AICTE Scheme and Syllabi

B.TECH. (BIOTECHNOLOGY)

(Effective from the admitted batch of 2019-20)

DEPARTMENT OF CHEMICAL ENGINEERING
AU COLLEGE OF ENGINEERING (A)
ANDHRA UNIVERSITY
VISAKHAPATNAM

2/4 B.Tech. (Biotechnology) - First Semester

BT 1301 **Microbiology**

3L-1T-0P-3C

Objectives:

- To make the student learn about origin and evolution of microbes.
- To make the student understand structure and functioning of different microbial groups.
- To make them to acquaint the cultivation of microbes in artificial medium.

Outcome:

- Students gain the knowledge and skills both theoretically and practically.
- Students are equipped with theoretical approach to study them and understand their importance in ecosystem

Syllabus:

History and Development of Microbiology: Contributions of van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck, further developments of microbiology,

Microbial Taxonomy: Bacteria, archea and their broad classification. molecular approaches to microbial taxanomy, physiology of extremophiles,

Morphology and Functions of Viruses, Yeast, Molds and Bacteria:

Viruses- Morphology of viruses- size, shape and symmetry, replication of viruses- Lytic and Lysogenic cycle,

Yeast and Molds: Morphology, life cycle, economic importance of yeast and *Aspergillus,*

Bacteria : Ultra structure of bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell,

Microbial growth: Definition of growth- growth curve, measurement of bacterial growth (cell number and cell mass) growth yield, continuous culture- chemostat, turbidostat, synchronous growth, effect of environmental factors on growth,

Microbial Nutrition and Control of Microorganisms: Nutritional requirements, nutritional types of bacteria, up-take of nutrients by cell, sterilization, and disinfection, effect of physical (moist and dry heat, radiation and filtration) and chemical agents, antibiotics- mode of action and resistance,

Methods in Microbiology: Culture media, synthetic and complex media, solidifying agents, types of media, isolation of pure cultures- spread plate, pour plate and streak plate, preservation of microorganisms, light (bright field only) and electron microscopy,

Applied Microbiology: Water, food and milk born contamination and remedy; basic microbial genetics- transformation, conjugation, transduction, strain improvement of industrially important micro-organisms.

Text book:

1. 'Microbiology', by Prescott L.M., Herley J.P., Klein D.A., McGraw- Hill

Reference books:

1. "Microbiology", Pelzar, M.J., Chan, E.C.S., Kreig N.R., Tata McGraw-Hill
2. "Brock biology of Microorganisms", Madigan M.T.,Martinco J.M. and Parker J., Prentice Hall

BT1302 **Organic Chemistry**

3L-1T-0P-3C

Objectives:

The student will be able to:

1. appreciate the nature and scope of organic chemistry.
2. apply key concepts from general chemistry including electronegativity, bonding (ionic and covalent), hybridization of atomic orbitals, and molecular orbital theory to organic systems.
3. draw skeletal structures for organic compounds.
4. apply acid-base concepts to organic systems; predict ordering of acid or base strength.
5. name alkanes, alkenes, polyenes, alkynes, alkyl halides, aromatic compounds, carbonyl compounds, amines and their various derivatives using systematic (IUPAC) nomenclature.
6. draw reaction mechanisms for some key reactions.
7. recognize stereochemistry and be able to apply the Cahn-Ingold-Prelog system to designation of stereochemistry (E/Z or R/S).
8. learn many of the reactions of alkanes, alkenes, polyenes, alkynes, aromatic, carbonyl, and amine compounds, and close related species. Be able to predict reactions involving these functional groups.
9. be able to solve problems employing spectroscopic methods including mass spectrometry, infrared and NMR spectroscopy
10. understand the basic chemical and structural features of biomolecules, including lipids, carbohydrates, amino acids and proteins, and nucleic acids

Outcome:

This course enables the students to acquire knowledge, comprehension and application in numerical problems related to organic chemistry, nomenclature and reactions of alkanes, alkenes, alkynes, dienes, electrophilic aromatic substitution, alcohols, acids, aldehydes and ketones, amines, soaps and detergents.

Syllabus:

Chapter 1:Numerical problems: Determination of percentage composition of carbon, hydrogen and nitrogen, molecular weight determination by depression in freezing point and elevation of boiling point methods, molecular weight of acids by silver salt method; molecular weight of bases by chloroplatinate method, determination of molecular formula of a compound, problems relating to reactions of carboxylic acids, functional derivatives of acids, carbonyl compounds, alcohols, amines, phenols, diazonium salts applications, alkenes and their laboratory tests,

Chapter 2:Nomenclature of alkanes, alkenes, alkynes, dienes, cyclic aliphatic hydrocarbons, structure of benzene, nomenclature of benzene derivatives, arenas, industrial preparation of ethylene, acetylene; sp, sp^2 and sp^3 hybridization; preparation and chemical reactions; conformational analysis of ethane, propane and butane, Wurtz reaction, Diels-Alder reaction, aromaticityMorkovinkov rule, Clemmensen and Wulf-Kishner reduction.

Chapter 3:Electro-philic and nucleo-philic aromatic substitution: Orientation in desubstituted benzenes, mechanism of nitration, halogenation, sulphonation, Friedel-Craft's alkylation and acylation reactions, nomenclature of alkyl halides, preparation and chemical reactions, mechanisms of SN_1, SN_2, E_1, E_2 reactions, nomenclature of aryl halides, preparation and chemical reactions: low reactivity of vinyl and aryl halides, Sandmeyer reaction,

Chapter 4: Nomenclature of alcohols; industrial preparation of ethyl alcohol, preparation and chemical reactions, Lucas test, nomenclature of mono, dicarboxylic acids, industrial preparation of formic, acetic, benzoic, phthalic, salicylic acids, preparation and chemical reactions, mechanism of HVZ reaction and Claisen condensation, nomenclature of functional derivatives of acids, preparation and chemical reactions, mechanism of Hoffmann bromamide reaction, acid and base catalyzed hydrolysis of ester, nomenclature of ethers and epoxides, industrial preparation of ether and ethylene oxide, preparation and chemical reactions; Williamson's synthesis,

Chapter 5:Nomenclature of aldehydes and ketenes: Industrial preparation of formaldehyde, acetaldehyde, benzaldehyde, salicyaldehyde, acetone; preparation and chemical reactions; mechanisms of Cannizaro, Aldol, Reformatsky and Wittig reactions, reactions without mechanisms -Perkin, Cope, Knoevenagel and Pinacol-Pinacolone reactions, difference between aldehyde and ketone, nomenclature of phenols, industrial preparation of phenol, preparation and chemical reactions, mechanisms of Fries rearrangement, Kobe reaction, Reimer-Tiemann reaction, classification of carbohydrates, structure of glucose and fructose, reactions of glucose and fructose, Ruff degradation, Wohls degradation, filiani-Fisher synthesis, glucose into fructose, fructose into glucose, glucose to vitamin-C, mechanism of Osazone formation,

Chapter 6:Nomenclature of amines, industrial preparation of aAniline, preparation and chemical reactions - exhaustive methylation, mechanism of Hoffmann elimination, benzedene rearrangement without mechanism, Hinsberg test, differentiation test using nitrous acid, preparation of diazonium salts and synthetic applications, preparation of sulphanilamide, sulphaguanidine, sulphamerazine, sulphapyridene (sulpha drugs), mode of action of sulpha drugs,

Chapter 7:Preparation of soaps and detergents: Mode of action of soaps, differences between soaps and detergents; preparation of malonic, acetoacetic ester and their synthetic applications, preparation of Grignard reagents and their synthetic applications, preparation of polyethylene, polystyrene, teflon, PVC, polyvinyl cyanide, rubber-vulcanisation, styrene-butadiene rubber, polychloroprene, bakelite, nylon-6 and nylon 6-6, plexiglas, terylene, Ziegler-Natta polymerization, definition of thermoplastics and thermosetting plastics,

Chapter 8:Isomerism: Structural and optical isomerism, geometrical isomerism, E Z configuration, sequence rules, R & S configuration, racemic mixture and their separation, asymmetric synthesis - Fischer projection formula, definitions of axial and equatorial bonds, 1-3-diaxial interaction, enatiomers, diastereomers, mesomers, isomerism in cyclic compounds, chair, boat and twisted boat structures (1-methylcyclohexane, 1, 2-cyclohexane diol), sSynthetic applications of - Zn/Hg, Na-$NH_3$$LiAH_4$, $NaBH_4$, diborane and zinc dust, soda lime, OsO_4, hydroxylamine, acetic anhydride, benzoylchloride and PCl_5.

Reference books:

1. 'Text Book of Organic Chemistry' by Morrison & Boyd
2. 'Text Book of Organic Chemistry' by Bahl&Tuli
3. 'Text Book of Organic Chemistry' by M.K.Jain
4. 'Text Book of Organic Chemistry' by I.L.Finar (Vols.1&2 as **reference books**)

BT 1303 **Material & Energy Balance**
3L-1T-0P-3C

Objective: To give intensive quantitative training in the practical applications of the principles of physical chemistry to the solution of complicated industrial problems and in methods of predicting missing physicochemical data from generalized principles.

Outcome: 1. Able to solve the problems based on stoichiometry, ideal gas and vapor pressure.
2. Able to write and solve material and energy balances for a process.

Syllabus:

Stoichiometry and composition relationships- the gram-mole and pound-mole, limiting reactant, excess reactant, degree of completion, basis of calculation, weight percent, volume percent and mole percent, density and specific gravity- Baume and API gravity scales,

Behavior of ideal gases- application of the ideal-gas law, Dalton and Amagat laws to gaseous mixtures, composition of gases on dry basis and on wet basis,

Vapor pressures- Effect of temperature on vapor pressure, Antoine equation, reference substance vapor pressure plots, vapor pressure of immiscible liquids, ideal solutions and Raoult's law, non-volatile solutes,

Humidity - Percentage saturation, relative saturation or relative humidity, dew point, vaporization, condensation, wet and dry bulb temperatures, adiabatic vaporization and adiabatic saturation temperature,

Material balances- Tie substance, yield, conversion, processes involving chemical reactions, material balance- calculations involving drying, dissolution, and crystallization, processes involving recycle, bypass and purge,

Heat capacities of gases and gaseous mixtures- effect of temperature on heat capacity of gas, mean heat capacity of gas, Kopp's rule, latent heats, heat of fusion, heat of vaporization, Trouton's rule, Kistyakowsky equation for non-polar liquids, estimation of latent heat of vaporization using Classius-Clayperon equation, enthalpy of humid air and humid heat capacity,

Standard heat of reaction - Standard heat of formation, laws of thermochemistry, standard heat of combustion, calculation of heat of formation from heats of combustion, calculation standard heat of reaction from heats of formation and from heats of combustion, standard integral heat of solution, effect of temperature on heat of reaction, Kirchoff's equation, adiabatic and non-adiabatic reactions, theoretical and actual flame temperatures.

Text book:

1. 'Chemical Process Principles, Part-I - Material and Energy balances' by Olaf A Hougen, K.M. Watson and R.A.Ragatz, CBS Publishers and Distributors (1995)

Reference books:

1. 'Basic principles and Calculations in Chemical Engineering' by David M. Himmelblau, Prentice Hall of India Pvt Ltd, 1995
2. 'Stoichiometry' by B.I. Bhatt and S.M. Vora, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi (1996)
3. 'Stoichiometry for Chemical Engineers' by Williams and Johnson, McGraw Hill Publishers.

BT 1304 **Biology**

3L-1T-0P-3C

Objective:

- To study about the cell structure and function.
- To study about the plant structure, functions of various cells in the plants, flower structure, pollination and fertilization.
- To study about the physiological processes in the plant and various methods of plant breeding techniques.
- To study about the general characters of animals- invertebrates, vertebrates.
- To study about the general physiological processes like digestion, respiration, and excretion etc of the animals.

Outcome:

- Students will obtain knowledge in the biological processes occurring in the cells.
- Students will obtain knowledge in the structure of plants, and understand the phenomena of Embryology so that they can acquire knowledge to produce new varieties of plants.
- Students will obtain knowledge in various physiological processes of the plants and they also acquire knowledge in plant breeding techniques.
- Students will obtain knowledge in the general characters of animals and understand the phenomena of reproduction and life cycle of plasmodium vival.
- Students will obtain knowledge in various physiological processes of the animals. Digestion, respiration Excretory system, Nervous system functions are understood to the student so that student can do research in their future studies.

