ANDHRA UNIVERSITY

DEPARTMENT OF CHEMICAL ENGINEERING

PROGRAM : M.TECH(BIO-TECHNOLOGY)

REGULATION AND SYLLABUS

EFFECTIVE FROM 2020-2021 BATCH

M.Tech. Biotechnology

Program Outcomes

PO1 Acquire knowledge on the fundamentals of biotechnology for sound and solid base which enables them to understand the emerging and advanced engineering concepts in life sciences

PO2 Acquire knowledge in domain of biotechnology enabling their applications in industry and

research **PO3** Implement the concepts of biotechnology for inter disciplinary research

PO4 Solve the research problem and write dissertations

PO5 Recognize the importance of Bioethics, IPR, entrepreneurship, Communication and management skills so as to usher next generation of Indian industrialists

Program Specific Outcomes

PSO1 Perform plant, animal and microbial culture

PSO2 Design own research ideas in medical, industrial and agricultural fields

PSO3 Attain research thoughts and entrepreneurial skills

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

SCHEME OF INSTRUCTION & EXAMINATION
1/2 M.TECH (BIOTECHNOLOGY) FIRST SEMESTER
(WITH EFFECT FROM 2020-21 ADMITTED BATCH ONWARDS)
UNDER CHOICE BASED CREDIT SYSTEM

Code No.	Course	Credits	Theory	Tutorial	Lab	Total	Sessional marks	Exam marks	Total marks
BIO 1.1.1	Advanced Microbiology	3	3	1	--	4	30	70	100
BIO 1.1.2	Advanced Biochemistry	3	3	1	--	4	30	70	100
BIO 1.1.3	Elective-I	3	4	--	--	4	30	70	100
BIO 1.1.4	Elective-II	3	4	--	--	4	30	70	100
BIO 1.1.5	Research Methodology & IPR	2	4	--	--	4	30	70	100
BIO 1.1.6	Audit Course–1*	0	2	-	--	2	--	--	--
BIO 1.1.7	Elective lab	2	--	--	3	3	50	50**	100
BIO 1.1.8	Seminar	2	--	--	3	3	100	--	100
	TOTAL	18	20	2	6	28	300	400	700

*To be included as 'Qualified' or 'Not Qualified' in the marks list

**Only internal evaluation.

Elective-I: 1. Bioanalytical Technics
2 Bioinformatics
3. Biosafety & Bioethics

Elective-II: 1. Corrosion Engineering-I
2. Energy Engineering-I
3. Reaction Engineering-I

Audit Course 1: 1. Yoga for working professionals
2. Organizational Behaviour

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SCHEME OF INSTRUCTION & EXAMINATION
1/2 M.TECH (BIOTECHNOLOGY) SECOND SEMESTER
(WITH EFFECT FROM 2020-21 ADMITTED BATCH ONWARDS)
UNDER CHOICE BASED CREDIT SYSTEM

Code No.	Course	Credits	Theory	Tutorial	Lab	Total	Sessional marks	Exam marks	Total marks
BIO 1.2.1	Genetic Engineering	3	3	1	--	4	30	70	100
BIO 1.2.2	Advanced Biochemical Engineering	3	3	1	--	4	30	70	100
BIO 1.2.3	Advanced Downstream Processing	3	3	1	--	4	30	70	100
BIO 1.2.4	Elective-III	3	4	--	--	4	30	70	100
BIO 1.2.5	Elective-IV	3	4	--	--	4	30	70	100
BIO 1.2.6	Audit Course-2*	0	2	-	--	2	--	--	--
BIO 1.2.7	Elective lab	2	--	--	3	3	50	50	100
BIO 1.2.8	Seminar	2	--	--	3	3	100	--	100
	TOTAL	19	19	3	6	28	300	400	700

*To be included as 'Qualified' or 'Not Qualified' in the marks list

Elective-III: 1. Industrial Biotech products
2. Pharmaceutical Biotechnology
3. Agricultural Biotechnology

Elective-IV: 1. Corrosion Engineering-II
2. Energy Engineering-II
3. Reaction Engineering-II

Audit Course 2 : 1. Disaster Management
2. Entrepreneurship

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(WITH EFFECT FROM 2020-21 ADMITTED BATCH ONWARDS)
UNDER CHOICE BASED CREDIT SYSTEM

Code No.	Course	Credits	Theory	Tutorial	Lab	Total	Sessional marks	Exam marks	Total marks
BIO 2.1.1	Elective-V	3	4	--	--	4	30	70	100
BIO 2.1.2	Elective-VI (Open Elective)	3	4	--	--	4	30	70	100
BIO 2.1.3	Dissertation (preliminary)	9	--	--	--	--	100	--	100
	TOTAL	15	8	--	--	8	160	140	300

Note: The dissertation shall be evaluated through Viva-voce examination by a committee with HOD, Chairman, Board of Studies and Research guide as members. The marks shall be awarded in the ratio of 30,30 and 40 percent by the members Respectively

Elective-V: 1. Enzyme Engineering
2. Stem cells in health care
3. Environmental Biotechnology

Elective-VI: 1. Nano Technology
2. Pollution Control
3. Corrosion Engineering

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(WITH EFFECT FROM 2020-21 ADMITTED BATCH ONWARDS)
UNDER CHOICE BASED CREDIT SYSTEM

Code No.	Course	Credits	Theory	Tutorial	Lab	Total	Sessional marks	Exam marks	Total marks
BIO 2.2.1	Dissertation	16	--	--	--	--	--	100	100
	TOTAL	16	--	--	--	--	--	100	100

Note: The dissertation shall be evaluated through Viva-voce examination by a committee with an external member nominated by University, HOD, Chairman, Board of Studies and Research guide as members. The marks shall be awarded in the ratio of 20, 20, 20 and 40 percent by the members respectively

I SEMESTER

BIO-1.1.1: ADVANCED MICROBIOLOGY

Objectives:

To understand basic as well as advanced aspects of microbiology like Epidemiology and infectious diseases and immunology.

Outcome :

Students are enriched with both theoretical and practical approaches to understand the problem and possible solutions.

Syllabus:

UNIT-1

Introduction to Microbiology: Origin and evolution of microorganisms, history of Microbiology, nature and scope of microbiology, major characteristics of prokaryotes and Eukaryotes, structure and functioning of bacterial cell, staining reactions.

