotic genome
- To give a background idea about Human genome project
- To introduce pharmacogenetics and epigenetics

UNIT I: INTRODUCTION TO GENOMICS **12 Hrs**

Introduction – Structure and organization of prokaryotic and eukaryotic genome; Genome size and C value paradox; Repetitive DNA sequences in genome, Tools for genome analysis-RFLP, DNA fingerprinting, RAPD-PCR. Analysis of sequence data : Gene identification, Open Reading Frame (ORF), Exon-intron boundary, Gene prediction methods in prokaryotes and eukaryotes.

UNIT II: GENOME ANALYSIS **12 Hrs**

Background of Human genome project, Physical mapping, Markers for physical mapping: Cytogenetic map, STS map, EST map, Radiation hybrid map; Genetic mapping and Linkage analysis; Whole genome sequencing methods – Clone by clone method and shotgun sequencing; Chromosome walking and chromosome jumping; Metagenomics, 16S rRNA typing.

UNIT III: ANALYSIS OF GENE EXPRESSION **12 Hrs**

Introduction to gene expression, Methods for gene expression analysis: RNAse protection assay, Real-time RT-PCR, SAGE; Comparing transcriptome: Differential Display, Subtractive hybridization; Microarrays – principle, types and methodology of cDNA arrays and Oligonucleotide arrays; Applications of microarrays; Analysis of microarray data.

UNIT IV: PHARMACOGENETICS **12 Hrs**

Single nucleotide polymorphisms (SNPs) and types, Techniques for detection of SNPs : RFLP, Allele specific PCR, Allelic discrimination assay; CYP enzymes involved in drug metabolism; Polymorphism in drug metabolizing enzymes and its effects; Process of drug discovery; Phases of clinical trials; High throughput screening for drug discovery.

UNIT V: EPIGENETICS **12 Hrs**

DNA methylation, DNA methyl transferases, CpG island methylation, Mechanism of transcriptional repression by methylation, Methods for detection of DNA methylation: Restriction analysis, Bisulfite PCR;

Total no of Hours : 60

TEXT BOOKS

1. Campbell AM & Heyer LJ, (2007) *Discovering Genomics, Proteomics and Bioinformatics*,(2nd Ed), Benjamin Cummings.

REFERENCE BOOKS

1. Brown TA, (2006) *Genomes*,(3rdEd), Garland Science.
2. Sahai S, (1999).*Genomics and Proteomics, Functional and Computational Aspects*, Plenum Publication.

BBT 13021 BIOMATERIALS AND TISSUE ENGINEERING 3 0 0 3

OBJECTIVES:

- To introduce polymers as biomaterial types and their applications
- To study about the tissue engineering process of cells and tissues and the regulatory issues regarding tissue engineering and its standardization.

UNIT I: INTRODUCTION 9 Hrs

Introduction: Biomaterial types-Natural-Artificial biomaterial-Processing-Skin grafts-Organo-typic culture-Cell polymer bioreactor-Functional cell mammalian cell constructs.

UNIT II: NATURAL BIOPOLYMERS 9 Hrs

Natural biopolymers: Introduction: Collagen, Chitosan, Sodium alginate, Hyaluronic acid, Fibrinogen-Stabilization-Chemical modification-Copolymers-Scaffolds-Porous matrices-Tubules-Cell surface interaction.

UNIT III: SYNTHETIC POLYMERS 9 Hrs

Synthetic polymers-Introduction: Aliphatic carbonate based polymers-Dioxepanone based polymers-Poly anhydrides-Poly amino acids-Hydrogels-Polymer scaffolds-Processing microencapsulation-Injectable polymers.

UNIT IV: ENGINEERING CELLS AND TISSUES 9 Hrs

Engineering cells and tissues: Introduction-Reconstruction-Vascular grafts-Synthetic valves-Replacement-Bio-artificial device-Engineering of tissues- Regenerative matrix-implants-Bi-layered skin constructs.

UNIT V: REGULATORY ISSUE AND STANDARDIZATION 9 Hrs

Regulatory issue and standardization-Safety consideration-Effectiveness consideration-Regulatory activities of FDA-Standardization through the ASTM-future prospects-Ethics and responsibility.

Total no of Hours : 45

REFERENCE BOOK

1. Anthony Atala, Robert P. Lanza (2001) *Methods of tissue engineering* .Academic press

BBT 13022 **FOOD BIOTECHNOLOGY** **3 0 0 3**

OBJECTIVES:

- To learn role of food additives in food processing and preservation.
- To know the role of bacteria, yeast and mould in food processing and role of fermentation of food
- To be aware of food borne diseases caused and food poisoning.

NIT I: HISTORICAL BACKGROUND **9 Hrs**

Historical background: History of microorganism in food, Historical developments,Taxonomy: role and significance of microorganism in foods, Intrinsic and extrinsic parameters of foods that affect microbial growth, Microorganisms in fresh meats and poultry, Processed meats, seafoods, Fermented and fermented dairy products and miscellaneous food products.

UNIT II: STARTER CULTURES **9 Hrs**

Starter cultures: Cheeses,beer, wine and distilled spirits, SCP, Medical foods, Probiotics and Health benefits of fermented milk and food products;Brewing ,malting ,mashing,hops, primary and secondary fermentation:Biotechnological improvements,catabolic repression,High gravity brewing , B – glucan problem,Getting rid of diacetyl,Beer , wine and distilled spirits.