Syllabus:

Cell Biology: Structure and function of prokaryotic and eukaryotic cell, cell organelles, cell membrane, chloroplast, mitochondria, golgi complex, endoplasmic reticulum, lysosomes, ribosomes and nucleus, chromosome structure, mitosis and meiosis,

Plant Biology: Parts of a flowering plant; flower-structure of a typical flower, outline description of floral parts – androecium, gynoecium,

Embryology: Structure of anther, microsporogenesis and development of male gametophyte, structure of ovule, megasporogenesis, development of embryo sac. fertilization, process of fertilization and post fertilization changes,

Anatomy: Structure and function of xylem and phloem, internal structure of dicot root, stem and leaf, monocot root, stem and leaf, secondary growth of dicot stem,

Plant Physiology: Water relations of plants, absorption of water by plants, diffusion, water potential, osmosis, plasmolysis, imbibition, active and passive absorption,
Mineral nutrition: Criteria for essentiality, macro elements (nitrogen, phosphorus and potassium) and microelements,
Photosynthesis: photosynthetic pigments, light reaction-Emerson enhancement effect, photo system I and II, photolysis of water, photophosphorylation, CO_2 fixation – C_3, C_4 and CAM pathway, photorespiration, factors affecting photosynthesis – Blackman's law of limiting factors,
Nitrogen metabolism: Introduction, nitrogen cycle, biological nitrogen fixation,

Plant Growth Regulators: Auxins, gibberellins, cytokinins, abscisic acid and ethylene,

Plant Breeding: Methods of plant breeding: selection, hybridization, hybrid vigor and mutational breeding,

Animal Biology: General characters of invertebrates, morphology, life cycle and reproduction of *Plasmodium Vivax*, general characters of vertebrates.

Animal Physiology: Animal nutrition- modes of nutrition, digestive system of humans and accessory digestive organs, gastrointestinal secretions, digestion, absorption and assimilation of digested products, egestion,

Respiration: Respiration in humans – respiratory system, mechanism of respiration,
Circulatory system: Blood vascular system in humans, blood and its components, heart, pumping action of heart, heart beat and pulse, important blood vessels and course of blood circulation, lymphatic system-lymph, lymph vessels, lymph nodes and lymphatic ducts and pacemakers,

Excretion: Elimination of nitrogenous waste- ammonotelic, ureotelic and uricotelic, structure of human excretory system, structure of urinary system, anatomy of kidney, and structure of nephron,

Nervous system: Structure of neuron, nerve impulse and its conduction, synapse, central nervous system- lobes of brain and its meninges, spinal cord, Peripheral nervous system- Cranial nerves and spinal nerves, autonomous nervous system, sympathetic and parasympathetic nervous system, reflex action, reflex arch of humans.

Text books:

1. 'Biology Text Book for class XI and XII', NCERT.
2. 'AP Academy Text Book for Botany and Zoology, for intermediate

BT 1305 **Cell And Molecular Biology**

3L-1T-0P-3C

Objectives :

1. The main objective is to prepare the students for career in fields that require advance knowledge of cell and molecular biology.
2. With the application of study in cell and molecular biology, the student can also provide services and economic opportunities to the communities.

Outcome:

1. The student can develop basic knowledge and skills in cell & molecular biology and become aware of the complexity and harmony of the cells.
2. The student will be able to conduct research in the frontier and multi disciplinary areas of modern biology.

Syllabus:

The nucleus, chromatin and the chromosome: structure and function of nucleus; organization of genetic material – Packing of DNA into chromatin, Nucleosome organization; Chromosome structure; Cell cycle – Check points, Cdks and regulation.

The biochemical basis of Inheritance: DNA as the genetic material, DNA structure and replication in prokaryotes and eukaryotes – Enzymes involved and mechanism, including replication at telomere.

Genetic code: properties of genetic code, Wobble hypothesis.

Gene Expression: Transcription in prokaryotic and eukaryotic systems – enzymes and factors involved and mechanism; RNA processing in eukaryotes – capping, addition of poly(A) and removal of introns; **Translation** in prokaryotes and eukaryotes – machinery involved and mechanism;

Regulation of gene expression in prokaryotes – Lac operon concept in *E.coli* ; regulation of gene expression in eukaryotes by promoters, enhancers, silencers and transcription factors.

Mutations – Terminology, types of mutations, Biochemical basis of mutants, Mutagenesis, Chemical mutagens - base analogues - Intercalating substances, Physical mutagens- U.V radiation and ionization radiation, AMES test - Repair of DNA damage.

TEXT BOOKS:

1. "The world of the cell" Becker, Klein smith & Hordin, Pearson education

REFERENCE:

1. Molecular cell biology by Lodish et.al . Freeman Publications
2. "Cell & Molecular Biology", De.Roberties. E.D.P., International Edition
3. "Molecular Biology", Friefelder, D., Narosa publications
4. "Molecular Biology of the Gene", J.D.Watson et.al, Banzamin

BT 1306 **Basic Electrical Engineering**
3L-1T-0P-3C

Objectives:

- An understanding of basic EE abstractions depends on analysis and design of electric and magnetic circuits and its elements.
- To provide the students with knowledge of fundamental laws in electrical engineering
- To develop the ability of the students to analyze electrical and magnetic circuits using the basic laws of electrical engineering
- To expose the students to the concepts of various types of electrical machines and application of electrical machines.
- To inculcate the understanding about the AC fundamentals
- To prepare the students to have a basic knowledge of transformers
- To acknowledge about three phase induction motor and its operating principle
- To know about the fundamentals of synchronous motors and its working principle

Outcomes:

After the completion of the course, the student should be able

- To predict the behavior of any electrical and magnetic circuits.
- student will be able to state and explain the basic laws of electromagnetic induction.
- To impart knowledge on Constructional details, principle of operation, types of Electrical Machines performance Characteristics ,speed control methods and its applications
- Ability to conduct experiments on Ac Machines to find its characteristics.
- Abel to calculate performance characteristics of transformer like regulation and efficiency
- The ability to formulate and then analyze the working of synchronous motors
- Able to solve simple problems on synchronous motors

Syllabus:
Magnetic circuits: Definitions of magnetic circuit, reluctance, magneto motive force (mmf), magnetic flux, simple problems on magnetic circuits, hysterisis loss (chapter 8, page nos. 155-175),

Electromagnetic induction: Faraday's laws of electromagnetic induction, induced E.M.F., dynamically induced E.M.F, statistically induced EMF, self inductance, mutual inductance (Chapter 9, page nos. 176-190),

D.C. generators: D.C generator principle, construction of D.C generator, E.M.F equation of D.C generator, types of D.C generators, armature reaction, losses in D.C generator, efficiency,

characteristics of D.C generators, applications of D.C generators (chapter 10, 11, pages 208-238),

D.C. motors: D.C motor principle, working of D.C motors, significance of back, E.M.F, torque equation of D.C motors, types of D.C motors, characteristics of D.C motors, speed control methods of D.C motors, applications of D.C motor, testing of D.C machines, losses and efficiency, direct load test and Swinburne's test (Chapter 12, 13, page Nos. 239-269),

A.C. circuits: Introduction to steady state analysis of A.C circuits, single and balanced 3 phase circuits (chapter 16, page nos. 323-348),

Transformers: Transformer principle, EMF-equation of transformer, transformer on load, equivalent circuit of transformer, voltage regulation of transformer, losses in a transformer, calculation of efficiency and regulation by open circuit and short circuit tests (Chapter 20, page Nos. 423-455),

Three phase inductance motor: Induction motor working principle, construction of 3-phase induction motor, principle of operation, types of 3-phase induction motor, torque equation of induction motor, slip-torque characteristics, starting torque, torque under running condition, maximum torque equation, power stages of induction motor, efficiency calculation of induction motor by direct loading (Chapter 21, page nos. 463-489),

Altemator: Altenator working principle, EMF equation of altenator, voltage regulation by Synchronised impedance method (Chapter 23, page nos. 505-515),

Synchonous motor: Synchronous motor principle of operation, construction, methods of starting of synchronous motor, (Chapter- 24, page nos. 516-526),

Text book:

1. 'Elements of Electrical Engineering & Electronics' by V.K. Mehta, S.Chand & Co.

Reference book:

'A first course in Electrical Engineering' by Kothari.

BT 1308 **Microbiology Laboratory**
0L-0T-3P-2C

List of Experiments:

1. Preparation of Nutrient broth and inoculation of Bacteria.
2. Preparation of Nutrient agar and inoculation of Bacteria
3. Isolation of pure cultures
4. Staining of Microbes- Simple staining, Gram staining, Negative staining, Capsule staining and spore staining.
5. Motility of Microbes.
6. Morphology of Fungi-(*Aspergillus niger)*
7. Morphology of Yeast-(*Saccharomyces cerevisiae*)
8. Bio-chemical tests- IMViC test, Amylase test, Hydrogen Sulphide production test
9. Testing of Microbiological quality of milk.
10. Testing of Microbiological quality of water.
11. Microbial assay of antibiotics.
12. Evaluation of disinfectant.

Text book:

'Microbiology- a Laboratory Manual' by Cappuccino T.G., Sherman N, Addison Wesley.

BT 1310 **Cell and Molecular Biology Laboratory**
0L-0T-3P-2C

Cell biology:

Study of mitosis, meiosis, differential staining of euchromatin and heterochromatin, florescent *in situ* hybridisation - FISH (principle & photographs),

Molecular biology:

Isolation of genomic DNA, quantification of DNA, Agarose gel electrophoresis, isolation of plasmid DNA, restriction digestion, ligation, transformation, southern blotting, isolation and analysis of RNA.

Text books:

1."A Guide to Molecular Cloning", Vol. 1,2 & 3, Sambrook, J. et al., Cold Spring Harbor Laboratory Publications
2. 'Chromosome Techniques' by Sharma & Sharma

2/4 B.Tech (Biotechnology) – Second Semester

BT 1401 **Biochemistry**

3L-1T-0P-3C

Objectives:

- To study about the principles and significance of biochemistry.
- To study about the structure and function of Carbohydrates, Proteins and Aminoacids and Lipids.
- To study about the Nucleic acids like DNA and RNA and also to study about the structure and function of enzymes.
- To study about haemoglobin and chlorophyll molecules and their functions.
- To study about the fat soluble and water soluble vitamins also to study about the structure and function of harmones.

Outcome:

- Student will obtain knowledge in the subject of Biochemistry- study of chemical reactions and processes in living systems
- Students will obtain knowledge in Carbohydrates, Proteins and Amino acids and Lipids. Students will obtain knowledge in quantitative and qualitative analysis of these biomolecules.
- Student will obtain knowledge in nucleic acids-DNA and RNA hereditary materials and also acquire knowledge in enzyme structure and functions.
- Students will obtain knowledge in the basic structure of porphyrins and the detailed structure of haemoglobin and chlorophyll molecules.
- Students will obtain knowledge in the structure and function of vitamins which are necessary for sound health and students will also obtain knowledge in the structure and function of endocrinal glands, which secrete harmones.

Syllabus:

Scope and importance of Biochemistry.

Carbohydrates: Classification, chemistry and properties of monosaccharides (Ribose, Glucose, and Fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (homopolysaccharides and heteropolysaccharides), metabolism of carbohydrates - glycolysis, TCA cycle, electron transport and oxidative phosphorylation, HMP shunt pathway, glycogenesis and glycogenolysis,

Proteins and amino acids: Classification and properties of amino acids and proteins, peptide bond, chemical synthesis of peptides and solid-phase peptide synthesis, structural organization of proteins- primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins,

Lipids: Classification, structure and physiological functions of triglycerides, fatty acids, phospholipids, cerebrosides, gangliosides and cholesterol, digestion and absorption of fats, biosynthesis and degradation of fatty acids and triglycerides,

Nucleic acids: Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides, cellular localization, isolation and estimation of nucleic acids, types of nucleic acids, double helical structure of DNA, types of RNA, biosynthesis and catabolism of purines and pyrimidines,

Enzymes: Introduction, nomenclature and classification of enzymes, kinetic properties of enzymes, factors affecting enzyme action, coenzymes, enzyme inhibition- competitive, non-competitive and uncompetitive inhibitions,

Porphyrins: Chemistry of hemoglobin and chlorophyll, synthesis of heme and chlorophyll and heme catabolism,

Vitamins and hormones: Definition, classification, chemistry, source, functions and deficiency of vitamins, outlines of hormones and their functions,

Text books:

1. "Fundamentals of Biochemistry" by J.L.Jain, S.Chand & Company Ltd, New Delhi
2. "Principles of Biochemistry" by Lehninger, Nelson and Cox, CBS Publications.