Classification of microorganisms: Major characteristics of microorganisms, concepts of Classification, classification methods, principles of nomenclature and identification, Modem trends in classification.

General features and classification of some groups of microorganisms - Algae, Fungi, Chlamydiae, Rickettsiae, Mycoplasmas, Viruses and Protozoa, economic importance of Micro-organisms

Learning outcomes:

By the end of the topic, the student will be able to

–understand and identify various micro organisms.

--memorize scientific names of individual micro organisms.

UNIT-2

Methods in microbiology: Nutritional requirements, nutritional types of bacteria, Characteristics of culture medium, type of culture media and preparation of culture media, isolation of microorganisms - general and selective methods, isolation of bacteria in pure culture, enrichment - enrichment methods, staining techniques, culture characteristics, maintenance and preservation of cultures, culture collections.

Learning outcomes:

By the end of this unit student will be able to

-prepare the culture media and isolations procedure, and staining procedures.

-Adapt, practice & perform various microbiological techniques.

UNIT-3

Reproduction and growth: Reproduction in bacteria, genetic transfer in bacteria, Bacterial growth, bacterial growth curve, growth measurement techniques, factors affecting growth, control of microorganisms by physical and chemical methods.

Metabolism and energy production: Respiratory chain, energy production by aerobic and anaerobic process, energy production by photosynthesis. Microbiology of air, water, soil, milk and food.

Learning outcomes:

By the end of the topic the student will be able to learn

- the process of aerobic and anaerobic energy production

- understand & describe various metabolic activities which occur in microbes.

UNIT-4

Epidemiology and infectious diseases: Epidemiological markers, role of host in infectious diseases - Air borne, water borne and food borne diseases.

Learning outcomes:

By the end of the unit the student can learn

- different epidemiological markers.

- study & identify various infectious diseases caused by micro organisms.

UNIT-5

Immunology: Natural resistance, internal defense mechanisms, non-specific defense mechanisms, immunity, types of immunity, immune systems, antibody and its diversity, Hypersensitivity, transplantation, autoimmunity, AIDS and other immune deficiencies, vaccines, types of vaccines, production of vaccines and synthetic vaccines, monoclonal anti bodies and their use, antibiotics, history of antibiotics, classification and production of antibiotics, microbial toxins, types of microbial toxins, effects of microbial toxins and their control.

Learning outcomes:

By the end of the unit the student can learn

-different types of vaccines, defense mechanism of immune system, history and role of antibiotics.

-Understand & analyze the types of immunity & immune systems.

TEXT BOOKS:

1. Microbiology by M. J. Pelczer, E. C. S. Chan, N. R. Kries. Tata McGrew Hill publications
2. Microbiology fundamentals and applications by S. S. Purohit. Agro botanical. Publications.

REFERNCE BOOKS:

1. Microbiology by Prescott, Harley, Klein. Mc Graw-Hill publications
2. General Microbiology by Roger Y. Stainer, Edward A. Adebery, John L. Ingraham. Published by Macmillan Press LTD.

BIO -1.1.2: ADVANCED BIOCHEMISTRY

Objectives:

- To study about the biomolecules and importance of biochemistry in the advanced level.
- To study the detailed structure and function of biomolecules like carbohydrates, amino acids, proteins, lipids and nucleic acids.
- To study the detailed structure and function of biocatalysts, enzymes. To study various types of enzyme inhibitions.
- To study in detailed vitamins, membrane assembling, bioenergetic principles and ATP cycle.
- To study the metabolism in advanced level and biosynthesis of fatty acids, DNA, RNA, and proteins.
- The student obtains advanced level knowledge n biomolecules and metabolic process a base for the higher research activity.

Outcome:

- Students will obtain knowledge in the advanced structure of biomolecules.
- Student will obtain knowledge in the biosynthesis and degradation of biomolecules.
- Student will obtain advanced knowledge in the metabolism and bioenergetic principles.
- The students can carry out independent research work to improve and to invent new biomolecules and can understand new metabolic processes.

Syllabus:

Scope and importance of biochemistry, molecular logic of living matter,origin of biomolecules.

Molecular structure of Water, macromolecular structure of water, hydrogen bonds, dissociation of water.

Unit-1

Carbohydrates: classification of carbohydrates, structure and properties of monosaccharides (ribose, glucose, fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (Starch, glycogen and cellulose).

Mechanism of photosynthesis, Embden-Meyerhof pathway of glucose metabolism(glycolysis), citric acid cycle(Krebs cycle), electron transport and oxidative phosphorylation.

Learning Outcomes:

on completion of the unit, the learner will be able to

- Understand & describe various types of carbohydrates.

-Describe the pathways & their metabolism.

Unit-2

Amino acids and proteins: Classification and properties of amino acids and proteins, peptide bond, structural organization of proteins: primary, secondary, tertiary and quaternary structure of proteins. Biochemical function of proteins, denaturation of proteins. Biosynthesis of proteins (translation).

Learning Outcomes:

on completion of the unit, the student will be able to learn and

- Understand & identify various types & structures of amino acids

- Development & synthesis of amino acids.

Unit-3

Lipids: classification, structure and physiological functions of triglycerides, fattyacids, phospholipids, cerebrosides, gangliosides and cholesterol.

Biosynthesis of fattyacids- palmitic acid biosynthesis, β-oxidation of fatty acids.

Learning Outcomes:

By the completion of the unit, the student will be able to learn and

- Identify, classify various lipids in detail.

-Identify & synthesize some fatty acids.

Unit-4

Nucleic Acids: Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides.Structure of nucleic acids-DNA and RNA. Biosynthesis of DNA (replication).

Biosynthesis of RNA (transcription).

Learning Outcomes:

on completion of the unit, the student will be able to learn and

- Understand & interpret the structures of all the nucleic acids.

- Biosynthesize various nucleic acids.

Unit-5

Enzymes: Classification of Enzymes, Mechanism of Enzyme action, factors affecting enzyme action, co-enzymes and regulatory enzymes.

Enzyme inhibition-competitive, non-competitive and uncompetitive inhibitions.

Structure and functions of vitamins. Membrane assembly and transport across the membranes. Bioenergetic principles and ATP cycle.

Learning Outcomes:

By the completion of the unit, the student will be able to learn and

- Compare & classify various enzymes

- Understand the mechanism of enzyme action.