UNIT III: NUTRITIONAL BOOSTS AND FLAVOUR ENHANCERS **9 Hrs**

Nutritional boosts and flavour enhancers: Emerging processing and preservation technologies milk and dairy products. Microbiological examination of surfaces, Air sampling, Metabolically injured organisms, Enumeration and detection of food – borne organisms. Bioassay and releated methods.

UNIT IV: FOOD PRESERVATION **9 Hrs**

Food preservation: Food preservation using irradiation, Characteristics of radiations of interest in Food preservation, Principle underlying the destruction of microorganisms by irradiation, Processing of foods for irradiation, Application of Radiation, Radappertization, Radicidation, and Radurization of foods legal status of food irradiation, Effect of irradiation of food constituents.

UNIT V: STORAGE **9 Hrs**

Storage stability food preservation with low temperatures, Food preservation with high temperatures, Preservation of food by drying, Indicator and food- borne pathogens, Other proven and food- borne pathogens. Food standards and Specifications: Compulsory and voluntary trade and Company standards. Consumer Protection Act (1986), AgMark, BIS, US, Canadian, EU, ISO and Codex Food Standards, Export Quality Control and Inspection act (1963),

. **Total no of Hours : 45**

TEXT

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg,(2005), *Microbiology* (5th Ed) TATA McGraw Hill.

REFERENCE BOOKS

1. James M. Jay (1993). *Modern Food Microbiology* (4th Ed). CBS Publishers Delhi.
2. W. C. Frazier & D.C. Westhoffs, (1993). "*Food Microbiology*" (4th Ed) TMH.

BBT13023 **DOWNSTREAM PROCESSING** **3 1 0 4**

OBJECTIVES:

- To understand the basic fundamentals of downstream processing for biochemical product recovery.
- To understand the basic principle of characterization of biomolecules and various cell disruption process.
- To model biochemical product recovery, including small molecule purification

UNIT I: INTRODUCTION **12 Hrs**

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

UNIT II: PHYSICAL METHODS OF SEPERATION **12 Hrs**

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III: ISOLATION OF PRODUCTS **12 Hrs**

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

UNIT IV: FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS **12 Hrs**

Crystallization, drying and lyophilization in final product formulation.

UNIT V: INDUSTRIAL HYGIENE **12 Hrs**

Government regulations, Identification, Evaluation, Control. Designs to prevent fires and explosions: Inerting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems.

Total no of Hours : 60

TEXT BOOK

1. P.A. Belter, E.L. Cussler And Wei-Houhu (1988*).Bioseparations – Downstream Processing For Biotechnology*, Wiley Interscience Pun.
2. D.A. Crowl & J.F. Louvar (1990). *Chemical Process Safety (Fundamentals with applications),* Prentice Hall

REFERENCE BOOKS

1. R.O. Jenkins, (Ed.) (1992).*Product Recovery In Bioprocess Technology – Biotechnology* Open Learning Series, Butterworth-Heinemann
2. J.C. Janson And L. Ryden, (Ed.)(1989).Protein *Purification – Principles, High Resolution Methods And Applications*, VCH Pub.
3. R.K. Scopes (1989) *Protein Purification – Principles And Practice,* (3rd Ed) Narosa Pub

BBT 13024 **BIO FUELS** **3 0 0 3**

OBJECTIVES:

- To give an introduction to biogas technology
- To understand the basics behind the bioethanol and biodiesel production
- To give basic idea for the production of green energy from biomass

UNIT I: BIOGAS TECHNOLOGY-I **9 Hrs**

Biogas Technology -I Worldwide perspective of anaerobic digestion, Review of anaerobic digesters, Realistic potential of biogas plant installation, Problems encountered in the installed plants, Analysis of biogas systems, Optimizing the prospects of different designs of biogas plants, Engineering design of fixed dome type - continuous type plants - semi continuous plants, Microbiology of biogas production, Methods to enhance the biogas production, Design parameters affecting the success and failure of biogas plants, Structural behavior and stress conditions in fixed dome biogas plant, Structural behavior and stress conditions in KVIC plant, Performance of different types of gas holders.

UNIT II: BIOGAS TECHNOLOGY-II **9 Hrs**

Biogas Technology-II Alternate constructions material for biogas plant construction, Various techniques for increasing gas production in cold region. Effect of heating , insulation and stirring on gas production, Design optimization for biogas production, Multi criteria optimization, Immobilization biogas plant system – principle, Application of immobilization, Modular biogas systems for tropical areas – principle, Prospects of modular biogas systems, Alternate feedstock for biogas production. Effect of pesticides on anaerobic digestion, Effect of herbicide on anaerobic digestion, Kinetic models for predicting biogas production, Monod kinetics and related studies, Determination of kinetic parameters, Design equations of biogas plants.

UNIT III: BIO-ETHANOL AND BIO-DIESEL TECHNOLOGY **9 Hrs**

Bio-Ethanol and Bio-Diesel Technology**:** Production of Fuel Ethanol by Fermentation of Sugars. Gasohol as a Substitute for Leaded Petrol. - Trans-Esterification of Oils to Produce Bio-Diesel.