BT 1402 **Genetics**

3L-1T-0P-3C

Objectives:

- To introduce Mendel's law of inheritance.
- To introduce interaction of Genes and inheritance.
- To introduce Gene linkage, crossing over and mapping.
- To introduce sex determination & linkage.
- To introduce chromosomes & chromosomal variation.

Outcome:

- To know inheritance, different types of inheritance.
- To know gene interaction. To know about complementary, duplicate genes and interaction between different two gene pairs.
- To know linkage patterns, different cross gene types.
- To know sex determination mechanisms and inheritance of sex linked traits.
- To know different types of cytogenetic effects and numerical changes in chromosomes.

Syllabus:

Mendel's law of Inheritance: Mendel's experiments–Mendels materials, crossing technique, results of Mendel's experiments, phenomenon of dominance, variation in dominance relation, incomplete dominance, co-dominance, principle of segregation-monohybrid cross, mechanism of segregation, monohybrid ratio, principle of independent assortment, Mendels dihybrid cross, mechanism of independent assortment, dihybrid ratio, back cross and test cross, deviations from dihybrid phenotypic ratio,

Interaction of Genes: Interaction of genes-combs in fowls, Epistasis, complementary genes, duplicate genes, additional interactions involving two gene pairs, interaction between more than two gene pairs,

Quantitative / Multiple factor inheritance: Multiple factors, quantitative and quantative traits, examples of quantitative inheritance, Kernel color in wheat, skin color in man, corolla length in tobacco, continuous variations,

Multiple alleles : (Based on classical concept of Allelomorphism): Multiple alleles and isoalleles, skin color in rodents, eye color in *Drosophila*, self sterility in *Nicotiana*, blood groups in humans, complementation test or cis-trans test,

Linkage, crossing over and mapping:

Linkage – coupling and repulsion hypothesis, Morgan's view on linkage, chromosome theory of linkage, kinds of linkage-complete linkage, incomplete linkage, linkage groups, significance of linkage,

Crossing over – Types of crossing over - mitotic and meiotic crossing over, mechanism - synapsis, duplication of chromosomes, crossing over by breakage and union, terminalization,

Molecular mechanism of recombination- Holiday model, cytological basis of crossing over; significance of crossing over,

Construction of a genetic mapping: Two point and three point test crosses and gene mapping, interference and coincidence,

Sex Determination :Genetically controlled sex determining mechanisms, sex chromosomal mechanism of sex determination, types-heterogenetic males, heterogenetic females, genic balance mechanism (X/A ratio in *Drosophila*), sex determination in man (TDF and SRY genes), sex determination in plants; Single gene control of sex; haploid males in hymenoptera; hormonal control of sex, environmental control of sex, dosage compensation (in man and *Drosophila*),

Sex Linkage: Inheritance of sex linked (X-linked) traits-eye color in *Drosophila*, haemophilia and color blindness in human and barred plumage in poultry, inheritance of Y-linked genes, inheritance of XY-linked genes, primary and secondary non-disjunction of sex chromosomes, sex influenced and sex limited traits, sex linked disorders in human beings,

Cytoplasamic Inheritance : Maternal effects-shell coiling in snails, pigment in flour moth, cytoplasmic inheritance involving dispensable heredity units, kappa particles in *Paramecium,* cytoplasmic inheritance by cellular organelles, plastid inheritance in variegated four-o-clock plant, mitochondrial inheritance, male sterility in plants, uniparental inheritance in chlymadomonas,

Chromosomal variations: Origin, types and cytogenetic effects,

Structural changes in chromosomes: Duplications, translocations, inversions (paracentric and pericentric cross over suppressors),

Numerical changes in chromosomes: Aneuploidy (monosomy, nullisomy, trisomy, tetrasomy), euploidy (monoploidy, haploidy, polyploidy-autopolyploids and allopolyploids).

Text books:

1. "Genetics", by P.K.Gupta, Rastogi Publications
2. "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", by P.S. Verma & V.K. Agarwal, S. Chand & Company

Reference book:

a. "Principles of Genetics", by E.J. Gardner, M.J.Simmons & D.Peter Snustard, John Wiley & Sons, INC.

BT 1403 **Bio-analytical Techniques**
3L-1T-0P-3C

Objective: Bioanalysis is a sub-discipline of analytical chemistry covering the quantitative measurement of xenobiotics (drugs and their metabolites, and biological molecules in unnatural locations or concentrations) and biotics (macromolecules, proteins, DNA, large molecule drugs, metabolites) in biological systems. Many scientific endeavors are dependent upon accurate quantification of drugs and endogenous substances in biological samples; the focus of bioanalysis in the pharmaceutical industry is to provide a quantitative measure of the active drug and/or its metabolite(s) for the purpose of pharmacokinetics, toxicokinetics, bioequivalence and exposure–response (pharmacokinetics/pharmacodynamics studies). Bioanalysis also applies to drugs used for illicit purposes, forensic investigations, anti-doping testing in sports, and environmental concerns. Modern drugs are more potent, which has required more sensitive bioanalytical assays to accurately and reliably determine these drugs at lower concentrations. This has driven improvements in technology and analytical methods.

Outcome: At the end of course the students would have learnt about the need of bio analysis and the techniques involve in various instruments which are useful in modern era.

SYLLABUS:

Unit 1: Chromatography- Distribution coefficient, modes of chromatography. Paper, Thin layer, Ion-Exchange and Affinity chromatography. GLC- Principle, sample preparation, apparatus, detectors types and applications. HPLC- Principle, Components and applications.

Unit 2: Electrophoresis- General principles, support media and applications. SDS-PAGE, Isoelectric focusing, Agarose gel electrophoresis, capillary electrophoresis. Centrifugation- Principle of sedimentation, sedimentation coefficient, Preparative and Analytical centrifuges, Ultracentrifuge. Differential centrifugation, density gradient centrifugation. Applications- in determination of molecular mass, purity and conformation of macromolecules.

Unit 3: Radioisotope techniques- Detection and measurement of radioactivity. Gas ionization, Excitation of solids and solutions, Autoradiography, Application in biological sciences- Metabolic pathways, turn over time determination, isotope dilution analysis, radiodating, clinical diagnosis and sterilization and tracer techniques. Biosensors- Principle and applications of Electrochemical, Thermometric, Optical and Peizoelectric Biosensors.

Unit 4: UV Visisble Spctroscopy- Principle, Beer-Lamberts law, Instrumentation of Single and Double beam spectrophotometers. Bathochromic and hypsochromic shifts and applications. Turbidometry and Nephlometry- Principles and Applications. Infra red and Raman Spectroscopy- Principles and Applications. Spectrofluorimetry- Principle and Applications.

Unit 5: ESR Spectroscopy- Principle, Hyperfine splitting, Instrumentation and applications. NMR Spectroscopy- Principle, Theory of Proton Magnetic resonance and Instrumentation. NMR parameters- Chemical shifts, spin-spin splitting, Intensity and line width and applications- Magnetic resonance imagning. Mass spectroscopy- Principle, Instrumentation, Ionization techniques, Electron impact and chemical Ionization, Ion desorption and evaporation methods, Magnetic and electric sector analyzers, detectors (Faraday cup). X-ray crystallography- Principle, Braggs equation, determination of crystal structure-Rotating crystal method and Powder method, and applications.

Reference book:

Practical Biochemistry- Principles and techniques- by Keith Wilson and John Walker.

Text book:

Biophysical techniques, by K.Upadhyay, A. Upadhyaya and N.Nath. Himalaya publishihng house.

BT 1404 **Managerial Economics**

(Common for all 1/4 B.Tech and 1/6 B.Tech + M.Tech Branches)

3L-1T-0P-3C

Unit -I

Significance of Economics and Managerial Economics:

Economics: Definitions of Economics- Wealth, Welfare and Scarcity definition Classification of Economics- Micro and Micro Economics. **(Two periods)**

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines. **(Four periods)**

Demand Analysis : Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve. **(Two periods)**

Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand. **(Four periods)**

Demand Forecasting - Need for Demand forecasting, Factors governing demand forecasting, Methods of demand forecasting: Survey methods- Experts' opinion survey method and consumers Survey methods. **(Four periods)**

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations**.** **(Two periods)**

Unit -II

Theory of Production and Cost analysis:

Production - Meaning, Production function and its assumptions, use of production function in decision making; Law of Variable Proportions: three stages of the law.

(Four periods)

Cost analysis - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. unavoidable costs, Economies and Diseconomies of scale. **(Four periods)**

Unit -III

Market Structures : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition. **(Four periods)**

Unit -IV

Pricing Analysis : Pricing - Significance: Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark- down pricing of retailers.

(Four periods)

Unit -V

Business cycles, Inflation and Deflation:

Business cycles - Definition , Characteristics , Phases, Causes and Consequences; Measures to solve problems arising from Business cycles. **(Four periods)**

Inflation -Meaning, Types, Demand- pull and Cost push inflation, Effects of Inflation, Anti-inflationary measures. **(Four periods)**

Deflation- Meaning, Effects of Deflation, Control of Deflation, Choice between Inflation and Deflation. **(Two periods)**

Text Books:

1. Sankaran,S., **Managerial Economics,** Marghan Publications, 2015, Chennai.
2. Aryasri, A.R., **Managerial Economics and Financial Analysis,** MC Graw Hill Education, New Delhi,2015.

Reference Books:

1. Dwivedi, D.N., **Managerial Economics,** Vikhas Publishing House Pvt. Ltd. 6th Edition, New Delhi,2004.
2. Dewett, K.K., **Modern Economic Theory**, S.Chand & Company Ltd., New Delhi, 2005.

BT 1405 **Fluid Mechanics and Heat Transfer**
3L-1T-0P-3C

The main objectives are to provide:

1. Knowledge on pressure distribution in static fluids.
2. Knowledge on rheological behavior of fluids, types of fluid flow, boundary layers and basic equations of fluid flow.
3. Knowledge of incompressible fluid flow in pipes
4. Knowledge on pipes, fittings, transportation and metering devices.
5. Knowledge on conduction, convection and radiation
6. Knowledge on heat flow by conduction and heat flow in fluids.
7. Knowledge on heat exchange equipment.

Outcome:

1. Able to estimate the pressure drop.
2. Enhance the flow by reducing boundary layer separation.
3. Estimating the pumping capacity and friction losses of flowing fluids.
4. Able to select pumps based on their performance.
5. Able to select proper measuring device and estimate the quantity of flow.
6. Able to solve heat transfer problems.
7. Able to design heat transfer equipment.

Syllabus:

Dimensional Analysis: Units and Dimensions, Dimensional Homogeneity, Dimensional Analysis, Buckingham π theorem, Geometric similarity, kinematic similarity, and dynamic similarity.
Fluid statics and applications: Nature of fluids, Hydrostatic Equilibrium, Applications of fluid statics – Manometers, continuous gravity decanter and centrifugal decanter.
Fluid Flow phenomena: Laminar flow, shear rate, shear stress. Rheological properties of fluids – Newtonian fluids, Non Newtonian fluids, time dependent flow, viscoelastic fluids. Viscosity, Reynolds number, Turbulence - nature of turbulence. Boundary layers - boundary layer formation over flat plate, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary layer formation in straight tubes, boundary layer separation and wake formation.
Basic Equations of Fluid Flow: Continuity equation (Mass Balance in a flowing fluid), equation of motion (Differential Momentum Balance), Navier - stokes equations, Euler's equation, Couette flow, Macroscopic Momentum Balance, layer flow with free surface, Bernoulli equation (Energy equation), corrections for effect of solid boundaries and pump work.

Incompressible flow in pipes and channels : Shear Stress and skin friction in pipes, Relation with skin friction and wall shear, Friction factor, relations between skin friction parameters, equivalent diameter, laminar flow in pipes and channels, velocity distribution, average velocity, Kinetic energy correction factor and momentum correction factor for laminar flow, Hagen-Poiseuille equation, laminar flow of non-Newtonian liquids, laminar flow in annulus. Turbulent flow in pipes and channels, Velocity distribution for turbulent flow, effect of roughness, friction factor chart, drag reduction, friction from changes in velocity or direction – sudden expansion, sudden contraction, pipe fittings, friction losses in Bernoulli equation, velocity heads, separation of boundary layer in diverging channel, minimizing losses.

Transportation of Fluids: Pipes, fittings, valves, positive displacement pumps (reciprocating, rotary and peristaltic pumps), centrifugal pumps

Metering of fluids: Full bore meters – Venturi meter, Orifice meter, Rotameters, Pitot Tube, Open orifice and V-notch.