Text Books:

1. Textbook of Biochemistry by Albert-Lehninger, Kalyani Publishers,Ludhiana,New Delhi.
2. Principles of Biochemistry- Lehninger, Nelson and Cox-CBS Publishers and distributors,Delhi.
3. A text book of Biochemistry by A.V.S.S.Rama Rao,UBS Publishers and Distributors Ltd,New Delhi,Chennai.
4. Fundamentals of Biochemistry-J.L.Jain,S.Chand and company Ltd. New Delhi.

BIO -1.1.3: Elective –I

BIO -1.1.3 A: Elective –I (Bio-Analytical Techniques)

Objectives :

The course is designed to impart the knowledge in the field of Pharmaceutical Analysis. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics will be taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to theoretical aspects, the basic practical knowledge relevant to the analysis will also be imparted.

Outcome: The appreciable knowledge will be gained in the Modern Analytical Techniques and can apply the theories in the analysis of various bulk drugs and their formulations. Able in developing the new methods for the determination and validate the procedures.

Syllabus:

Unit I : Chromatographic Techniques - Affinity - Adsorption - paper - Thin layer - Column - Ion Exchange - Gel Chromatography - Applications.

Learning Outcome:

- The students will be able acquire knowledge in handling instruments for the analysis of the samples.
- Understand the principles of Chromatographic Techniques.

Unit II : Gas liquid chromatography - High Pressure liquid chromatography - Equipment - Applications.

Learning Outcome:

- Understand advantages, disadvantages and applications of chromatographic techniques.
-

Unit III : Spectrophotometric Techniques - IR - UV - Visible - NMR - ESR - Optical density - Circular dischroism.

Learning Outcome:

- The students will be able to demonstrate instruments required for spectral methods.
- Understand the principles and applications of UV - Visible - NMR – ESR etc.

Unit IV : pH - pH titrations - Determination of pKa values - Buffers - Preparation - Buffer Action - Physiological buffers - potentiometric titration - centrifugal dialysis - lyophilization

Learning Outcome:

- Determine different values in pH titrations.
- Explain preparation and role of various buffers in pH titrations.
- Discuss stepwise procedure in potentiometric titration.

Unit V : Notes from Unit-I to Unit-IV

Learning Outcome:

- Prepare material for teaching and learning process.
- Able to understand and demonstrate various instrumental methods.

Text Books:

1. " Instrumental methods of Chemical Analysis - Chatwal, G & Anand, S. Himalaya Publishing House, Bombay.
2. "Instrumental methods of Chemical Analysis - Sharma, B.K. Goel Publishing House, Meerut.
3. "Instrumental Methods Analusis - Willard, Merritt, Dean & Settle, CBS Publishers & Distributors, Delhi.

BIO -1.1.3 B: Elective –I (Bioinformatics)

Syllabus:

Unit-1

Introduction, Molecular Biology and Bioinformatics, Biological database:
Primary, Secondary and Structural data bases, tools for web search, data retrieval tools

Learning Outcomes:

By the completion of the unit, the student will be able to learn

- The basics knowledge of bioinformatics and the about the biological databases.

- data retrieval tools and structural databases.

Unit-2

Genome analysis and gene mapping: sequence assembly problem, genetic mapping and linkage analysis, genome sequencing, sequence assembly tools, Human genome project.

Learning Outcomes:

By the completion of the unit, the student will be able to learn

- Genetic mappimng ang linkage analysis
- genome sequencing, and tools and human genome project.

Unit-3

Alignment of pairs of sequences, scoring matrices, multiple sequences, phylogenetic analysis, Tree evaluation, automated tools for phylogenetic analysis, working with FASTA and BLAST.

Proteomics: Tools and techniques in proteomics, protein – protein interactions, gene family identification methods. Computational Methods for pathways and systems Biology: Analysis of pathways, metabolic network properties, metabolic control analysis, simulation of cellar activities.

Learning Outcomes:

By the completion of the unit, the student will be able to learn

- Alignment of pairs of sequences, phylogenetic analysis with blast and fasta.
- Tools and technioques in proteomics, analysis of biological cellular pathways.

Unit-4

Gene identification and prediction: Basis for gene prediction, pattern recognition, gene prediction methods, working with DNA, Micro arrays, Micro array analysis.

Learning Outcomes:

By the completion of the unit, the student will be able to learn

- gene identification and prediction methods.

Unit-5

Protein classification and structure visualization: structure – based protein classification, protein structure databases, visualization databases and tools, protein structure alignment, tools for plotting protein-ligand interaction. Protein structure prediction: Analysis and prediction of primary structure and secondary structure, motifs, profiles, patterns and fingerprints search, Ab Initio approach, 2-D structure prediction, protein function prediction from DNA sequence.

Learning Outcomes:

By the completion of the unit, the student will be able to learn

- Protein structure and classification , visualization of databases, protein – ligand interaction.
- Structure prediction from DNA sequence.

Text-book:

S.C..Rastogi, N.Mendiratta and P.Rastogic, **Bioinformatics**, Prentice- Hall of India Pvt.Ltd, New Delhi, 2004

Reference books:

1. T.K.Attwood and D.J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Asia, Delhi, 2002
2. A.M. Lesk, Introduction to Bioinformatics, Oxford University press, New Delhi, 2004.

BIO -1.1.3 C: Elective –I (Systems Biology)

Course Outcomes:

The student will be able to

- Explain the principles of system biology and experimental techniques.
- Apply achieved methodological knowledge to biologically relevant problems.
- Interpret the results from commonly used systems biology methods.

Syllabus

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.

BIO -1.1.4: Elective –II

BIO-1.1.4 A - Elective-II (Corrosion Engineering-I)

Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

Objectives : The main objectives are to provide:

1. Basic aspects of electrochemistry relevant to corrosion phenomena,
2. Importance and forms of corrosion.
3. Knowledge on corrosion rate expressions and measurement techniques.
4. Knowledge on factors influencing corrosion of iron and steel exposed to atmospheric, soil and aqueous medium.
5. Basic knowledge on remedial measures for corrosion.

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

1. Acquires knowledge on basic principles of electrochemistry, importance of corrosion.
2. Predict whether corrosion will occur for a particular environment.
3. Estimate corrosion rates and analyze.
4. Identify the type of corrosion and propose viable remedial measures.