UNIT IV: GREEN TECHNOLOGY – MICROBIAL FUEL CELL: **9 Hrs**

Green Technology – Microbial Fuel Cell**:** Types of Biological fuel cells – Working Principle - Applications of biological Fuel cells. A brief study of the principle, construction of different types of fuel cells. Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.

UNITV: ENERGY FROM BIOMASS **9 Hrs**

Energy from Biomass – Introduction – Biomass conversion Technologies – Photosynthesis – Biogas generation – Factors affecting Biodigestion – Classification – Types – Construction Details – Methods of obtaining energy from Biomass – Pyrolysis – Alcohol fuels - Design and operation of Fixed and Fluidized Bed Gasifiers. Combustion of Biomass and Cogeneration Systems:Combustion of Woody Biomass: Theory, Calculations and Design of Equipments. Cogeneration in Biomass Processing Industries. Case Studies: Combustion of Rice Husk, Use of Bagasse for Cogeneration.

Total no of Hours : 45

TEXT BOOKS :

1. G.D.Rai (2011), *Non-Conventional Energy Sources* , Khanna Publishers.
2. B.H.Khan,(2006*) Non-conventional Energy Sources* , The McGraw Hill Companies.

REFERENCE BOOKS :

1. Halwagi,(1984) *Biogas Technology - Transfer and Diffusion.* MNES Publication.
2. Chawla, O.P, (1986)*Advances in Biogas technology.* Publications and Information Division, Indian Council of Agricultural Research.

BBT 13L10 TISSUE CULTURE LAB 0 0 3 1

OBJECTIVES:

- To be aware of tissue culture laboratory practices and maintaining sterility in lab
- To learn the composition and preparation of plant and animal tissue culture medium
- To apply the concepts learned in biochemistry and microbiology for understanding the role of medium in animal cell culture

Any Five Experiments from animal Tissue Culture and 5 from Plant Tissue Culture will be offered

1. Preparation of media, sterilization by filtration.
2. Preparation of single cell suspension from chick embryo, rat liver, human cord blood.
3. Preparation of single cell suspension: Homogenization, sonication , enzymatic treatment.
4. Cell counting using haemocytometer, cell viability using Trypan blue and MTT assay.
5. Fibroblast tissue culture, Mutant cell line culture, serial passage and cryopreservation.
6. Cytotoxicity and Cell proliferation kinetics.
7. Mutagenecity in cell lines& screening method: Drug induced, UV treatment, Chromosome aberration assay.
8. Isolation of DNA from animal cell culture
9. Principles of Plant Tissue Culture
10. Organ Culture
11. Plant Transformation procedures
12. Plant Regeneration Procedures

REFERENCE BOOKS

1. Ian Freshney (2010) Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, (6th Ed) Wiley-Blackwell.

BBT 13L11 DOWNSTREAM PROCESSING LAB 0 0 3 1

OBJECTIVES:

- To understand the fundamentals of pharmaceutical crystallization and downstream processing
- To identity was to enhance the efficiency of crystallization and downstream processing.
- To design for any common bioseparation unit operation

1. Solid liquid separation – centrifugation, microfiltration
2. Cell disruption techniques – ultrasonication, French pressure cell
3. Cell disruption techniques – dynomill – batch and continuous
4. Precipitation – ammonium sulphite precipitation
5. Ultra filtration separation
6. Aqueous two phase extraction of biological
7. High resolution purification – affinity chromatography
8. High resolution purification – ion exchange chromatography
9. Product polishing – gel filtration chromatography
10. Product polishing – spray drying, freeze drying

REFERENCE BOOKS

1. Ponmurugan *Experimental Procedures In Bioprocess Technology & Downstream Processing* (1st Ed) Anjanaa Publishing

BBT13L12 **SCIENTIFIC READING AND WRITING** **0 0 3 1**

Students will be trained for reading different research articles and their understanding capability will be evaluated by a committee of faculty

BBT 13025 LEGAL ASPECTS OF BIOTECHNOLOGY (UPGRADED) 3 0 0 3

OBJECTIVES:

- To learn the importance of IPR
- To learn the process involved in patenting and claims
- To understand the requirements of disclosure and patent litigation

UNIT I: INTRODUCTION TO INTELLECTUAL PROPERTY 9 Hrs

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs, IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; History of GATT & TRIPS Agreement; Madrid Agreement; Hague, Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent, Act 1970 & recent amendments.

UNIT II: BASICS OF PATENTS AND CONCEPT OF PRIOR ART 9 Hrs

Introduction to Patents; Types of patent applications: Ordinary,PCT, Conventional, Divisional and Patent of Addition;Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching, International Databases; Country-wise patent searches (USPTO,esp@cenet(EPO), PATENTScope(WIPO), IPO, etc.)

UNIT III: PATENT FILING PROCEDURES 9 Hrs

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting –disclosure/non-disclosure; Financial assistance for patenting -introduction to existing schemes, Patent licensing and agreement, Patent infringement- meaning, scope, litigation, case studies.

UNIT IV: BIOSAFETY 9 Hrs

Introduction; Historical Backround; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; BiosafetyLevels; Biosafety Levels of Specific Microorganisms; RecommendedBiosafety Levels for Infectious Agents and Infected Animals;Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNITV: BIOETHICS 9 Hrs

Human genome project and its ethical issues. Gene testing, prenatal diagnosis, genetic manipulations, germline therapy, genetic studies on ethnic races.