HEAT TRANSFER

Nature of heat flow - Conduction, convection and radiation

Heat transfer by Conduction: Basic law of conduction, thermal conductivity, steady state conduction, compound resistances in series, heat flow through a cylinder and a sphere, unsteady state conduction – one dimensional heat flow with constant surface temperature.

Principles of heat flow in fluids: countercurrent and parallel flows, energy balances, heat flux and heat transfer coefficients, overall heat transfer coefficients, LMTD, individual heat transfer coefficients, fouling factor.

Heat exchange equipment: condenser, heat exchanger, evaporator, boilers and calendears

Heat transfer to fluids without phase change: boundary layer, prandtl number, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, Natural convection.

Text Books:

1. "Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

Reference Books:

1. "Introduction to Chemical Engineering" by W L Badger and J T Banchero, Tata Mc Graw Hill

BT 1406 **Environmental Science**
3L-0T-0P-0C

Objective: The main objective of this course is to understand the importance of the environment, various sources of pollution, impact of pollution on environment, social issues related to the atmosphere.

Outcome: At the end of course the students would have learnt about the ecosystems, different sources of land, energy, water, forest. Different types of environmental issues with their causes are also discussed. Social issues affecting the environment along with different case studies will be explored.

SYLLABUS:

MODULE-1 INTRODUCTION

Definition, scope and importance; measuring and defining environmental development: indicators.

MODULE-2 ECOSYSTEMS

Introduction, types, characteristic features, structure and functions of ecosystems-Forest, grassland, desert and aquatic(lakes, rivers and estuaries)

MODULE-3 ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT

Land resources-land as a resource, common property resources, land degradation, soil erosion and desertification, effects of modern agriculture, fertilizers-pesticides problems

Forest resources- Use and over exploitation, mining and dams- their effects on forest and tribal people

Water resources- Use and over utilization of surface and ground water, floods, droughts, water logging and salinity, dams- benefits and costs, conflicts over water

Energy resources- Energy needs, renewable and non renewable energy sources, use of alternate energy sources, impact of energy use on environment.

MODULE-4 BIODIVERSITY AND ITS CONSERVATION

Value of biodiversity- Consumptive and productive use, social, ethical, aesthetic and option values, bio-geographical classification of India- India as a mega diversity habitat, threats of biodiversity- in-situ and ex-situ conservation

MODULE-5 ENVIRONMENTAL POLLUTION- LOCAL AND GLOBAL ISSUES

Causes, effects and control measures of- air, indoor air, water, soil, marine, noise pollutions, solid waste management, composting, vermiculture, urban and industrial wastes, recycling and re-use, nature of thermal pollution and nuclear hazards, global warming, acid rain, ozone depletion.

MODULE-6 ENVIRONMENTAL PROBLEMS IN INDIA

Drinking water, sanitation and public health, effects of activities on the quality of environment- urbanization, transportation, industrialization, green revolution, water scarcity and ground water depletion, controversies on major dams- resettlement and rehabilitation of people: problems and concerns, rain water harvesting, cloud seeding and watershed management.

MODULE-7 ECONOMY AND ENVIRONMENT

The economy and environment interaction, economics of development, preservation and conservation, sustainability: theory and practice, limits to growth, equitable use of resources for sustainable life styles, environmental impact assessment

MODULE-8 SOCIAL ISSUES AND THE ENVIRONMENT

Population growth and environment, environmental education, environmental movements, environmental vs development

MODULE-9 INSTITUTIONS AND GOVERNANCE

Regulation by government; monitoring and enforcement of environmental regulation; environmental acts, water(prevention and control of pollution) act, air(prevention and control of pollution) act, environmental protection act, wild life protection act, forest conservation act, coastal zone regulations; institutions and policies relating to India; environmental governance.

MODULE-10 INTERNATIONAL CONVENTIONS

Stockholm conference 1972, earth summit 1992, world commission for environmental development(WCED).

MODULE-11 CASE STUDIES

Chipko movement, narmada bachao andolan, silent valley project, Mathura refinery and taj mahal, industrilisation of pattancheru, nuclear reactor at nagarjuna sagar, their dam, ralegaon siddhi(anna hazare), kolleru lake- aqua culture, flourosis in AP

MODULE-12 FIELD WORK

Visit to local area to document and mapping environmental assests- river/forest/grassland/hill/mountain; study of local environment- common plants, insects, birds; study of simple ecosystems- pond, river, hill, slopes, etc; visit to industries, water treatment plants, effluent treatment plants.

TEXT BOOK:

1. Environmental Studies by Anubha Kaushik & C.P. Kaushik
   Second Edition, New Age International (P) Limited.

BT 1408 Biochemistry and Bio-analytical Laboratory
0L-0T-3P-2C

1. Estimation of total Carbohydrates
2. Estimation of Proteins
3. Estimation of Lipids and of Cholesterol
4. Assay of Enzymes- Amylase. Determination of its K_m value
5. Estimation of DNA, Determination of T_m of DNA
6. Paper chromatography of sugar
7. Thin layer chromatography of lipids
8. Ion exchange chromatography for biomolecules separation
9. Electrophoresis of proteins and determination of their molecular weight by SDS-PAGE
10. Estimation of turbidity by Nephlometer
11. Separation of biomolecules by GLC

Text books:

1. 'Introduction to Practical Biochemistry', by Plummer, Tata Mc-Graw Hill
2. 'Practical Biochemistry', by Sawhney
3. 'Laboratory Manual in Biochemistry' by J.Jayaraman, New Age International

BT 1410 **Fluid Mechanics Laboratory**
0L-0T-3P-2C

1. Discharge through an open orifice
2. Venturi meter
3. Orifice meter
4. V- Notch
5. Rotameter
6. Bernoullis theorem
7. Friction factor
8. Centrifugal pump
9. Reciprocating pump
10. Reynolds apparatus

3/4 B.Tech (Biotechnology) - First Semester

BT 1501 **Biostatistics**
3L-1T-0P-3C

Objectives :

To make them understand about the Introduction of bioinformatics, Moments like skewness and kurtosis, correlation, Probability distribution and sampling theory, Sampling Theory: sampling, random sampling, parameters and statistic, objectives of sampling and Numerical solutions of PDEs.

Outcome:

- Able to know about collection and classification of data, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion.
- Acquiring knowledge on the empirical relation between measures of dispersion, standard deviation of combined samples.
- Acquiring knowledge about coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation.

Syllabus:

Introduction, collection and classification of data, graphical representation, histogram, frequency polygon and cumulative frequency curve, comparison of frequency distributions, measures of central tendency, mean, median and mode, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion – range, quartile deviation or semi-inter quartile range, mean deviation, root mean square deviation, standard deviation, variance, coefficient of variation, empirical relation between measures of dispersion, standard deviation of combined samples

Moments, skewness and kurtosis, correlation, scatter diagram, coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation

Probability distribution and sampling theory: Random variable both discrete and continuous, probability distribution both discrete and continuous, cumulative distribution, expectation, variance, standard deviation, moment generating function, binomial distribution, constants of binomial distribution, mean, standard deviation, skewness and kurtosis, fitness of a binomial distribution, Poisson distribution, constant of poisson distribution, mean, standard deviation, skewness and kurtosis – fitting of a poisson distribution, normal distribution, standard normal distribution, propertive normal distribution, probability error, fitting of normal distribution, **Sampling Theory:** sampling, random sampling, parameters and statistic, objectives of sampling, sampling distribution, standard error, testing of hypothesis, errors, null hypothesis, level of significance, testing significance, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples, test of significance for means of two large samples, sampling of variables, small samples, number of degrees of student t-distribution, significance test of difference between sample means, f-distribution, Fisher's z-distribution, Chi-square distribution

Numerical solutions of PDEs – Elliptic (Liebmann iteration process), Parabolic (Schmidt explicit formula), Hyperbolic and Poisson's equations (Gauss – siedel method)

TEXT BOOKS:

Higher engineering mathematics by B.S.Grewal

REFERENCES:

1. Numerical methods for Scientific and Engineering Computation by M.K.Jain, S.R.K.Iyengar, R.K.Jain, and Publishers New age international (P) Ltd. New Delhi
2. Probability, Statistics and random process by T. Veerarajan, Tata McGraw Hill.
3. Probability, Statistics with Reliability, Queing and Computer Science Application by Kishore S. Trivedi

BT 1502 **Mass Transfer**

3L-1T-0P-3C

Objectives:

- To explain the students with the basic principles of mass transfer operations and other separation processes with examples.
- To impart knowledge on how certain substances undergo the physical change with diffusion/mass transfer of components from one phase to other phases.
- To describe the students with equipment used in operations involving mass transfer and other separation processes and their advantages and disadvantages.
- To focus on absorption and distillation operations and the process design aspects of the same operations.
- To provide the knowledge on humidification and dehumidification operations and their applications in real situations

Outcome:

- An ability to define the basic principles of mass transfer operations and other separation processes
- An ability to identify the basic techniques for measurement of diffusivity, mass transfer coefficient, evaporation rate,
- An ability to understand the importance of mass transfer phenomena in the design of process equipment in distillation operation
- An ability to understand the VLE concepts and application to different distillations
- An ability to identify the major parts of various mass transfer equipment
- An ability to understand the design of sizing of packed columns in absorption and plate columns in distillation
- An ability to understand the importance of humidification and dehumidification processes and their industrial applications

Syllabus:

Introduction: Mass transfer Operations.

Molecular diffusion in fluids: Binary solutions, Fick's law, equation of continuity, Steady state equimolal counter current diffusion, Stefan's diffusion, estimation of diffusivity of gases and liquids, application of molecular diffusion.

Mass transfer coefficients: Mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlations for mass transfer coefficients in simple situations, diffusion in solids.

Interphase mass transfer: Concept of equilibrium, diffusion between phases, two resistance theory, material balances in steady state co-current and counter-current stage processes, Murphy stage efficiency.

Equipment for gas-liquid operations: Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, tray towers, sieve tray for absorption and distillation, venturi scrubbers, spray towers and spray chambers, packed towers for absorption and distillation, tray towers versus packed towers.

Absorption: Solubility's of gases in liquids, two component systems, multi-component systems, ideal and non-ideal solutions, choice of solvent for absorption, single component absorption material balances, counter current multistage operations, dilute gas mixtures, on-isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single operation absorption with chemical reaction.

Distillation: Principles of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe-Thiele method, Ponchon-Savarit method, tray efficiencies, introduction to multi-component distillation, azeotropic and extractive distillations.

Text book:

1. Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co.,

Reference books:

1."Unit Operations in Chemical Engineering" by McCabe,W.L.,Smith,J.C.and Harriot,P., 5th Edition, McGraw-Hill Book Co.,

2. "Chemical Engineering Hand Book" by J.H. Perry.

BT 1503 **Enzyme Engineering**
3L-1T-0P-3C

Objectives:

- Improvement in the activity and usefulness of an existing enzyme or creation of a new enzyme activity by making suitable changes in its amino acid sequence is called enzyme engineering. When this approach is used to modify the properties of any protein, whether enzyme or non-enzyme, it is termed as protein engineering.
- Since enzymes are proteins, enzyme engineering is a part of the larger activity of protein engineering. Enzyme engineering utilizes recombinant DNA technology to introduce the desired changes in the amino acid sequences of enzymes.
- Recombinant DNA technology is also used to transfer genes encoding useful enzymes from dangerous, unapproved, slow growing or low producing microorganisms into safe, fast growing and high producing microorganisms. In addition, the level of production of an enzyme may be increased by introducing more copies of the gene into the concerned organism.
- The recombinant strain produced the enzyme in considerably higher quantities than did the original/parent strain, which reduced production costs and enhanced enzyme purity. For the present, such applications of recombinant DNA technology are likely to be much more fruitful as well as numerous than that for modifying amino acid sequences of enzymes. But it should be kept in mind that these are not examples of enzyme or protein engineering, which must rest on modification of the amino acid sequence of the concerned enzyme or protein.

The chief objective of enzyme engineering is to produce an enzyme that is more useful for industrial and/or other applications.

The various properties of an enzyme that may be modified to achieve this objective are as follows:

1. Improved kinetic properties
2. Elimination of allosteric regulation
3. Enhanced substrate and reaction specificity
4. Increased thermostability
5. Alteration in optimal pH
6. Suitability for use in organic solvents
7. Increased/decreased optimal temperature
8. Modification of substrate specificity
9. Increased stability to oxidizing agents
10. Improved stability to heavy metals
11. Resistance to proteolytic degradation
12. Fusion of two or more enzymes to create bi- and poly-functional enzymes.

Outcome:

After passing the course, the student should be able to:

- describe design of enzymatic reactions based on kinetic principles, also updated vision of the potentials and limitations of biocatalysis, especially with respect to recent applications in processes of organic synthesis.