Syllabus:

Basic Concepts and Outlines of Electrochemistry: Fundamentals of Electrochemical reactions, Faraday's Laws Electrolytic and ionic conductance, ionic mobility's, Transport Nos. Galvanic Cell and Electrolytic cells.

Definition and importance of corrosion, Dry cell, analogy, Corrosion Cells, Types of Corrosion Cells- a) Dissimilar electrode cells b) Concentration cells such as a salt concentration cells, differential aeration cells c) differential Temperature cells. Corrosion Rate Expresions - mdd, ipy, cpy, mpy, etc.

LO1: Choose a specific cell for a given situation
LO2: Identify the type of corrosion cell that will form in that particular environment

Corrosion Tendency and Electrode Potentials: Free Energy changes, Development of Nernst Equation for calculation of Half-cell potentials, Hydrogen electrode, Spontaneity of a reaction, Reversible cells and potentials – convention of Sign and calculations of EMF from standard Equilibrium potentials., EMF Series and Galvanic series, Reference Half Cells – Calomel, Silver-Silver Chloride and Saturated Copper-Copper Sulphate Half Cells. Pourbaix Diagram for Iron, Aluminum and magnesium, limitations of pourbaix diagrams.

LO3: Predict the tendency of corrosion to occur
LO4: Identify the corrosion zones based on pH of media

Polarization and Corrosion Rates: Polarization and a Polarized Cell, Causes of Polarization – Concentration Polarization, Activation Polarization and IR drop. Hydrogen Over potentials, combined polarization and Mixed potential theory. Tafel Slopes and Tafel Equation. Graphical method of expressing Corrosion Reactions (Polarization diagrams/Evans diagrams), Derivation of Stern-Geary Equation, Influence of Polarization on Corrosion rates.

LO5: Derive the equations for estimating corrosion rates
LO6: Evaluate and Analyze data for corrosion rates

Passivity: Characteristics of Passivation, Flade potential, behavior of passivators, transpasivity, Theories on Passivity.

Forms of Corrosion: Uniform attack, Galvanic Corrosion, Crevice Corrosion, Pitting, Intergranular Corrosion, Selective Leaching, Erosion Corrosion and Stress Corrosion. Hydrogen damage. Factors influencing, mechanisms and prevention techniques for all forms of corrosion. Calculation of Corrosion rates using weight lost method and Polarization data. Electrochemical Impedance Spectroscopy.

Effect of Dissolved Oxygen (Air saturated Water, High Partial Pressure of Oxygen and Anaerobic bacteria), Temperature, pH, Galvanic coupling, velocity, dissolved salts concentration. Wet and dry corrosion.

LO7: Identify the type of corrosion
LO8: Recommend proper remedial measures

Textbooks :

1. Corrosion and Corrosion Control by Herbert, H. Uhlig John Wiley and Sons Inc., New York.
2. Corrosion Engineering by Mars F Fontana, McGraw Hill.
3. An Introduction to Electrochemistry by Samuel Glass stone, Affiliated East West Press Pvt. Ltd.,

Reference Books :

1. Corrrosion Volumes 1 & 2 by L.L. Shrier, Newnes - Butter-worths, London.

BIO - 1.1.4 B - Elective-II (Energy Engineering-I)
Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

Objectives:

To lean overview of solar radiation and it's potential for collection to meet the energy needs of mankind and potential for solar energy option. To learn measuring techniques of solar radiation and its compilation.

To learn various design and operational aspects of solar energy collection and storage.

To learn the design and operation of solar energy appliances like liquid flat plate collectors, Solar Air Heaters, Thermal energy storage, Thermal energy storage, Solar Pond, Solar thermal power generation.

To learn theory and application of Photovoltaic cells

Outcome:

The student learns collection and design of various kinds of equipment operated on solar energy. The student learns principles and practice of Photo voltaic cells.

Syllabus:

The Solar Energy option

Thermal conversion – collection and storage Thermal applications – photovoltaic conversion – wind energy – Energy from Bio – mass – ocean thermal energy conversion.

Solar Radiation

Solar Radiation outside the earths – atmosphere Solar radiation at the Earth's surface – Instruments for measuring Solar Radiation – Solar Radiation data – Solar Radiation Geometry Empirical equations for predicting the availability of Solar Radiation – Solar radiation on tilted surface.

Liquid flat – Plate Collectors

Components of liquid flat plate – various types of collectors – Performance Analysis – Transmissivity – Absorptivity product – Overall loss coefficients and heat Transfer correlations – Collector efficiency heat removal factors – effect of various parameters on performance. Transient Analysis – Testing procedures.

Solar Air Heaters

Various types of solar Heaters – Performance Analysis of a conventional Air Heater – Testing procedures – Concentrating collectors – various types of concentrating collectors cylindrical and parabolic collectors – General receiver collectors.

Thermal energy storage

Sensible heat storage – Latent heat storage – Thermochemical storage

Solar Pond

Description – Performance analysis – Experimental studies – Operational problems.

Solar Air Conditioning and Refrigeration

Heat pump cycle – Coefficient of performance of the heat pumps – solar air-conditioning with absorption – Refrigeration system (Ammonia water and lithium bromide – water systems).

Solar thermal power generation

Thermal and direct electricity generation – Major sub-stations of a solar thermal power plant, Examples of installed systems – Concentration ratio. Temperature and efficiency concepts – Solar farm and tower – Economics.

Photovoltaic Energy Conversion

Photovoltaic Energy Conversion Fundamentals – band theory of solids – Physical processes in a solar cell – Solar cell with light incidence – Solar cell module – Silicon Solar Cells – Copper Sulphate / Cadmium sulphide Solar Cells.(Banasal et at.,chapters 9;Taylor, chapters 6, pages 256-298.

Text Books:

1. Solar Energy: Principles of thermal collection and storage by S.P. Sukhatme, Tata McGraw Hill, New Delhi 1984 (Chapters 2 to 8)
2. Renewable energy sources and conversion technology by N. K. Bansal, M. Kleemann, Michael Mcliss, 1990 (Chapters 2 – 9).

BIO - 1.1.4 C - Elective-II (Reaction Engineering-I)
Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

Unit I : (Scope : J.M. Smith : Chapter 7): Heterogeneous Processes, catalysis, and absorption: Global Rates of Reaction - Types of Heterogeneous Reactions - The nature of catalytic Reactions - The Mechanism of catalytic Reactions - Surface Chemistry and Absorption - Absorption Isotherms - Rates of Absorption.