Total no of Hours : 45

TEXTS/REFERENCES

1. BAREACT, (2007) *Indian Patent Act 1970 Acts & Rules*, Universal Law Publishing Co. Pvt. Ltd.,
2. Kankanala C.(2007*) Genetic Patent Law & Strategy*, (1st Ed), Manupatra Information Solution Pvt. Ltd.,

IMPORTANT LINKS:

1. http://www.w3.org/IPR/
2. http://www.wipo.int/portal/index.html.en
3. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
4. www.patentoffice.nic.in

BMG 13002 **TOTAL QUALITY MANAGEMENT** **3 0 0 3**

OBJECTIVES:

- To learn the basic concepts of TQM
- To understand the different components in management, customer - supplier relationship and services
- To learn the elements of quality systems and quality auditing

UNIT I: INTRODUCTION **9 Hrs**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II: TQM PRINCIPLES **9 Hrs**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III: STATISTICAL PROCESS CONTROL (SPC) **9 Hrs**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV: TQM TOOLS **9 Hrs**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V: QUALITY SYSTEMS **9 Hrs**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Total no of Hours : 45

TEXT BOOK

1. Dale H.Besterfiled, et al., (1999) Total Quality Management, Pearson Education Asia. (Indian reprint 2002).

REFERENCE BOOKS

1. James R.Evans & William M.Lidsay, (2002) *The Management and Control of Quality*, (5th Ed), South-Western (Thomson Learning), (ISBN 0-324-06680-5).
2. Feigenbaum.A.V(1991),*Total Quality Management*, McGraw Hill.
3. Oakland.J.S. (1989). *Total Quality Management* Butterworth – Hcinemann Ltd., Oxford.
4. Narayana V. and Sreenivasan, N.S.(1996). *Quality Management – Concepts and Tasks*, New Age International
5. Zeiri. (1991)"*Total Quality Management for Engineers* Wood Head Publishers.

BBT13L13	**PROJECT WORK**	**3**	**0**	**24**	**10**

Indiviual or a group comprising of 2 or 3 students were expected to choose a research problem and execute it with proper data. They will explain their research project to a committee of faculty members

BBT 13E 01 SOLID AND HAZARDOUS WASTE MANAGEMENT 3 0 0 3

OBJECTIVES:

- To study the types and source of solid and hazardous waste and its generation rates.
- To study the handling and segregation and processing of wastes.

UNIT I: TYPES AND SOURCES 9 Hrs

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management - Legislations on management and handling of municipal solid wastes, hazardous wastes, and biomedical wastes.

UNIT II: WASTE GENERATION 9 Hrs

Waste generation rates – Composition - Hazardous Characteristics – TCLP tests – waste sampling- Source reduction of wastes – Recycling and reuse.

UNIT III: HANDLING AND SEGREGATION 9 Hrs

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations - labeling and handling of hazardous wastes.

UNIT IV: WASTE PROCESSING 9 Hrs

Waste processing – processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes.

UNITV: DISPOSAL IN LANDFILLS 9 Hrs

Disposal in landfills - site selection - design and operation of sanitary landfills- secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – landfill remediation. Elements of integrated waste management.

Total no of Hours: 45

TEXT BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, (1993) *Integrated Solid Waste Management*, McGraw- Hill, New York.

REFERENCE BOOK

1. CPHEEO, (2000) *Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization*, Government of India, New Delhi.

BBT13E02 **MARINE BIOTECHNOLOGY** **3 0 0 3**

OBJECTIVES:

- To gain knowledge on marine microbial diversity and its importance.
- To learn the importance of marine microbes, marine flora and fauna and microbial metabolites.
- To learn microbial leaching and biofouling.

UNIT I: INTRODUCTION **9 Hrs**

Introduction to marine environment; Marine Flora – Phytoplankton, seaweeds, sea grasses and mangroves-their characteristics and identification; Biology

UNIT II: MARINE FAUNA **9 Hrs**

Marine fauna-zooplankton; major marine invertebrates; vertebrates and marine mammals-characteristics and identification, Biology

UNIT III: MARINE MICROBES **9 Hrs**

Marine microbes – Types, classification, methods of culturing and identification; methods of preservation.

UNIT IV: MICROBIAL NITROGEN FIXATION **9 Hrs**

Microbial Nitrogen fixation, their role in carbon, phosphorous and sulphur cycle, degradation of organic matter; Microbial leaching and Biofouling

UNIT V: MARINE PHARMACOLOGY **9 Hrs**

Marine pharmacology – Microbial metabolites; Metabolites from marine flora and fauna

Total no of Hours : 45

TEXT BOOK

1. Bhakuni, D.S., Rawat, D.S. (2005). *Bioactive Marine Natural Products*. Springer.

BBT13E03 STEM CELLS &DEVELOPMENTAL BIOLOGY 3 0 0 3

OBJECTIVES:

- To study the principles of developmental biology in the early embryonic development.
- To study the stem cell processing and its therapeutic applications.