- describe the classification of enzymes, their sources, production and purification methods for an enzyme, also the application of enzymes in various sectors
- describe basic principles of enzyme structure and function to reactor design for homogeneous systems with soluble enzymes and heterogeneous systems with immobilized enzymes.
- explain the key structural and energetic factors which give rise to increased enzyme stability important for industrial application.
- research a contemporary application of enzyme technology or metabolic engineering and present the results in a well-structured oral presentation.
- describe methods for selection and optimization of industrial enzymes using genetic and biochemical techniques.
- summarize current processes involved in industrial enzyme production, from protein production to purification and formulation.

Syllabus:

Introduction: Catalysis and biocatalysis, enzyme structure functionality and relationship, enzyme activity, classification of enzymes, enzymes as process catalysts,

Enzyme Production: Enzyme sources, synthesis, recovery, purification, and formulation of enzymes,

Homogeneous Enzyme Kinetics: Hypothesis of enzyme kinetics, rapid equilibrium and steady-state hypothesis, determination of kinetic parameters, various types of kinetic inhibition, reactions with more than one substrate, effect of environmental variables- pH, temperature, and ionic strength,

Heterogeneous Enzyme Kinetics: Various methods of enzyme immobilization, mass transfer effects in heterogeneous biocatalysis, partition effects, external (film) diffusion, internal (pore) diffusion,

Enzyme Reactors: Design of ideal reactors with enzymes (Batch, CSTR, PFR), effect of diffusion on enzyme reactor design, effectiveness factor, effect of thermal inactivation and mass transfer limitation on design and performance of enzyme reactors,

Application of Enzymes: Application in biosensors, Food processing applications, Medical and pharmaceutical applications.

Text books:

1. "Enzyme Biocatalysis: Principles and Applications' by A.Illanes, Springer
2. "Enzyme Technology" by M.F.Chaplin and C.Bucke, Cambridge University press, 1990. (Website for the book, www:lsbu.ac.uk/biology/enztech/)

Reference books:

1. "Biocatalysts and Enzyme Technology" by K. Buchholz,V. Kasche and U.T. Bornscheur, Wiley,2005
2. "Enzyme Technology", by Shanmugam,S. and Satish Kumar,T.,IK International Pvt. Ltd, New Delhi, 2008
3. "Biochemical Engineering Fundamentals' by Bailey,J.E., and Ollis,D.F., Mcgraw-Hill,1986.
4. "Bioprocess Engineering", 2nd edition, by Shuler and Kargi, Prentice-Hall

BT 1504 **Thermodynamics**
3L-1T-0P-3C

Objective: To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and to predict phase equilibria and chemical reaction equilibrium.

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

- Understand the laws of thermodynamics
- Understand the degrees of freedom and phase & chemical reaction equilibria
- Calculate thermodynamic parameters involved in biochemical reactions
- Differentiate between ideal and non-ideal solutions

Syllabus:

The first law and other basic concepts : Joule's experiments, internal energy, the first law of thermodynamics, thermodynamics state and state functions, enthalpy, the steady state, Steady flow process, equilibrium, the phase rule, the reversible process, constant V and constant P processes, heat capacity.

Heat effects: Sensible heat effects, internal energy of ideal gases, microscopic view, latent heats of pure substances, standard heat of reaction, standard heat of formation, standard heat of combustion.

The second law of Thermodynamics: Statement of the second law, heat engines, thermodynamic temperature scales, ideal gas scale, entropy, entropy changes of an ideal gas, mathematical statement of second law, the third law of thermodynamics, entropy from the microscopic view point.

Thermodynamic properties of fluids : Property relations for homogeneous phases, residual properties, Solution thermodynamics : partial properties, concepts of chemical potential and fugacity, ideal and non-ideal solutions, Gibbs-Duhem equation, excess properties of mixture, activity coefficients, activity coefficients correlations.

Criteria for phase equilibria: Vapour-liquid equilibrium calculations for binary mixtures, Liquid-liquid equilibria and solid liquid equilibria, Chemical reaction equilibria.

Biochemical thermodynamics : Energetics of metabolic pathways, Energy coupling (ATP & NADH), Energetic analysis of cell growth and product formation. Thermodynamics of microbial growth, oxygen consumption and heat evolution in aerobic cultures, energy balance equation for cell culture, reaction thermodynamics.

Text books:

1. Introduction to Chemical Engineering Thermodynamics by J.M. Smith, H.C. Van Ness and M.M. Abbott, 6th Ed. McGraw-Hill, 2000.
2. Kinetics and Energetics in Biotechnology, J.A. Roels, Elsevier, 1983.

Reference Book :

1. Chemical Engineering Thermodynamics, Y.V.C. Rao, University Press.

BT 1505 (A) **Food Technology (Elective - I)**
3L-0T-0P-3C

Objective: To identify Pathogenic and spoilage microorganisms in foods, the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow, the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods, laboratory techniques to identify microorganisms in foods, beneficial microorganisms in food systems ,understand the principles involving food preservation via fermentation processes, influence of the food system on the growth and survival of microorganisms, understand the role and significance of microbial inactivation, adaptation and environmental factors (i.e., pH, temperature) on growth and response of microorganisms in various environments, Understand the principles involving food preservation via fermentation processes.

Outcome: At the end of the course the students must be able to identify the conditions, including sanitation practices, under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.

SYLLABUS:

Food processing and preservation: Biotechnology in relation to the food industry, nutritive value of the food, types of microorganisms associated with the food, food colors and flavors, enzymes and chemicals used in food processing, food preservation.

Fermented food products: Microbial culture used in food industry, fermentation technology for food industry & waste utilization. Bioprocessing and fermentation of meat, vegetables, fruits, dairy products, non-beverage plant products, beverages and related products of baking,

Food spoilage and Food Microbiology: Food spoilage, food borne illness, food quality and quality control, HFCS (High Fructose Corn Syrup), single cell protein production,

Food processing operations: Food engineering operations: characteristics, cleaning, sorting and grading of food raw materials, food conversion operations, size reduction, mixing, emulsification, filtration, membrane separation, centrifugation, extraction, and crystallization, microwave heating, thermal inactivation of microorganisms, freezing and thawing of foods,

Text books:
"Biotechnology: Food fermentation", by V.K. Joshi & Ashok pandey.
"Food processing and preservation", by B. Sivasankar

Reference books:
I. "Food Biotechnology", by Roger Angold, Gordon Beech & Taggart 2. "Basic Food Microbiology", by George J Banward, CBS publishers
"Modern Food Microbiology", by James M Jay, CBS publishers.

BT 1505 (B) **Process Optimization (Elective I)**
3L-0T-0P-3C

Basic Concepts of Optimization: Introduction to process optimization; continuity of functions, unimodal versus multimodal functions, convex and concave functions, convex region, necessary and sufficient conditions for an extremum of unconstrained function, interpretation of the objective function in terms of its quadratic approximation,

Optimization of unconstrained Functions - One-dimensional Search: Numerical methods for optimizing a function of one variable, scanning and bracketing procedures; Newton, quasi-Newton and secant methods of unidimensional search, Newton's method, quasi-Newton method, secant method,

Region Elimination Methods, polynomial approximation methods - quadratic interpolation, cubic interpolation, how the one-dimensional search is applied in a multidimensional problem, evaluation of unidimensional search methods,

Unconstrained Multivariable Optimization: Direct methods- random search, grid search, univariate search, simplex method, conjugate search directions, Powell's method, indirect methods first order - gradient method and conjugate gradient method, indirect method second order – Newton's method,

Linear Programming and its Applications: Basic concepts in linear programming, degenerate LP's – graphical solution, natural occurrence of linear constraints; the Simplex method of solving linear programming problems,

Nonlinear Programming with Constraints: Lagrange multiplier method, necessary and sufficient conditions for a local minimum, generalized reduced-gradient method, random search methods, and comparative evaluation of different methods,

Global Optimization: Overview of genetic algorithm, simulated annealing and other global optimization methods, heuristic search methods.

Text book:

1."Optimization of Chemical Processes", 2nd Edition, by T.F.Edgar, D.M.Himmelblau and L.S.Lasdon McGraw-Hill, 2001.

Reference books:

1. "Applied Optimization with MATLAB" by . P.Venkataraman, John Wiley
2.'Optimization for Engineering Design' by K.Deb, Prentice Hall of India Private Limited, New Delhi, 2003
3. 'Engineering Optimization', 3rd Edition, by S.S. RaoWiley, 1996.

BT 1505 (C) **Energy Engineering (Elective-I)**

3L-0T-0P-3C

Conventional energy sources: The present and scope for future development, _ utilization of coal, formation, analysis, classification, storage and carbonization, byproduct recovery,

Petroleum: Origin, classification, single and multi-stage fractionation, reforming, catalytic cracking, specification of kerosene, motor gasoline and fuel oils, liquified petroleum gas and nature gas, composition, properties and uses,

Non-conventional energy sources: Solar radiation, principles of heating, cooling and photo-voltaic cells,

Biogas production: Biomass, wind energy, tidal and wave energy, geothermal energy, nuclear energy, ocean thermal energy, hydrogen energy,

Fuel cells: Storage of energy, types - water storage, packed bed storage, solar storage, chemical storage, phase change storage, mechanical energy storage and windmill storage.

Text books:

1. "Fuels and Combustion", by S. Sirkar, Orient Longmans, 2nd Ed.
2. "Solar Energy, Thermal Storage", by S.P. Sukhatme, TMH
3. "Non-conventional Energy Sources", by G. D. Rai, Khanna Publications.

BT 1505 (D) **Systems Biology (Elective- I)**

3L-0T-0P-3C

Introduction: Basic principles of systems biology, experimental techniques,

Standard models and approaches: Metabolism- enzyme kinetics and thermodynamics, metabolic networks, metabolic control analysis,

Biological processes: Signal transduction- introduction, function and structures, interactions, structural components, signaling selected biological processes,

Evolution: Introduction, mathematical models, prediction of biological systems, data integration,

Applications: Systems biology in various fields, databases and tools, modeling tools.

Text books:

1. "Systems Biology in Practice-Concepts, Implementation and Application" by Edda Klipp and Ralf Herwig, Wiley VCH, I Edition
2. "Systems Biology: Definitions and Perspectives" by Lilia Alberghina and Hans V. Westerhoff, Springer, 2005.

Reference books:

1. "Systems Biology: Principles, Methods, and Concepts" by Andrzej K. Konopka, CRC Press, 2006
2. "Stochastic Modelling for Systems Biology" *by* Darren James Wilkinson, CRC Press, 2006.

BT 1506 **Down Stream Processing**

3L-1T-0P-3C

Objectives:

The course will help to:

1. Learn the fundaments of downstream processing
2. Understand the principle, working and application of major unit operations in Bioprocessing of industrially important products.
3. Understand strategies for development of novel Bioprocessing protocol by applying the concise principles of downstream processing.

Outcome: On completion of this course student will have improved ability:-

1. To better understand the applied concepts of downstream processing.
2. To execute precise and efficient bioseparation process, which in cost effective and yield high degree of pure substance.
3. To develop novel bio separation process which is gives high resolution, economical bioproducts.

Syllabus :

SEPARATION OF INSOLUBLE PRODUCTS: Filtration, centrifugation (batch, continuous, basket), Coagulation and flocculation, gravity sedimentation, settling, decanting.

CELL DISRUPTION: Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), Chemical methods (alkali, detergents), Enzymatic methods.

SEPARATION OF SOLUBLE PRODUCTS: Extraction, precipitation, adsorption, dialysis, reverse osmosis, ultra filtration, Cross- flow ultra filtration and micro filtration, electrophoresis, gel exclusion chromatography, ion exchange chromatography, electro dialysis.

PRODUCTS PURIFICATION & POLISHING: Crystallization, drying and pervaporation.

ADSORPTION: Theory of adsorption, industrial adsorbents, adsorption equilibria, freundlich equation, single and multi stage operations, unsteady state adsorption, equipment for single stage and continuous contact, ion- exchange.

TEXT BOOKS:

1) “Bioprocess Engineering” by Michael L.Shuler Fikret Kargi, Prentice Hall of India
2) “Bioseperations – downstream processing for Biotechnology”, by paul A belter and E.L.cussler.

REFERENCE BOOKS:

1) "Biochemical engineering fundamentals" 2nd ed. by J E Bailey and D Ollis, McGraw-Hill (1986).
2) "Bioseperations–principles & techniques” by B.Siva sankar.
3) "Priniciples of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press (1984).