Unit II (Scope : J. M. Smith: Chapter 8 : Solid Catalysts: Determination of surface area - Void Volume and solid density - Fore volume distribution - Theories of Heterogeneous Catalysis - Classification of catalysts - Catalyst Preparation - Promoters and Inhibitors Catalyst Deactivation (Poisoning).

Unit III: (Scope: J.M. Smith : Chapter 9): Rate equations for fluid - Solid Catalytic Reactions: Rates of adsorption, Desorption, Surface Reaction - Rate equations in terms of Fluid phase concentrations at the catalyst surface - Qualitative analysis of rate equation - Quantitative inter pretation of Kinetic data - Redox Rate equations.

Unit IV: (Scope : Octave Levenspiel : Chapter 15) : Deactivating Catalysts : Mechanism of Catalyst Deactivation - The ratre of equation - The rate of equation from experiment - Batch - solids: Determining the rate for Independent Deactivation Batch - solids : Determining the rate of parellel, series or side - by - side Deactivation - Flowing solids experimental Reactors - Finding the Mechanism of Decay from experiment Design.

Unit V: (Scope : J. M. Smith : Chapter 10) : External transport Processes in Heterogeneous Reactions: Fixed bed reactors - The effect of physical processes on observed rate of reaction - Mass and Heat transfer coefficients (fluid particle) in packed beds - Quantitative treatment of external transport effects - Stable operating conditions - Effect of external transport Processes on selectivity.

Fluidised bed reactors - Particle - fluid Mass and Heat transfer Slurry Reactors - Mass transfer coefficients: Gas bubble to liquid (K_l) - Mass transfer coefficients: Liquid to particle (K_c) - The effect of mass - transfer on observed rates Trickle - Bed reactors - mass transfer coefficients: Gas to liquid ($K_l a_g$) - Liquid to particle ($k_c a_c$) - Calculation of global rate.

Text Books:

1. Smith. J.M., " Chemical Engineering Kinetics", McGraw Hill book Company, New Delhi (Third Edition) 1981.
2. Octave Levenspiel, " Chemical Reaction Engineering" , Wiley Eastern Limited - Second Edition - 1972.

Reference Books :

1. Thomas, J.M. And Thomas, W.J. " Introduction to the Principles of Heterogeneous Catalysis". Academic Press Inc., New York 1967.
2. Carbnerry, James, J., " Chemical and Catalytjic Reaction - Engineering", McGraw - Hill, Engineering Series.

BIO 1.1.5: RESEARCH METHODOLOGY AND IPR

Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis, Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science
2. & engineering students’”

3. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

4. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”

5. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.

6. Mayall , “Industrial Design”, McGraw Hill, 1992.

7. Niebel , “Product Design”, McGraw Hill, 1974.

8. Asimov , “Introduction to Design”, Prentice Hall, 1962.

9. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
10. Technological Age”, 2016.

11. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

BIO 1.1.6 A: Audit Course-1 (YOGA FOR WORKING PROFESSIONALS)

Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

Course objectives:

1. To make the student understand various practices of yoga and yoga diet.
2. To make the student be familiar with various asanas and other associated practices.
3. To make the student appraise the holistic benefits of yoga
4. To make the student identify a therapeutic solution for common health issues.
5. To make the student experience the pranahuti aided meditation.

Course outcomes:

1. The students will discover the importance of yoga for leading a disciplined way of life.
2. The students would improve their wellness by adapting various yogic practices in their day to day life.
3. The students would perceive the holistic benefits of yoga
4. The students can judge the causes of common diseases and can recommend therapeutic solutions based on yogic practices
5. The student can compare the placebo meditation and meditation with pranhuti.

Unit-I: Introduction to Yoga

The Origins of Yoga – Definitions - Concepts - Aims and objectives of Yoga - Yoga is a Science and Art - Ideal Practice of Yoga in the new millennium. Streams of Yoga - Karma Yoga - Bhakti Yoga -Jnana Yoga - Raja Yoga (Astanga Yoga) - Hatha Yoga - Yoga and Diet - - Yoga Disciplined way of life. Difference between Yogasanas and Physical Exercises.

Learning outcomes:

1. After completing this unit, the students will be able to recognize the differences between yogic practices and physical exercises.
2. At the end of this unit, the students will be able assess the relevance of yogic practices for holistic wellness in the contemporary times.

Unit-II: Yogasanas with practical

Loosening the joints- Joint freeing series, Suryanamaskar, Tadasana, Trikonasana, Artha chandrasana, Danurasana, Utkatasana, Dandasana, Pavanamuktasana, Hamsasana, Arthakati

chakrasana, Artha chakrasana, Janusirasasana, Vajrasana, Makarasana, Padmasana, Sukhasana, Natrajasana, Savasana. Introduction to Kriyas, Pranayamas, Bandhas and Mudras.

Learning outcomes:

1. The students will be able to demonstrate some selective yogasanas.
2. The students will be able to appraise the importance of allied yogic practices such as pranayama, mudras, bandhas and kriyas.

Unit-III: Physiological benefits of Yoga

Physiological Benefits of Asanas and Pranayama – Chest Cage – Regulation of Breathing – Types of Breathing. Physiological Benefits of Bandhas – Mudras – Kriyas - Meditation – Nadis – Chakras – Kundalini shakti – Psycho-neuro Immunology. Role of Yoga on Psychological Qualities and Psychological Disorders.

Learning outcomes:

1. By studying this unit, the students will be able to value the physiological benefits of yoga practices.
2. The students will be able to support the role of yoga in the treatment of psychological disorders at the end of this chapter.

Unit-IV: Introduction to Yoga Therapy

Essence and Principles of Yoga therapy- Physiology and Pathology in the yoga – Shatra- koshas – doshas- Granthis – Pancha prana – Application of Yoga and its types- Methodology in Yoga Therapy – Factors (Heyam, Hetu, Hanam and Upayam) - Methods (Darsanam, Sparsanam, Prasnam, Nadi, Pariksa) Examination of Vertebra, joints, Muscles, Abdomen and Nervous system and therapeutic applications – Modification of yogic practices for Human Systems- Yogic diet.

Learning outcomes:

1. At the end of the unit, the students become familiar in assessing the health of an individual.
2. After completing this unit, the students can recommend appropriate yoga therapy for health problems faced by an individual.