UNIT I: PRINCIPLES OF DEVELOPMENTAL BIOLOGY 9 Hrs

Developmental biology: The anatomical tradition/Life cycles and the evolution of developmental patterns; principles of experimental embryology; The genetic core of development; The paradigm of differential gene expression, cell commitment, differentiation & induction of cell fate; concept of morphogen, cell-cell communication in development.

UNIT II: EARLY EMBRYONIC DEVELOPMENT 9 Hrs

Fertilization: Beginning a new organism. Early development in selected invertebrates; the genetics of axis specification in Drosophila; Early development and axis formation in amphibians; the early development of vertebrates: fish, birds and mammals.

UNIT III: INTRODUCTION TO STEM CELLS 9 Hrs

Development of differentiated tissues from embryonic germ layers, Function of placenta, amniotic fluid and umbilical cord; Stem cells : Definition, Classification and Properties; Properties and application of Embryonic stem cells; Hematopoiesis – Hierarchy, Properties of Hematopoietic Stem Cells (HSCs) and types.

UNIT IV: STEM CELL PROCESSING AND TRANSPLANTATION 9 Hrs

Sources of stem cells; Cell types for transplantation: Bone marrow, Peripheral stem cells, cord blood stem cells; Types of transplants; Methods of obtaining bone marrow and peripheral blood for transplant, Stem cell processing and storage; HLA matching; Advantages and drawbacks of autologous and allogeneic transplants.

UNIT V: STEM CELLS AND THERAPY 9 Hrs

Overview of embryonic and adult stem cells for therapy; Normal stem cells vs Cancer stem cells, Clinical uses of hematopoietic stem cells in leukemia and inherited blood disorders; Use of stem cells in diabetes, myocardial infarction, Parkinson's disease.

Total no of Hours: 45

TEXT BOOK

1. Scott F Gilbert (2000) *,A companion to Developmental Biology*,(9th Ed), Sunderland (MA): Sinauer Associates;
2. Robert Lonza (2009) *Essentials of Stem Cell Biology*, (2nd Ed) Academic Press.

REFERENCE BOOK:

1. Anthony Atala, Robert Lonza, James A.Thomson, Robert Nerem (2011) *Principles of Regenerative Medicine*, (2nd Ed) , Academic Press.
2. StemBook Cambridge (MA): 2008.Harvard Stem Cell Institute;

BBT 13E04 DESIGN OF INDUSTRIAL WASTEWATER MANAGEMENT 3 0 0 3

OBJECTIVES:

- To study different characters of the waste water. Sources and types of industrial waste water and fundamentals of anaerobic treatment were explained.
- To study the different types of waste minimization and its industrial manufacturing process.

UNIT I: WASTE WATER CHARACTERISTICS 9 Hrs

Wastewater characteristics: composition and microbiology of wastewater, Mathematical modeling of BOD, kinetics. Wastewater treatment: Basic design consideration, principles of reactor design and process flow sheets. Objectives and fundamentals of biological treatment, types of biological treatment processes. Conventional activated sludge process, process kinetics and design considerations, process control measures, operational problems. Design of aerobic suspended growth systems including activated sludge process (Activated sludge process and its modifications, integrated design procedure, design and control parameters, applications) and aerated lagoon. Biological Nitrogen Removal, Biological Phosphorous Removal. Trickling filter: Classification- standard and high rate, Principles of design, process design considerations, construction and design of oxidation ponds, aerobic sludge digestion, theory and design of waste stabilization ponds and oxidation ditches, factors affecting the design, design of digestion tank, septic tanks: working principles and design, soak pits. Biosorption contact stabilization. Biological film flow processes - Sanitation land fill - Municipal and compost treatment - Predigestion of waste. Theory and design of aerobic attached growth systems including rotating biological contactor.

UNIT II: FUNDAMENTALS OF ANAEROBIC TREATMENT 9 Hrs

Fundamentals of anaerobic treatment, types, Anaerobic lagoons - Anaerobic digestion - contact and filter digestion - Energy production by digester and Non homogeneous reactions - reactors – physical and chemical removal of dissolved materials - Gas transfer - mass models - Bubble aeration - film flow oxygen transfer - stripping - solids removal. Discrete particle - sedimentation and thickening. General design considerations, of anaerobic reactors. Anaerobic sludge blanket processes, Design considerations for Up flow Anaerobic Sludge Blanket process and hybrid reactors. Theory and design of Sludge treatment, sludge thickening, sludge drying, incineration, aerobic and anaerobic digestion of sludge. Sewage treatment plant layout, concept of sustainable wastewater treatment.

UNIT III: SOURCES AND TYPES OF INDUSTRIAL WASTEWATER 9 Hrs

Sources and types of industrial wastewater – Environmental impacts – Regulatory requirements – generation rates – characterization – Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution– Source reduction techniques – Waste Audit- Evaluation of pollution prevention options.

UNITIV:WASTE MINIMIZATION 9 Hrs

Waste minimization - Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal – adsorption – Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal Individual and Common Effluent Treatment Plants – Zero effluent discharge systems - Wastewater reuse – Disposal of effluent on land – Quantification, characteristics and disposal of Sludge.

UNIT V: INDUSTRIAL MANUFACTURING PROCESS 9 Hrs

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Petrochemical -Pharmaceuticals – Sugar and Distilleries – Food Processing – fertilizers – Thermal Power Plants and Industrial Estates, ISO 14000:2003 – Waste Audit.