BT 1508 **Unit Operations laboratory**

0L-0T-3P-2C

1. Emissivity measurement apparatus
2. Natural Convection
3. Forced Convection
4. Pin Fin Apparatus (Natural Convection)
5. Pin Fin Apparatus (Forced Convection)
6. Liquid-Liquid Extraction
7. Solid –Liquid Equilibrium
8. Hydrodynamic Studies in Sieve tray tower
9. Ternary – Liquid Equilibrium
10. Single drop Liquid – Liquid equilibrium

BT 1510 Down Stream Processing Laboratory
0L-0T-3P-2C

1. Cell Disruption by Sonication
2. Cell Disruption by Enzymatic Reaction
3. Centrifugal Separation- Ultra Centrifugation, Gel Filtration
4. Micro filtration
5. Ultra filtration
6. Aqueous Two-phase Extraction
7. Dialysis
8. Ammonium Sulphate Precipitation
9. Isoelectric Precipitation
10. Affinity Chromatography
11. Ion Exchange Chromatography
12. Gas Chromatography
13. Adsorption Chromatography.
14. Gel Exclusion Chromatography
15. Crystallization
16. Freeze Drying.

BT 1512 **Slot for MC (Constitution of India)**

3L-0T-0P-0C

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

3/4 B.Tech (Biotechnology) – Second Semester

BT 1601 **Chemical Reaction Engineering**
3L-1T-0P-3C

Objectives:
To learn principles of rate law and stoichometry. Isothermal reactor- Batch, plug flow reactor nd mixed flow reactor.

Outcome: The student learns the design of homogeneous reactors

Syllabus:

Introduction and overview of the subject, kinetics of homogeneous reactions, non elementary reactions, Arrhenius relation, Collision theory and Transition-state theory, various methods of analyses of batch reactor data obtained for various types of reactions including variable volume and variable pressure data .

Isothermal batch reactor design, **Homogeneous flow reactors**: Design equation for plug flow reactor (PFR) and continuous stirred tank reactor (CSTR), data analysis in flow reactors, space time, space velocity, recycle reactor, cascade of CSTRs and combination for PFR and CSTR.

Text book:

1. Chemical Reaction Engineering' by Octave Levenspiel, 3rd Edition, John Wiley & Sons, 1999

Reference books:
1. Elements of Chemical Reaction Engineering by H. S. Fogler, 3rd Edition, Printice Hall International, 2000
2. Chemical Engineering Kinetics by J. M. Smith, 3rd Edition, McGraw Hill, 1981

BT 1602 Engineering Economics & Bioprocess Design
3L-1T-0P-3C

Objectives:

- To introduce bioprocess design with its basic function of a bioreactor.
- To study the construction of bioreactor.
- To introduce the basic fundamentals such as aeration and agitation used in fermentation industrial.
- Designing of fermentation vessels and problems related to scale up of microbial processes.
- Engineering economics deals with value of money equivalence and depreciation.

Outcome:

- Fundamentals concepts of bioprocessing
- Bioprocess design and operation.
- Ability to design of fermentation vessels.
- To understand the value of money equivalence and depreciation.

Syllabus:

Engineering Economics:

Value of money equivalence: Value of money, equations for economic studies, equivalence, types of interest, discrete, continuous, annuities: relation between ordinary annuity and the periodic payments, continuous cash flow and interest compounding, present worth of an annuity, perpetuities and capitalised costs, bonds and debentures: value of a bond and yield rate,

Depreciation: Types and various methods of calculating depreciations, depreciation accounting, cost accounting- basic relationship in accounting, balance sheet and income statements.

Bioprocess Design:

Basic function of a Bioreactor for plant and microbial or animal cell culture, factors involved in bioreactor design and principal operating characteristics of bioreactors.

Body construction: construction material, temperature control,

Aeration and agitation: Agitators (impellers), stirrer glads and bearings, baffles, aeration system (spargers), valves and steam traps used in fermentation industries,

Scale up: Basic concepts, problems related to the scale up of the microbial processes, designing of other fermentation vessels,

Text books:

1. 'Plant Design and Economics for Chemical Engineers' fourth edition, by Max S Peters and Klans D Timmerhans, Mc Graw Hill Book Company
2. 'Fermentation and Biochemical Engineering Handbook' 2nd Edition by Henry C. Vogel and Celeste L. Todaro, Noyes Publications, 1997.

Reference books:

1. 'Biochemical Engineering Fundamentals', 2nd edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986
2. 'Bioprocess Engineering' 2nd edition, M.L.Shuler and F.Kargi, Prantice Hall India, New Delhi
3. 'Principles of Fermentation Technology' by Stanbury, Pergamon
4. 'Text Book of Biochemical Engineering', by D.G. Rao, Tata McGraw Hill

BT 1603 **Immunology**

3L-1T-0P-3C

Objective:

To study about the process of immunity and organs and cells of lymphoid system.

- To study about the properties of antigens and structure and function of antibodies and various reactions of antigen and antibody.
- To study about complement system, major histocompatibility and various immune responses.
- To study about the hypersensitive reactions and their role in graft rejection and to study transplantation and various auto immune diseases.
- To study the hybridoma technology and to study the various vaccines and vaccination process.

Outcome:

- Student will obtain knowledge in immunology, the structure and function of lymphoid organs and cells.
- Student will obtain knowledge in the process of antigenecity, and in the production of antibodies and student will also acquire knowledge in the precipitation, agglutination, and other antigen-antibody reactions so that student will become a good immunologist.
- Student will obtain knowledge in the complement system which is in the blood and immune response –humoral and cell mediated and student will also obtain knowledge in MHC(Majorhistocompatibility).
- Students will obtain knowledge in the hypersensitive reactions, organ transplantations and also obtain knowledge in various auto immune diseases.
- Students will obtain knowledge in the fusion of cells to produce hybrid cells(Hybridoma technology) so that they can obtain knowledge to produce monoclonal antibodies. Student will also obtain knowledge in the preparation of vaccines and understand clearly the method of vaccination

Syllabus:

Immunity, Lymphoid organs and cells: Introduction to Immunology and its origin in vertebrates and invertebrates, immunity-innate immunity and acquired immunity and the various lines of defence, organs of immune system, Thymus, bone marrow, bursa of fabricius, spleen, lymphnode and MALT, cells of immune system- B-cells, T-cells, antigen presenting cells, monocytes, NK cells and langerhan cells,

Antigens, Antibodies and Ag-Ab reactions: Antigens- properties of antigens, haptens, epitopes, T-dependent and T-independent antigens, adjuvants and their clinical importance, immunoglobulins- classification, structure and functions of immunoglobulins, antigenic determinants on antibodies, antigen – antibody reactions, and tests involving them - precipitation tests, agglutination tests, complement fixation tests, immunofluorescence, RIA, ELISA, Western blotting and ELISPOT,

Complement, MHC and Immune response: Complement system- its components, complement fixation pathways and consequences, MHC- In mice and human, structure of MHC molecules and their role in antigen presentation, immune response- humoral and cell, mediated immune response, IR curve, role of cytokines in immunity, interferons and interleukins, immune suppression, immune tolerance,

Hypersentivity, Transplantation, Autoimmune disease: Hypersensitive reactions- Type I, II, III and IV reactions and their role in graft rejection, transplantation immunology- classification of grafts and immunology of graft rejection, agents used for preventing graft rejection, autoimmune diseases- definition and few examples,

Hybridoma and Vaccination: Hybridoma technology- production of monoclonal antibodies and their applications, vaccines and vaccination, methods of attenuation of live forms, types of vaccines- whole organisms as vaccines, attenuated forms, purified molecules as vaccines, recombinant organisms, DNA vaccines and synthetic peptides.

Text book:

1. 'Immunology' by A.Goldsby, Thomas J.Kindt, Barbara A.Osborne and Janis Kuby
2.'A Text book of Microbiology' by R.Ananthanarayan and C.K.J.Pandey.

BT 1604 **Bioinformatics**
3L-1T-0P-3C

Objective: Objectives of this course essentially focuses on the development of skills of students for a successful career in industry or research. The course emphasizes enough effort on theory. The course emphasizes on the delivery of the state of the art technologies in Genomics, Proteomics and Drug discovery. It is essential for the students to read research papers and deliver seminars that would help them to know the recent advances in the subject and also develop the communication skills.

Outcome: At the end of the course the students would have learnt about the major bioinformatics resources available so far, sequencing alignments and its data bases, taxonomy and phylogenetics neural networks leading to the role idea of the Dna in computer applications.

SYLLABUS:

UNIT – I Major Bioinformatics Resources:

Knowledge of the following databases with respect to: organization of data, retrieval of data using text-based search tools, sources of data method for deposition of data to databases.

Introduction, Primary & Secondary databse, Nucleic acid sequence databases: GenBank, EMBL, DDBJ Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD Genome Databases at NCBI, EBI, ExPASy, TIGR, SANGER Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI

Sequence and Structure Databases: PDB, MMDB Metabolic pathways databases such as KEGG, EMP.

UNIT – II Sequence Alignment and Database Searching:

Introduction- Collection, annotation and alignment of sequences. Basic concepts of sequence similarity, identity and homology. Scoring matrices – PAM and BLOSUM, gap penalties, Database similarity searching, FASTA, BLAST.

Pairwise sequence alignments: basic concepts of sequence alignment, Dynamic programming-Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments

Multiple sequence alignments (MSA): the need for MSA, basic concepts of MSA (e,g. progressive, hierarchical etc.). Algorithm of CLUSTALW. Use of HMM method, concept of dendograms and its interpretation.

UNIT – IV Taxonomy and phylogenetic analysis:

Basic concepts in taxonomy and phylogeny; molecular evolution; nature of data used, Definition and description of phylogenetic trees and various types of trees, tree building and tree evaluation methods, Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Neighbor-Joining; Maximum likelihood algorithm.

UNIT – V: Secondary structure prediction methods- ChouFASMAN/GOR, Nearest neighbor, Neural network

UNIT – VI Genome Mapping and Applications:

Human genome project, application of genome mapping, DNA microarrays.

TEXT BOOKS:

1.Introduction to Bioinformatics. T.K. Attwood and P.J.Parry – Smith. Pearson Bioinformatics.

2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

REFERENCES:

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.

2. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.

3. Bioinformatics Basics. Applications in Biological Science and Medicine by Hooman H. Rashidi and Lukas K.Buehler CAC Press 2000.

4. Algorithms on Strings Trees and Sequences Dan Gusfiled. Cambridge University Press

BT 1605 **Bioprocess Engineering**
3L-1T-0P-3C

Objectives:

1. To understand the importance of bioprocess engineering and the role of bioprocess engineer and the importance of regulatory constraints.
2. To understand the mechanism of enzyme action, their kinetics and about stoichiometry of microbial growth.
3. To know the configuration of various bioreactors for cell growth and their operations.
4. To understand the instrumentation and control of bioreactors their scale up aspects etc.

Outcomes:

1. The student is able to know the importance of bioprocess aspects and the role of bioprocess engineer.
2. The student can analyze the kinetics and mechanism of enzyme action.
3. The student will be able to design a bioreactor.
4. The student will know about the instrumentation used in bioreactors and their operation.

Syllabus:

Introduction to biotechnology and bioprocess engineering, role of bioprocess engineer, regulatory constraints in bioprocesses, FDA, GMP, GLP and SOPs.

Enzyme kinetics: Mechanism of enzyme action, Michaelis-Menten equation and determination of kinetic parameters, effect of pH and temperature.

Stoichiometry of microbial growth and product formation: Elemental balances, degree of reduction, yield co-efficients, maintenance co-efficients.

Cell kinetics and fermentor design: Batch growth cultivation, batch, continuous and plug flow fermentors, Monod growth kinetics in continuous culture and evaluation of kinetic parameters, Fed batch operation, chemostat with cell recycle, multistage chemostat systems.

Non-conventional bioreactors, Scale up of bioreactors, bioreactor instrumentation and control, bioreactors for animal culture.

Principles and mechanism of media and air sterilization: Batch and continuous sterilization of media, air sterilization, air filter design.

Text books:

1. Bioprocess Engineering 2nd edition, M. L. Shuler and F. Kargi, Prantice Hall India, New Delhi.
2. Biochemical Engineering fundamentals, 2nd Edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986.

Reference Books:

1.Textbook of biochemical engineering, D.G. Rao, Tata McGraw Hill, New Delhi,2004.
2. Biochemical Engineering, J. M. Lee, Prantice Hall 1992.