Unit-V: Meditation

(The student has to maintain a diary to record his observations during meditation. This diary will help him to understand the extent of his progress)

Meaning and Concept of Meditation – Need of meditation- techniques of meditation-Tools of meditation-Advantages of Meditation- Experience of meditation- Obstacles. Sahaj Marg

Meditation, Heartfulness movement. Elements of sahaj marg meditation: Prayer, cleaning, sitting, satsang, universal prayer and suggestions. Ten maxims of sahaj marg.

Learning outcomes:

1. The student will be well versed in the benefits of meditation at the end of the unit.
2. The student can experience the difference in normal situation and meditative condition after experiencing pranahuti aided meditation.

Reference books

1. George Feuerstein: The Yoga Tradition (Its history, literature, philosophy and practice).
2. Georg Feuerstein. The Psychology of Yoga: Integrating Eastern and Western Approaches for Understanding the Mind.
3. Swamy Satyananda Saraswathi: Asana, Pranayama, Mudra, Bandha (India: Yoga Publications Trust, Munger, Bihar).
4. Swami Sivananda **:** Practice of Yoga (The Divine Life Society, Shivananda Nagar.P.O.,U.P. Himalayas, India).
5. Krishna Raman: A Matter of Health (Integration of Yoga and western medicine for prevention and cure) (Chennai East West Books(Madras) Pvt. Ltd.,1998.
6. Bhavanani, A.B. (2011): Application of Yoga Concept in the Health Improvement. In: P.Nikic, ed.
7. Ram Chandra, Complete works or Ram Chandra (Babuji) Vol. I, Sri Ram Chandra Misssion, SPHT, Calcutta.

BIO 1.1.6 B- Audit Course -I Organizational Behavior

Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

UNIT-I: Organizational Behavior: Concept of Organization - Concept of Organizational Behavior - Nature of Organizational Behavior - Role of Organizational behavior - Disciplines contributing to Organizational Behavior.

UNIT-II: Motivation: Definition - Nature of Motivation - Role of Motivation - Theories of Motivation: Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and McGregor's Theory X and Theory Y.

UNIT –III: Group Dynamics: Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

UNIT-IV: Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

UNIT-V: Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of communication: Downward, Upward and Horizontal communication.

UNIT-VI: Organizational conflicts: Concept of conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intragroup conflict, Intergroup conflict, Inter organizational conflict - Conflict management.

UNIT –VII: Organizational Change: Nature - Factors in Organizational change -Planned change: Process of planned change - Resistance to change: Factors in resistance to change - Overcoming resistance to change.

Text Books.

1.L.M.Prasad: Organizational Behavior, Sultan Chand & Sons, New Delhi -110002

2.K. Aswathappa: Organizational Behavior, Himalaya Publishing House, New Delhi

Reference Books.

1. Stephen Robbins: Organizational Behavior, Pearsons Education, New Delhi.

II SEMESTER

BIO- 1.2.1- GENETIC ENGINEERING

Objective: 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 or genetic modification 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.

Outcome: At the end of the course the students would have learnt about the importance of developing and practicing of genetic engineering as noble and beneficial for mankind. Understand the basic processes involved in manipulating genetic information used by recombinant and cloning methods, different ways that genetic engineering has used in manufacturing, agriculture, medicine and identify several current issues surrounding genetic engineering. The domain of genetic engineering can extend from plants to cover both the animal and human life.

Syllabus:

I. (a) Introduction to Gene manipulation. (b) Enzymology of gene cloning, modification methylases, restriction endonucleases .

Learning Outcomes:

By the completion of the chapter, the student will be able to-

- Understand gene manipulations.

- Explain various enzymes involved in gene cloning

II. (a) Reverse transcriptase and D N A cloning in E. Coli. (b) Plasmids, cosmids and bacteriophages as cloning vectors.

Learning Outcomes:

By the end of the unit, the student will be able to-

- Understand & identify DNA cloning.

- Identify various cloning vectors

III. (a) Cloning strategies and gene libraries. (b) Recombinant selection and screening.

Learning outcomes:

By the end of the topic, the student will be able to-

- Illustrate various cloning strategies & gene libraries.

- Summarize selection & screening of recombinant genes.

IV. (a) Expression of cloned genes cloning in bacteria other than E. Coil, in yeasts, in plant cells and in mammalian cells in culture. b) Micro injection of genes into ocytes, eggs and embryo.

Learning outcomes:

By the end of the topic, the student will be able to

- Explain the demonstration & expression of cloned genes.

- Identify & Explain the process of micro injections of genes.

V. (a) The genetic code and regulation of gene expression. b) Application of genetic Engineering in the fields of biology, medicine and industries.

Learning outcomes:

By the end of the unit, the student will be able to

- Understand Genetic code & its regulation.

- Select & develop numerous applications of Genetic Engineering.

Text Books: 1. Introductory Bio-Technology by R. P. Singh.

2. Principles of genetic Engineering by old and primarose.

BIO-1.2.2- ADVANCED BIOCHEMICAL ENGINEERING

Objectives:

1. To introduce enzymes, enzymatic and microbial growth kinetics
2. To introduce transport of materials in biological systems with respect to mass transfer and heat transfer
3. To introduce different types of bio-reactors and special reactors like animal and plant cell reactors
4. To introduce immobilization and sterilization techniques

Outcome:

1. To determine the enzyme activity, parameters affecting activity and enzyme immobilization
2. To know gas liquid mass transfer. To determine the K_La and to know inter particle and intra particle diffusion
3. To know about working and analysis of all types of rectors
4. To know thermal death kinetics and sterilization of air and medium

Syllabus:

Enzyme Kinetics: effects on enzyme activity, deactivation, immobilized enzymes.

Learning Outcomes

1. Explain lock and key mechanism of enzyme kinetics
2. Describe different methods of immobilization
3. Distinguish the factor affecting enzyme activity.
4. Derive MM equation.

Microbial growth kinetics: Batch growth, unstructured models, growth in continuous culture, structured models, product formation kinetics, cell immobilization.

Learning Outcomes

1. Compare structured and unstructured models
2. Explain different methods of cell immobilization.
3. Examine the batch growth curve and batch cultivation.
4. Interpret the rate of continuous culturing.

Transport Phenomena: Gas-liquid Mass transfer; Theoretical models for K_{La}, interfacial area and bubble oxygen transfer, gas-liquid mass transfer of components other than oxygen. Mass transfer into solid particles: External transfer, intra particle diffusion.Heat transfer correlations.