Total no of Hours : 45

TEXT BOOKS :

1. S.K.Garg (2004) *Environmental Engineering*(Vol I & II) Khanna publishers
2. Marcos Von *Sperling (2007), Waste Water Characteristics, Treatment and Disposal, Biological Waste Water Treatment, Serie I, Iwa Publishing* (Intl water Association).

REFERENCES

1. Eckenfelder, W.W., (1999). *Industrial Water Pollution Control*,(3rd Ed) McGraw-Hill.
2. Arceivala, S.J., (1998). *Wastewater Treatment for Pollution Control* (2nd Ed), McGraw-Hill, 1998.
3. Frank Woodard, (2001*). Industrial waste treatment Handbook*,(1st Ed) Butterworth Heinemann New Delhi,

BBT13E05 PHYTO CHEMICAL TECHNOLOGY 3 0 0 3

OBJECTIVES:

- To explain the concept of phytochemical technology and various methods of its extraction.
- The objective also includes the analysis of plant drugs and standardization of herbal drugs.

UNIT I: INTRODUCTION TO MEDICINAL PLANTS 9 Hrs

Introduction to Medicinal Plants, Classification of secondary metabolites, Medicinal importance of secondary metabolites like Flavonoids, Phenols, Alkaloids, Tannins Terpenes and Saponins.

UNIT II: EXTRACTION 9 Hrs

Extraction of Phyto pharmaceuticals – Infusion, Decoction, Digestion, Maceration, Percolation, Successive Solvent Extraction, Super Critical Fluid Extraction

UNIT III: EXTRACTION 9 Hrs

Steam Distillation, Headspace Techniques, Sepbox, Selection of Suitable Extraction Process, Carbohydrates, Proteins, Alkaloids, Glycosides.

UNIT IV: PLANT DRUG ANALYSIS 9 Hrs

Application of Chromotography and Spectroscopy in Plant Drug Analysis – Infrared Spectroscopy, NMR Spectroscopy, Mass Spectroscopy.

UNIT V: STANDARDIZATION OF HERBAL DRUGS 9 Hrs

Standardization of Herbal Drugs – Importance of Standardization and Problems Involved in the Standardization of Herbs, Standardization of Single Drugs and Compound Formulations, WHO Guidelines for Quality Standardized Herbal Formulation, Estimation of Parameter Limits used for Standardization, Herbal Extracts.

Total no of Hours : 45

TEXT BOOK :

1. S.S. Agarwal, M.Paridhavi (2007) *Herbal Drug Technology* (1st Ed), University press (India) private limited

REFERENCE BOOK

1. A.P.Purohit, C.K.Kokate , S.B.Gokhale (2001) *Pharmacognosy* (32nd Edition) Nirali Prakshan pune.
2. Trease GE , Evans WC *Pharmacognosy* (14th Edition) W.B.Sondars & Co Ltd London.

BBT13E 06 **CANCER BIOLOGY** **3 0 0 3**

OBJECTIVES:

- To understand the fundamentals of cancer biology regarding cell cycle, mutational changes in signaling molecules, types of cancer, early detection methods and cancer screening methods, etc.

UNIT I: FUNDAMENTALS OF CANCER BIOLOGY **9 Hrs**

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

UNIT II: PRINCIPLES OF CARCINOGENESIS **9 Hrs**

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 **9 Hrs**

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes,retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases.

UNIT IV: PRINCIPLES OF CANCERMETASTASIS **9 Hrs**

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V: NEW MOLECULES FOR CANCER THERAPY **9 Hrs**

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

Total no of Hours : 45

TEXT BOOK

1. L M Franks and N M Teich. (1991)*"An Introduction Top Cellular And Molecular Biology Of Cancer",* Oxford Medical Publications,

REFERENCE BOOKS

1. Maly B.W.J,(1987) *" Virology A Practical Approach ",* IRLl Press, Oxford,
2. Dunmock N.J And Primrose S.B., (1988) *" Introduction To Modern Virology ",*Blackwell Scientific Publications, Oxford.

BBT 13E07 ENVIRONMENTAL IMPACT ASSESSMENT 3 0 0 3

OBJECTIVES:

- To understand the Concepts and methodologies of environmental impact assessment
- To study the impact of assessment procedures.
- To know the documentation process of environmental impact assessment.

UNIT I: EVOLUTION OF EIA 9 Hrs

Evolution of EIA – Concepts – Methodologies – Screening – Scoping – Base line studies - Mitigation – Matrices – Check list.

UNIT II: RAPID AND COMPREHENSIVE EIA 9 Hrs

Rapid and Comprehensive EIA – Legislative and Environmental clearance procedures in India – Prediction tools for EIA.

UNIT III: ASSESSMENT OF IMPACTS 9 Hrs

Assessment of impacts – Air – Water – Soil – Noise – Biological. Socio cultural environment – Public participation – resettlement and rehabilitation.

UNIT IV: DOCUMENTATION OF EIA 9 Hrs

Documentation of EIA – Environmental Management plan – Post project monitoring – Environmental Audit – Life cycle assessment – EMS

UNIT V: CASE STUDIES 9 Hrs

Case studies in EIA.