BT 1606 A **Pharmaceutical Biotechnology (Elective –II)**
3L-0T-0P-3C

Objective: The main objective of this course is to contribute to improve human health by exploiting the potential biopharmaceutical research by

* Promoting research and development in the field of pharmaceutical biotechnology.

* Promoting interactions between academia, biotechnology and pharma companies within the field of pharmaceutical biotechnology to support creativity, innovations and facilitate the commercialization of scientific finding.

Outcome: At the end of course the students would have learnt about the * Promoting appropriate education and training for students in the field of pharmaceutical biotechnology

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SYLLABUS:

Introduction- Development of Drug and Pharmaceutical Industry, Therapeutic agents – their uses and economics, Regulatory aspects.

Drug metabolism and Pharmacokinetics- Metabolism, Physico-chemical principles, radioactivity, Pharmaco kinetics action of drugs on human bodies.

Important Unit Processes and their applications: Bulk drug manufacturing, Types of reactions in bulk drug manufacturing and processes, Special requirements for Bulk Drug manufacture.

Manufacturing Principles: Wet granulation, Dry granulation or slugging, Direct compression, Tablet presses. Coating of tablets, capsules. Sustained action dosage. Forms- Parental solutions, oral liquids, injections, ointments. Various topical drugs and pharmaceuticals, Packaging- Packaging techniques, Quality management and GMP.

Pharmaceutical products and their control- Therapeutical categories such as laxatives, vitamins, analgesics, non-steroid contraceptives, antibodies and Biologicals- Hormones.

REFERENCE BOOK:

Remington’s Pharmaceutical Sciences, Mark publishing and Co.

TEXT BOOKS:

Leon and Lachman et al- Theory and Practice of Industrial pharmacy.

Cooper and Gunn’s – Dispencing Pharmacy.

BT 1606 B Animal Cell Culture and Hybridoma Technology (Elective II)
3L-0T-0P-3C

Cell culture: Laboratory design and equipments planning, construction and services and equipment, cryopreservation equipment and principle, water purification system, washing, packing and sterilization of different materials used in animal cell culture, asceptic concepts, maintenance of sterility in cell culture vessels,

Media and Reagents: Types of cell culture media, ingredients of media; physiochemical properties, CO2 and bicarbonates, buffering, oxygen, osmolarity, temperature, surface tension and foaming, balance salt solutions, antibiotics and growth supplements, foetal bovine serum, serum free media, selection of medium and serum, conditioned media, other cell culture reagents, preparation and sterilization of cell culture media, serum and other reagents.

Different types of cell cultures: Primary culture and its preparation, establishment of primary culture, subculture –passage number, split ratio, seeding efficiency and criteria for subculture, continuous cell lines, suspension culture, behavior of cells in culture conditions: division, growth pattern, estimation of cell number, development of cell lines, characterization and maintenance of cell lines, common cell culture contaminants, cell transformation, normal Vs transformed cell and agents that cause transformation.

Scale-up: Cell culture reactors, scale-up in suspension, scale and complexity, mixing and aeration, rotating chambers, perfused suspension cultures, fluidized bed reactors for suspension culture, scale-up in monolayers, multisurface propagators, multiarray disks, spirals and tubes, roller culture, microcarriers, perfused monolayer cultures, membrane perfusion, hollow fiber perfusion, matrix perfusion, microencapsulation, growth monitoring,

Applications: Cell cloning and selection, transfection and transformation of cells, commercial scale production of animal cells, stem cells and their application, application of animal cell culture in pharmaceutics, production of vaccines, growth hormones and interferons, hybridoma technology, production of hybridoma, screening and applications of monoclonal antibodies in various fields.

Text books:

1. “Culture of Animal Cells”, (3rd Edition) by F1. Ian Freshney, Wiley-Liss,

2. “Animal Biotechnology” by M.M.Ranga, 2002 Edition.

BT 1606 C **Cancer Biology (Elective II)**

3L-0T-0P-3C

Fundamentals of Cancer Biology: Introduction, regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, classification of cancer, modulation of cell cycle in cancer. Carcinogenesis, cancer initiation, promotion and progression,

Causes for Carcinogenesis: Chemical carcinogenesis, metabolism of carcinogenesis, natural history of carcinogenesis, targets of chemical carcinogenesis, principles of physical carcinogenesis, X - ray radiation, mechanism of radiation carcinogenesis,

Molecular Cell Biology of Cancer: Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, growth factor and growth factor receptors that are oncogenes, oncogenes / proto oncogene activity, growth factors related to transformations, tumor suppression, tumor suppressor genes,

Principles of Cancer Metastasis: Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three-step theory of invasion, proteinases and tumor cell invasion,

Detection of Cancer; Detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, different forms of therapy, chemotherapy, radiation therapy and immuno therapy, advantages and limitations.

Text books:

1. "Cancer Biology" by Raymond W. Ruddon, Oxford University Press Inc., 2007 Ed., NY.
2. "The Basic Science of Oncology" by Ian F.Tannock et al, 4th edition, 2007. Mc Graw Hill Company.

BT 1606 D **Stem Cells in Health Care (Elective II)**
3L-0T-0P-3C

Stem cell basics: Unique properties of stem cells, embryonic stem cells, adult stem cells, umbilical cord stem cells, similarities and differences between embryonic and adult stem cells, properties of stem cells – pluripotency, totipotency, multipotency,

Embryonic stemcells: Invitro fertilization, human embryonic stem cells, blastocyst, inner cellmass, growing ES cells in laboratory, laboratory tests to identify ES cells, stimulating ES cells for differentiation, properties of ES cells, human ES cells, monkey and mouse ES cells,

Adult stem cells: Somatic stem cells, test for identification of adult stem cells, adult stem cell differentiation, trans-differentiation, plasticity, different types of adult stem cells,

Stem cell in drug discovery and tissue engineering: Target identification, manipulating differentiation pathways, stem cell therapy Vs cell protection, stem cell in cellular assays for screening, stem cell based drug discovery platforms, drug screening and toxicology,

Genetic engineering and therapeutic application of stem cells: Gene therapy, genetically engineered stem cells and animal cloning (transgenic animals), biomarkers in cancer, therapeutic applications in parkinson's disease, neurological disorder, limb amputation, heart disease, spinal cord injuries, diabetes, matching the stem cell with transplant recipient, HLA typing, Alzheimers disease, spinal cord injuries, tissue engineering application, production of complete organs – kidney, eyes, heart, brain.

Text books:

1. "Stem Cells, Human Embryos and Ethics: Interdisciplinary Perspectives" by Larstnor, Springer, 2008
2. 'Handbook of Stem Cells', Volume-1, by Robert Paul Lanza, Gulf Professional Publishing, 2004

Reference books:

1. "Embryonic Stem cells"by Kursad and Turksen. 2002, Humana Press.
2. "Stem Cell and Future of Regenerative medicine by Committee on the Biological and Biomedical Applications of Stem cell Research", 2002, National Academic Press.

BT 1606 E **Intellectual Property Rights (Elective – II)**
3L- 1T- 0P-3C

Intellectual property Rights: Patents and intellectual property rights (IPR): definition, scope, objectives, sources of patent information, patent processing, copy rights, trade marks,

Plant biotechnology: Indian patents and foreign patents, plant variety protection act, the strategy of protecting plants, patent litigation, role of patent in pharmaceutical industry,

Why there is a need to commercialize biotechnology? Creating and marketing the image of the biotechnology company, art of negotiation and effective communication, role of venture capitalism, business plan, selection of CEO and personnel, real estate for a biotech start-up,

Role of a biotechnology manager, role of research and development, university-industry technology transfer arrangements, how and why a biotech company can benefit.

Text / Reference books:

1. 'The Law and Strategy of Biotechnological Patents' by Sibley, Butterworth publications.
2. 'Good Manufacturing Practices for Pharmaceuticals' by S.H. Willing
3. 'Intellectual Property Rights' by Ganguli, Tat Mc-Graw Hill
4. 'Intellectual Property Right' by Wattal, Oxford Publishing House
5. 'Positioning' by All Rise and Jack Trout (1986), Warner Books
6. 'Protection of Industrial Property Rights' by P. Das and Gokul Das
7. 'Biotechnology: The Science & The Business' by V. Moser and R.E. Cape, (1999) Harwood.
8. Latest review articles and papers on the subject.

BT 1608 Bioprocess and Reaction Engineering Laboratory
0L-0T-3P-2C

Bioprocess Engineering

1. Isolation and characterization of industrial cultures for use as biocatalysts in bioprocesses and Analysis of raw materials used in common industrial bioprocesses
2. Production Ethanol & Protease
3. Parameter optimization studies in bioprocesses eg. Ethyl alcohol, amino acid production etc.
4. Product purification in bioprocess studies. Eg. Enzyme production (amylase, protease etc).
5. Measurement of Volumetric Oxygen transfer coefficient
6. Cell immobilization protocols
7. Immobilized bioprocess with cells and enzymes
8. Filter efficiency of common air filters
9. Heat inactivation of microbial cells, thermal death rate

Reaction Engineering

1. Batch Reactor (Order)
2. Batch Reactor (Rate Constant)
3. CSTR (Rate Constant)
4. PFR (Rate Constant)
5. CFR (CSTR to PFR)
6. CFR (PFR to CSTR)
7. RTD studies in a packed bed Reactor
8. RTD studies in a Plug flow reactor

BT 1610 **Bioinformatics Laboratory**
0L-0T-3P-2C

1. Sequence retrieval from DNA & Protein databases.
2. Sequence alignment /Annotation-Dot Plot
3. BLAST
4. Multiple Sequence Alignment (CLUSTALW).
5. Phylogenetic Analysis.
6. Structure Visualization of Proteins
7. Restriction Mapping.
8. Identification of Genes in Genomes.
9. Primer Design.
10. Molecular Docking

4/4 B.Tech (Biotechnology) - First Semester

BT 1701 **Environmental Biotechnology**

3L-1T-0P-3C

Objectives:

- To make the student learn about origin and evolution of microbes.
- To make the student understand structure and functioning of different microbial groups.
- To make them to acquaint the cultivation of microbes in artificial medium.

Outcome:

- Students gain the knowledge and skills both theoretically and practically.
- Students are equipped with theoretical approach to study them and understand their importance in ecosystem

Syllabus:

Environment:

Types and Components of Environment, Environmental Education,Ecology,Ecosystems, Ecological Pyramids, Food Chains, Food Web, Nutrient Cycling, Ecological Succession, Microbial Associations. History of Environmental Biotechnology.

Biological Waste Water Treatment:

Biological Processes for Domestic and Industrial Waste Water Treatment. Trickling filters, Activated Sludge Process, Rotating Biological Contactors (RBC), Packed Bed Reactors (PBR), Anaerobic Digestion, Fixed Film Reactors, Up Flow Anaerobic Sludge Blanket Reactor(UASBR), Waste Water Cycling.

Biodegradation and Bioremediation:

Introduction, Factors Effecting Bioremediation, Enzyme Systems for Bioremediation, Types of Bioremediation, Bioremediation of Contaminated Soils and Waste Lands, Phytoremediation, Degradation of Xenobiotic Compounds:Petroleum products, Alkanes, Aromatic Compounds.

Biofertilisers and Biopesticides, Biopolymers and Bioplastics, Bioabsorption, Bioleaching Biofuels, Biodiversity.

TEXTBOOKS:

1. Environmental Biotechnology: Basic concepts and applications by Indu Sekhar Thakur I.K. International Pvt. Ltd. New Delhi.
2. Buiotechnology by U. Satyanarayana, Books and Allied (P) Ltd. Koldata.

REFERENCE BOOKS:

1. Biotechnology and Biodegradation. Advances in applied biotechnology, Vol-4 by Karnely, D. Chakraborthy, Omen, G.S. Guld Publications co; LONDON.
2. Bioremediation Engineering: Design and Applications by John CooksonJr; McGrawHill.INC.

BT 1702 **Genetic Engineering**

3L-1T-0P-4C

Objectives:

- The objective of this course is to discipline to students knowledge of main engines of implementation and transmission of a genetic material at molecular and cellular levels, and also methods of change of a genetic material and constructioning of transgene organisms with the given properties.
- Genetic engineering: refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics.
- A gene is a basic constituent unit of any organism. It is a locatable region of a genome which contains the whole hereditary information of the organism. A gene corresponds to a unit of inheritance. It is a segment of the DNA which determines the special features or functions of the organism.
- Genetic engineering meddles with the organism's natural reproductive process, whether sexual or asexual. It gives it a new direction which is different from its natural disposition and development. The process involves the isolation and manipulation of the genes by introducing the new DNA into the cells. DNA is a blue print of the individual characteristics of an organism. The information stored in the DNA controls the management of biochemical process of each organism. The life, development and unique characteristics of the organism depend upon on its own DNA.