Learning Outcomes

1. Explain gas liquid mass transport in biological systems.
2. Illustrate different methods of K_La determination.
3. Compare external transport and intra particle diffusion.
4. Summarize heat transfer correlations.

Bioreactors: Review of various types of bioreactors used in the fermentation industry. Multiphase bioreactors: packed bed, bubble-column, fluidized bed and trickle-bed reactors. Alternate fermenters: new bioreactor configurations used in the fermentation technology and plant cell reactor technology.

Learning Outcomes

1. Demonstrate different types of bioreactors.
2. Describe alternate bioreactor configurations.

Sterilization: Sterilization methods, thermal death kinetics, design criterion, batch and continuous sterilization, air sterilization.

Learning Outcomes

1. Define sterilization and explain thermal death kinetics.
2. Explain air sterilization.
3. Compare batch and continuous sterilization

TEXT BOOK:

Shuler, M. L and F. Kargi, Bioprocess Engineering: Basic concepts, 2nd ed., Prentice Hall India, New Delhi, 2003.

REFERNCES:

1. Lee, J. M., Biochemical Engineering (e Book), Prentice Hall, Englewood Cliffs, 2001.
2. Bailey, J. E., and D. F. Ollis, Biochemical Engineering Fundamentals, 2nd edition, Mcgraw-Hill, New York, 1986.
3. Blanch, H. W., and D. S. Clark, Biochemical Engineering, Marcel Dekker, New York, 1996.
4. Swamy,A.V.N.,' Fundamentals of Biochemical Engineering' , BS publications, 2007

BIO-1.2.3-ADVANCED DOWN STREAM PROCESSING

Objectives:

1.To learn and understand the applied concepts of downstream processing.
2. To enable the students to Understand the methods to obtain pure proteins, enzymes and in general about Product development R & D Have depth knowledge and hands on experience with on Downstream processes

Outcome:

At the end of the course,

1. The student would have learnt about, methods to obtain purify various types of compounds
2. Purification and characterization of various types of bioproducts in large scale level.
3. To execute precise and efficient bioseperations, which in cost effective and yield high degree of pure substance

Syllabus:

UNIT.l: Introduction - An Overview of Bioseparations: Bioprocesses, Range and characteristics of bioproducts, Need for down stream processing, Characteristics of Fermentation broths, An overview of bioseparations; A few case studies.

Cell Disruption: Intracellular products, Cell wall, Cell disruption, Proteins of inclusion bodies. **Reverse Phase and Hydrophobic Interaction Chromatography:** hydrophobic interaction chromatography; Reverse phase chromatography. Basic theory of retention in RPC and HIC; Hydrophobic Interaction Chromatography. Electrokinetic Methods of Separation: the various Method; Electrophoresis; Capillary Electrophoresis; Isoelcctric Focusing; Isotachophoresis.

Learning outcomes:

- Recognize the structures of cells that cause cell lysis to be necessary for the recovery of bioproducts.
- Summarize the factors to be considered in selection of cell disruption method.
- Differentiate between mechanical and non-mechanical cell disruption methods and within these categories, choose appropriate methods for general classes of applications.

UNIT.2: Liquid- Liquid Extraction with Ternary Systems-Instructional objectives: industrial example; Equipment: mixer- settlers, spray columns, packed columns, plate columns, columns with mechanically agitated agitation; General design considerations; Hunter- Nash graphical equilibrium- stage method: number of equilibrium stages, minimum and maximum solvent- to-feed flow rate- ratios, use of right- triangle diagrams, use of an auxiliary distribution curve with McCabe- Thiele diagram, extract and raffinate reflux; Maloney- Schubert graphical equilibrium-stage method; Theory and scale-up of extractor performance: mixer- settler units, multi-compartment columns, axial dispersion.

Learning outcomes:

- Describe the extraction separation process
- Understand the equipment for extraction.
- Apply the principles of extraction and develop basic design of extractor.

UNIT.3: Membrane Separations: Instructional objectives: industrial example; Membrane materials; Membrane modules; Transport in membranes: porous membranes, bulk flow, liquid diffusion in pores, gas diffusion, nonporous membranes, solution- diffusion for liquid mixtures, solution- diffusion for gas mixtures, module flow patterns, cascades, external mass transfer resistances, concentration polarization and fouling; Dialysis and electro dialysis; Reverse osmosis; Gas permeation; Pervaporation; Ultra filtration: process configurations; Micro filtration: constant- flux operation, constant- pressure operation, combined operation. Introduction to liquid membranes, principle, its advantages and its applications.

Learning outcomes:

- understand the principles and materials properties for different membrane separation processes
- Identify the best membrane modules and manufacturing process for different applications
- identify and design the suitable membrane separation technique for intended problem

UNIT.4: Crystallization: Instructional objectives: industrial example; Crystal geometry: crystal-size distributions, differential screen analysis, cumulative screen analysis, surface mean diameter, mass- mean diameter, arithmetic- mean diameter, volume- mean diameter; Thermodynamic considerations: solubility and material balances, enthalpy balances; Kinetic and transport considerations: super saturation, nucleation, crystal growth; Equipment for solution crystallization: circulating, batch crystallizers, continuous, cooling crystallizers, continuous, vacuum, evaporating crystallizers; The MSMPR crystallization model: crystal population balance; Precipitation.

Learning outcomes:

- the effect of the supersaturation on nucleation and crystal growth kinetics - classic and more recent theories for nucleation, crystal growth and agglomeration
- assess the effect of temperature, solvent composition, and supersaturation on the particle size distribution of the crystalline product and how this affects solid-liquid separation

UNIT.5: Drying of Solids: Instructional objectives: industrial example; Drying equipment: batch operation, continuous operation; Psychrometry: wet- bulb temperature, adiabatic-saturation temperature, moisture- evaporation temperature; Equilibrium- moisture content of solids; Drying periods: constant- rate drying period, falling- rate period; Dryer models: materials and energy balances for direct- heat dryers, belt dryer with through- circulation, direct- heat rotary dryer, fluidized- bed dryer.

Learning outcomes:

- understand the operations of drying equipments.
- draw the drying curve and drying rate curve for a wet solid being dried with air of fixed humidity and temperature

Text Books:

Units 2 to 5: 'Separation Process Principles', Seader, J.D. and Henley, EJ, 2Ed.Wiley India.