Total no of Hours : 45

TEXT BOOKS

1. Canter R.L.(1997) *Environmental Impact Assessment*, Mc Graw Hill International Edition,

REFERENCE BOOKS

1. John G. Rau and David C. Wooten (Ed)(1980), *Environmental Impact Analysis Handbook*, (1st Ed)McGraw Hill Book Company.

BBT 13E08 MOLECULAR MODELING AND DRUG DESIGN 3 0 0 3

OBJECTIVES:

- To understand the concepts of computational chemistry and molecular orbital methods bonding and non bonding parameters for the application of insilico molecular modeling
- To understand and analyze the problems involved in molecular modeling to accurate develop the molecular structure
- To study various simulation and energy minimization methods

UNIT I: COMPUTATIONAL CHEMISTRY 9 Hrs

Computational Chemistry**:** Concepts of computational chemistry, Born Oppenheimer approximations, Application of Hartree-Fock equations to molecular systems, approximate Molecular orbital theories.

UNIT II: **MOLECULAR MECHANICS 9 Hrs**

Molecular mechanics**:** general features, bond stretching, angle bending, improper torsions, out of plane bending, cross terms, non-bonded interactions, point charges, calculation of atomic charges, polarization, van der Waals interactions, hydrogen bond interactions, Water models, Force fields, all atoms force field and united atom force field

UNIT III: ENERGY MINIMIZATION 9 Hrs

Energy minimization**:** statement of the problem, Derivatives; Non-derivative minimization methods: The simplex method, Sequential univariative method. Derivative methods: First-order Derivative, Steepest decent methods, Conjugate gradients. Second-order Derivative: Newton-Raphson method, Minima, Maxima, saddle points, convergence criteria

UNIT IV: SIMULATION METHODS 9 Hrs

Simulation methods: Time averages, ensemble averages, Molecular dynamics methods, Monte Carlo methods, Differences between MD and MC, Energy, Pressure, Temperature, Temperature dynamics: Simulated Annealing procedure. Initial configuration, Periodic Boundry conditions, Solvent access, Equilibration, cutoffs, Problems and overcoming it, Time step, Constraint dynamics, Systematic methods, Random search methods, Distance geometry.

UNIT V: DOCKING AND DRUG DESIGN 9 Hrs

Docking and Drug Design**: C**omputer representation of molecules, 3D database searching, Deriving and using the 3D Pharmacophore, constrained systematic search, Clique detection techniques, Maximum likelihood method, molecular docking: scoring functions, Pharmacophore keys, Structure-based *De Novo* Ligand design, Quantitative Structure Activity Relationship Qualitative structure activity relationship.

Total no of Hours : 45

TEXT BOOK :

1. Andrew R. Leach (2001) *Molecular Modelling Principles and Applications*,(2nd Ed) Prentice Hall.

REFERENCE BOOKS

1. Jhony Wiley & sons (2005) *Current Protocols in Bioinformatics*, Wiley Publishers.

BBT 13E09 BIOSENSORS AND BIOMEDICAL DEVICES IN DIAGNOSTICS 3 0 0 3

OBJECTIVES:

- To understand the fundamentals of biosensors and types of biosensors.
- To study the uses of clinical and non-clinical uses of biosensors.
- To study the concepts behind the reagentless biosensors & array-based chips.

UNIT I: FUNDAMENTALS OF BIOSENSORS 9Hrs

Biosensors as Functional Analogs of Chemo receptors- Immobilization and biosensor construction, Biosensor instrumentation-Transduction principles used in a biosensor, Biocomponent of the sensor. Biological sensing elements and transducer systems- their sensitivity specificity and linearity.

UNIT II: TYPES OF BIOSENSORS 9 Hrs

Thermometric Indication with Thermistors, Opto electronic Sensors, Piezoelectric Sensors, Electrochemical Sensors, Potentiometric Electrodes, Amperometric Electrodes, Conductometric Measurement. Flow injection analysis based biosensors, fiber optics biosensors, Bioluminescence biosensors, Microbial biosensors, Affinity biosensors, immunosensors.DNA Probes, organic acid probes, antigen-antibodies reaction, biochemical detection of organelles, receptors, sensors for pollution gases stability and reusability of sensors.

UNIT III: BIOSENSORS FOR CLINICAL ANALYSIS 9 Hrs

Biosensors for personal diabetes management (Glucose, Galactose, Gluconate, Lactate, Pyruvate Sensors) Noninvasive Biosensors in Clinical analysis and health care.

UNIT IV: NON CLINICAL APPLICATION OF BIOSENSORS 9 Hrs

Applications in Veterinary, Agriculture, Food production, Environmental control and pollution monitoring, and bioprocess industry.

UNIT V: REAGENTLESS BIOSENSORS & ARRAY-BASED CHIPS 9Hrs

Surface Dielectric Enhancement, Gold nanoparticle enhanced surface plasmon resonance, carbon nanotube and silicon nanowire enhanced conductivity, catalytic activation, electro catalytic detection, catalytically enabled optical and magnetic detection, Reagent less Immunoelectrodes, biomolecule conformational modulated effects, Biosensors based on DNA conformation changes, Biosensors based on protein conformation changes

Total no of Hours : 45

TEXT BBOK

1. Turner A.P.F, Karube I and Wilson G.S, (1987) *Biosensors- Fundamentals and applications*, Oxford Univ.Press.

REFERENCE BOOKS

1. Yang V.C. and T.T.Ngo,(2000) *Biosensors and their Applications*, Academic/Plenum Publishers.
2. Ashok Mulchandani and Kim R Rogers,(1998)*Enzyme and Microbial bio sensors: Techniques and Protocols,*Humana Press Totowa, NJ.
3. Turner A.P.F and Wilsons G.S, (1997) *Biosensors: Fundamentals and Applications,* Oxford Science Publications.