OUTCOMES

After passing the course, the student should be able to know about:

The aims of the study, development and practice of **genetic engineering** are noble and beneficial for mankind. Genetic engineering may help make crops resistant to herbicides used to kill the unwanted plants and weeds which obstruct their full growth. Though some herbicides are selective and kill only the specifically targeted unwanted plants, there are others which are non selective and besides killing the useless and obstructive weeds, kill any plants they come in contact thus killing the plants which are sought to be protected.

The domain of genetic engineering can extend from plants to cover both the animal and human life. It can, for example, hybridize the production of the animals and promote the growth of healthy species of milk producing animals, stronger and healthier horses, cows and bullocks which can better withstand the wear and tear of life.

Introduction, Purification and manipulation of DNA: History and scope of gene manipulation, isolation and purification of total cell DNA and plasmid DNA, DNA manipulative enzymes, restriction endonucleases- types, nomenclature, recognition sequence, cleavage pattern, restriction digestion and its analysis, Ligases – mode of action, strategies of ligation, linkers, adaptors and homopolymer tailing, DNA modifying enzymes,

Cloning Vectors and Libraries: *E. coli* vectors – construction and features of plasmids – p^{BR322}, p^{UC8}, p^{UC18}, p^{GEM3Z}, bacteriophage vectors – Lambda phage & M-13 phage vectors, cosmids, phasmids, shuttle vectors, yeast vectors - 2µm plasmid, yeast episomal plasmid and YACs, transfer and cloning of recombinant vectors, construction of genomic DNA libraries, cDNA libraries and their screening, gene cloning strategies,

PCR, Blotting and Fingerprinting techniques: Preparation of labeled probes and primers, DNA sequencing methods – Maxam & Gilbert method, Sangers and Automated sequencing method, PCR and its applications, southern blotting, northern blotting, DNA finger printing technique- RFLP and RAPD and its applications,

Gene transfer methods and mutagenesis: Gene transfer techniques – transformation, transfection, electroporation, lipofection and gene gun methods, cause of the mutagenesis, site specific mutagenesis, transposon mutagenesis, gene knockout technologies,

Applications, achievements and limitations: Application of genetic engineering in agriculture, animal husbandry, medicine, environmental management and in industry, achievements, limitations and negative aspects of geneic engineering.

Text books:

1. "Gene cloning and DNA analysis" – An Introduction, T. A. Brown, Blackwell Publishing, 2006.
2. "Biotechnology" – B.D.Singh, kalyani Publishers, New Delhi, 2006.

Reference books:

1. "Principles of Gene Manipulation and Genomics", S. B. Primrose and R. M. Twyman, Blackwell Publishing, 2006.
2. "From Genes to Clones- Introduction to Gene Technology", Winnacker, Panima Publishing Corporation, New Delhi.

BT 1703 **Process Control**
3L-1T-0P-3C

Objectives :

The main purpose of teaching Process Dynamics & Control for first year postgraduate students is to take the student from basic mathematics to a variety of design applications in a clear, concise manner. This course is focused on the use of the digital computer in complex problem solving and in process control instrumentation. For chemical engineering problem solving students need more advanced mathematical preparation like partial differential equations, linear algebra and Fourier series all are introduced in this course.

Outcome:

- Able to know the sampled data control systems consists of sampling and advanced mathematical model Z- transforms.
- Able to describe the process in which the flow of the signals is interrupted periodically like in chromatograph.
- Able to calculate the open loop response of a sampled data system and can develop a pulse transfer function that is the counterpart of the transfer function for continuous systems.
- Able to know the sophisticated instruments used for the analysis of water and air pollutants, The student should have knowledge to design the equipment used for the abatement of these pollutants.
- In a position to modernize the solid waste management and the student must be in a position to get awareness on accidents that are occurring in industries during handling, storage, and manufacturing of chemicals, remedial measures to arrest the accidents immediately.

Syllabus:

Chapter-1: Review of time domain, Laplace domain and frequency domain dynamics of process and control system

Chapter-2: Sampled data control system – sampling and Z–Transforms , open loop and closed loop response, Stability.

Chapter-3: State space methods – representation of physical systems – transfer function matrix – Multivariable systems – Analysis and control.

Chapter-4: Non linear control –examples of non linear systems – Methods of phase plane analysis.

Chapter-5: Control of heat exchangers, distillation columns and Chemical Reactors.

Textbooks:

1. Process system Analysis and control, 2nd edition, Donald R Coughanower and Koppel.
2. Automatic process Control by Peter Harriot.
3. Process Modeling, Simulation and control for Chemical Engineers by W.L. Luyben.

BT 1704 Industrial Management and Entrepreneurship

(Common for all 1/4 B.Tech and 1/6 B.Tech + M.Tech Branches)

3L-1T-0P-3C

Unit-I

Basic Concepts of Management :

Management :- Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management; **(Eight Periods)**

Unit-II

Forms of Business Organizations: Introduction, **Types of Business organizations: Private Sector**- Individual Ownership , Partnership, Joint stock companies and Co-Operative organizations**; Public sector**- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management. **(Eight periods)**

Unit-III

Production and operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance. **(Ten periods)**

Unit-IV

Entrepreneurship : Definition, Characteristics and Skills , Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship. **(Six periods)**

Unit-V

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government. **(Eight periods)**

Text Books:

(1) Sharma,S.C, and Banga, T.R., **Industrial Organization & Engineering Economics**, Khanna Publishers, Delhi, 2000.

(2) Vasant Desai , **The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth),** HImalayan Publishing House, 2018.

Reference Books:

(1) Aryasri , A.R., **Management Science,** McGraw HIll Education (India Private Limited , New Delhi 2014.

(2) Sheela, P. , and Jagadeswara Rao, K., **Entrepreneurship**, Shree Publishing House, Guntur, Andhra Pradesh, 2017.

BT 1705 **Industrial Biotech Products**
3L-1T-0P-3C

Objectives:

- To study about fermentation process and to study the culturing of micro organisms and maintenance of cultures.
- To study about the preparation of alcohol using yeast cells and sugars by fermentation process.
- To study about the production of Acetic acid, Citric acid and lactic acid using fermentation technology.
- To study about the production of fungal foods- mushroom and other foods like cheese. And also studies the production of bakers yeast, amino acids and vitamins(Microbial origin)
- To study about the antibiotics production, industrial enzymes-amylase, protease, lipase, and the production of biopolymers- Xanthan gum.

Outcome:

- Students will obtain knowledge in the preparation of microbial slants, maintenance of stock cultures and other microbial techniques and they will also acquire knowledge in fermentation technology.
- Students will obtain knowledge in the production of alcohols using fermentation technology.
- Students will obtain knowledge in production of acetic acid, citric acid, lactic acid using micro organisms and biological substrates by fermentation technology.
- Students will obtain knowledge in the production of foods using microorganisms and Students will obtain knowledge in the production of mushrooms, cheese and vitamins, etc.
- Students will acquire knowledge in the production of antibiotics and enzymes used in large scale and also in the production of vaccines and biopolymers eg- Xanthan gum, Dextran.

Syllabus:

Microbial Processes: Introduction, types of fermentations, components of industrial microbial process, source of industrial cultures, maintenance and improvement of culture for better production,

Alcohol fermentation: Production of industrial alcohol, biosysthetic mechanism, recovery of latest developments, wine manufacture, glycerol fermentation, production of acetone and butanol,

Organic acid production- Biochemistry of acetic acid production, vinegar manufacture, production of citric acid and lactic acid,

Microbial foods: Mushrooms, cheese, Baker's yeast

Amino acids – L-Glutamic acid, Lysine

Vitamins – Vitamin B_{12}

Antibiotics – Penicilin and streptomycin.

Industrial enzymes: production of amylase, protease and lipase

Miscellaneous-Biopolymers (Xanthan gum, dextran etc), vaccines.

Text books:

1. "Industrial Microbiology" by Cruger & cruger
2. "Industrial Microbiology" by Cassida
3. "Industrial Microbiology" by A.H.Patel

Reference books:

1 'Industrial Microbiology' by Prescott & Dunn

2 "Biotechnology" by U. Satyanarayana.

BT 1706 **Plant Cell And Tissue Culture**

3L-1T-0P-3C

Objectives:

- To know the basics of plant tissue culturing.
- To know the production of callus from carrot.
- To measure the efficacy of root and shoot.
- To develop the graduate capabilities of knowledge ability, comprehension and applications of plants in cell and tissue culture systems.
- To know how cell and tissue culture contributes to global sustainability.
- To develop the practical skills and confidence of students to successfully culture plant cells and tissues.

Outcome:

By the end of the course, students could be able to:

- Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components
- Explain the various steps taken to establish and optimize media for particular purposes in particular species, without the aid of texts.
- Explain and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting.
- Establish and maintain plants in tissue culture and micropropagation, including morphogenesis.
- Explain the various cell lines used in tissue culture and their origins and uses.

Syllabus:

UNIT I: Fundamentals of plant tissue culture: laboratory organization, sterilization methods, culture medium and growth regulators.

Totipotency, callus culture and organogenesis- Expression of totipotency in cell culture and importance; Principle of callus culture, characteristics of callus culture and importance; Principle of organogenesis, factors effecting organogenesis and applications.

UNIT II: Cell culture: single cell culture-isolation, methods of single cell culture and importance; Cell suspension culture, types of suspension culture, growth pattern, synchronization, assessment of growth and viability of cultured cells, significance of suspension cultures.

UNIT III: Somatic embryogenesis and synthetic seeds: principle, induction of embryogenesis, embryo development and maturation, factors effecting somatic embryogenesis, synchronization, large scale production and importance of Somatic embryogenesis, synthetic seeds- methods of making synthetic seeds and applications.

Germplasm conservation

UNIT IV: Somoclonal variations – its genetic basis and application in crop improvement- cell line selection for resistance to herbicides, stress and diseases. **Haploid production and its advantages-** androgenesis, principle, pollen culture, advantages of pollen culture over anther culture, homozygous diploids, importance of anther and pollen culture.

UNIT V: Clonal propagation –technique- multiplication by axillary and apical shoots, adventitious buds/bulbs/protocorms, by callus culture, transplantation, acclimatization

Production of disease free plants- meristem tip culture- virus indexing.

UNIT VI: Protoplast technology- isolation, culture and plant regeneration, protoplast fusion, methods, identification and characterization of somatic hybrids, cybrids and importance of somatic hybridisation.

UNIT VII: Genetic transformation – plant vectors – Ti plasmids, Ri plasmids - indirect and direct methods, current status and limitations.

Automation and Economics of tissue culture.

TEXT BOOKS

1. Plant tissue culture – Kalyan Kumar De – New Central Book Agency

REFERENCE

1. An Introduction to Plant tissue culture. Razdan. M. K., Oxford & LBH.
2. Plant tissue culture- theory and practice. Bhojwani, SS & Razdan

   MK.Elsevier
3. Plant tissue and Cell culture. Street, HE.Blackwell

BT 1708 **Process Control Laboratory**
3L-0T-0P-3C

1. Response of Bare Thermometer for a step input
2. Response of Bare Thermometer for a impulse input
3. Response of first order system for a step input
4. Response of Non – Interacting system for a step change
5. Response of Non – Interacting system for a impulse input
6. Response of a Interacting system for a step change
7. Response of Interacting system for a impulse change
8. study of Control Valve Coefficient
9. Study of inherent characteristics of Control Valve
10. Temperature Control trainer

BT 1710 **Plant Cell and Tissue Culture Laboratory**
0L-0T-3P-2C

1. Sterilization methods
2. Preparation of stock solutions
3. Preparation of medium
4. Establishment of callus cultures from carrot cambial explants
5. Establishment of cell culture
6. Establishment of growth and preparation of growth curve
7. Embryo culture of maize or any suitable crop, root/shoot initiation (organogenesis) from different explants
8. Micro propagation and plant regeneration
9. Isolation, culture and fusion of plant protoplasts
10. Anther and pollen culture

4/4 B.Tech(Biotechnology) Second Semester

BT 1801 **Project Work**

0L-0T-0P-12C

The project work should consist of a comprehensive design of a chemical plant in the form of a report with the following chapters.

1. Introduction
2. Physical and chemical properties and uses
3. Literature survey for different processes
4. Selection of the process
5. Material and energy balances
6. Specific equipment design (Process as well as mechanical design with drawings)
7. General equipment specifications
8. Plant location and layout
9. Materials of construction
10. Health and safety factors
11. Preliminary cost estimation
12. References