BMG 13E10 MANAGEMENT CONCEPTS FOR ENGINEERS AND TECHNOLOGISTS 3 0 0 3

OBJECTIVES:

- To learn Organization of management and leadership qualities
- To understand marketing and consumer orientation including human resources and finance

UNIT I: ORGANIZATION **9Hrs**

a. Structure and design-flat structure
b. Functions of management-planning, organizing, directing, controlling etc.,
c. Different functional areas-marketing, finance, operations, HR etc.,
d. Delegation, decentralization,
e. Team & group working concepts-motivation & leadership issues

UNIT II: MARKETING & COMPETITIVE ANALYSIS **9Hrs**

a. Consumer orientation-definition & concepts
b. Understandings Buyer behavior
c. Marketing Mix issues-product, branding, packing, labeling, distribution channel selection, pricing & promotional issues
d. Competitive analysis & bench marking
e. Market segmentation, target market selection-global market in focus
f. Marketing program, organization
g. Use if internet, web based technology for marketing

UNIT III: MANAGEMENT OF HUMAN RESOURCE **9Hrs**

a. Meaning & importance of HR
b. Compensation
c. Motivation
d. Performance appraisals & career counseling etc.,

UNIT IV: MANAGEMENT OF FINANCE **9Hrs**

a. Definition of finance
b. Costs-fixed/variable, CVP analysis, BEP
c. Cash flow-importance and management
d. Project appraisals-evaluation methods
e. Budgets and forecasting
f. Capital-working capital and importance
g. Ways of raising capital for project proposals

UNIT V: CREATIVITY AND INNOVATION **9Hrs**

a. Identification/design of product/service concepts
b. Motivating & managing human resources
c. Distribution/reaching the end consumers
d. Financing the ventures

Total no of Hours : 45

TEXT BOOK:

1. Koontz O' Dannel, (1968) *Principles of Management* (4th Ed) Mc Graw Hill Publishing Co.Ltd.
2. L.M. Prasad,(1914) *Principles and Practice of Management* (8th Ed), Sultan Chand & Sons.

REFERENCE BOOKS

1. Stephen P. Robbins and David A. Decenzo, (2001) *Fundamentals of Management*, (3rd Ed) Pearson Education.
2. Philip Kotler, (2011) *Marketing Management*, PHI.
3. Boyd Walker,(2006) *Marketing Management*, (5th Ed)McGraw Hill
4. Robert L Mathis and John H Jackson, (2010) *Human Resource Management* (13th Ed) Joseph Sabatino.
5. Beardwell Holden, (2003) *Human Resource Management*, A contemporary approach (4th Ed) Pearson.
6. Luis Gomez- Mejia, David Balkin Robert cardy, (2013) *Human Resource Management* (7th Ed) Pearson.
7. James C Vanhorne, (2012) *Financial Management & Policy* (12th Ed) Pearson.
8. I M Pandey, (2009) *Financial Management* (9th Ed) Vikas Publishing.
9. Khanand Jain, *Basic Financial Management & Practice*, Tata McGraw Hill.

BBT 13E10 **ENVIRONMENTAL TOXICOLOGY** **3 0 0 3**

OBJECTIVES:

- To know the toxic chemicals present in the environment and their mode of entry
- To understand the presence of carcinogens insecticides present in the environment

UNIT I: TOXIC CHEMICALS IN THE ENVIRONMENT **9 Hrs**

Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide.

UNIT II: MODE OF ENTRY **9 Hrs**

Mode of entry of toxic substance, biotransformation of xenobiotics detoxification

UNIT III: CARCINOGENS IN AIR **9 Hrs**

Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.

UNIT IV: INSECTICIDES **9 Hrs**

Insecticides, MIC effects, Concept of major, trace and Rare Earth Element (REE)- possible effects of imbalance of some trace elements

UNIT V: BIOGEOCHEMICAL FACTORS **9 Hrs**

Biogeochemical factors in environmental health. Epidemiological issues goiter, fluorosis, arsenic poisoning.

Total no of Hours : 45

TEXT BOOKS

1. G. S Sodhi (2009) *Fundamental Concepts of Environmental chemistry*, (3rd Ed) Alpha Science International.
2. Stanley E. Manhan (2009) *Principals of Environmental chemistry*,(9th Ed) CRC press.

REFERENCE BOOKS

1. R.B. Philip (2005) *Environmental hazards & human health*, Lewis publishers, Boca Raton.
2. Raymond Niesink, Mannfred A.Hollinger & Jon De Vries ,(1996) *Toxicology - Principles & applications*. CRC Press.
3. Chatterjee (2009) *Parasitology*, (13th Ed) CBS
4. K. Perk (2013) *Preventive & Social medicines*,(22nd Ed) Banarsidas Bhanot-Jabalpur publishers.