Unit 1: 'Bioseparations: Principles and Techniques' by B.Sivasankar, Prentice-Hall India.

BIO-1.2.4-Elective-III

B10-1.2.4 A -Elective-III (Industrial Biotech Products)

Objectives:

- To study the structure and functions of various fermentors and study indetail the production media preparation, inoculums preparation and sterilization methods.
- To study the production ethyl alcohol, vinegar, lactic acid , citric acid and amino acids using microbial fermentation processes.
- To study the production of alcoholic and non alcoholic beverages in detail and to study the production of antibiotics, vitamins and baker's yeast, microbial enzymes and co-enzymes in detail using modern fermentation techniques.

Outcome:

- Students will obtain vast knowledge in the fermentation technology to produce various industrially important bio products.
- Students will acquire knowledge in handling bioreactors and sterilization methods.
- Students can start small scale industries to produce bio products using fermentation techniques.
- As this subject gives advanced level knowledge in the production of industrial biotech products, the further improvement and advances can be achieved by research.

Syllabus:

I: Fundamentals involved in the' production of industrial Microbial products such as details of the Fermentors, Synthetic and natural medium, processors, Sterilization methods, and innocuium preparation. A detailed study of 'Ethanol' production by fermentation, using black blinap molasses, aarchy substance and glus\cosic like waste sulphate liquid purification methods of the fermented broth and production, of absolute ethyl alcohol. 2. - industrial microbial processes and source of industrial cultures.

Learning Outcomes:

On completion of this topic, the student will be able to learn

- basic fundamentals involved in the fermentation process and microbial production of various products like ethanol etc

II: Materials for fermentative production of Vinegar, Lactic Acid, Citric Acid, and Amino acids. The method Involves selection of the particular strain of the micro-organism for Industrial Fermentation, process details and purification.

Learning Outcomes:

At the end of the course study, the student will be able to learn

-the production of citric, lactic and vinegar production

-Selection of starin for fermentation , process details and purification process.

III: Production of Alcoholic beverages with Beer, Brandy, Whisky and Wine. Baked goods, cheese and other dairy products.

Learning Outcomes:

On completion of this topic, the student will be able to learn

-Production of alcoholic beverages and dairy products.

IV: Production *of* Antibiotics, Tetracyclines, Alkaloids Bakers yeast and Microbial Enzymes and Co-enzymes.

Learning Outcomes:

On completion of this topic, the student will be able to learn

Antibiotic production like tetracyclines, Bakers yeast and enzymes.

V: Fermentative materials for producing vitamins, Products from plant cell Cultures, Non - alcoholic beverages (Coco, Coffee, Tea fermentation).

Learning Outcomes:

On completion of this topic, the student will be able to learn

Fermentation materials like vitamins , cell culture products and alcoholic beverages.

Textbook:

"Industrial Microbiology" by Samuel C. Presscott and Cecil, G. Dunn; A McGraw - Hill Publication.

References:

1. "Industrial Mic~obiology" by L.E. Casida. Jr. Wiley Eastern Limited. , .
2. "Microbial Technology Vol. 1 and Vol. 2 by H.J. Peppler and D. Pulman (Academic Press).

B10-1.2.4 B -Elective-III (Pharmaceutical Biotechnology)

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

.**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.

B10-1.2.4 C -Elective-III (Agricultural Biotechnology)

Objective: Agriculture has been theorized to have become the dominant way of producing food since the Neolithic Revolution. Throughout the history of agriculture, farmers have inadvertently altered the genetics of their crops through introducing them to new environments and breeding them with other plants — one of the first forms of biotechnology. Agricultural Biotechnology is being used to address problems in all areas of agricultural production and processing. This includes plant breeding to raise and stabilize yields; to improve resistance to pests, diseases and abiotic stresses such as drought and cold; and to enhance the nutritional content of foods. Biotechnology is being used to develop low-cost disease-free planting materials for crops such as cassava, banana and potato and is creating new tools for the diagnosis and treatment of plant and animal diseases and for the measurement and conservation of genetic resources. Animal feeds and feeding practices are being changed by biotechnology to improve animal nutrition and to reduce environmental waste. Biotechnology is used in disease diagnostics and for the production of vaccines against animal diseases.

Outcome: Student gains fair knowledge clearly by coming to a conclusion that biotechnology is more than genetic engineering. Indeed, some of the least controversial aspects of agricultural biotechnology are potentially the most powerful and the most beneficial for the poor. In general we can say agricultural biotechnology as understanding, characterizing and managing genetic resources.

Syllabus:

Introduction - Definition, classical vs modern approach, demand for biological resources, achievements,

Nitrogen Fixation- Basic concepts, nif genes and their regulation, potential scope in crop improvement,

Genetic engineering - aims of genetic engineering, techniques of gene manipulation, **Transformation Techniques** -Physical methods, *agrobacterium,* mediated transformation. **Transgenics -** Basic concept and essential steps of the process, some examples of transgenic plants, use of suitable promoters, gene silencing and measures to overcome it, commercial aspects of the technology. **Molecular Markers -** concept, SNPs, RAPD, RFLP, role in crop improvement and genome mapping,

Molecular and biochemical basis, signalling pathways in the production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, pest resistance, drought and other abiotic stress resistance,

Plant as Biofactories - Concept, production of chemicals, pigments, perfume, flavors, insecticides, anticancer agents and other important compounds, molecular farming, use of plants for production of neutraceuticals, edible vaccines and other desired products,

SCP - micro organisms, nutritional value, production of algal biornass, bio fertilizers and bio pesticides, mass cultivation of *Rhizobium, AzatLibacter, Azospirillum, Mycorrhiza,* bluegreen algae and *Azolla.*

Text books:

1. "Agricultural Biotechnology" by Arie Altman, Marcel Dekker, Inc. (2001)
2. "Agricultural Biotechnology", by S.S.Purohit, Agro Bios (India)

Reference book:

1. "Molecular Biotechnology Principles and Applications of Recombinant DNA", by Bernard R. Glick and Jack J. Pasternak,. ASM Press

BIO-1.2.5- ELECTIVE-IV
BIO-1.2.5 A-ELECTIVE-IV (Corrosion Engineering-II)
Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

Objectives:

- To enable the principles of corrosion, common corrosion forms, uniform, galvanic, pitting, inter granular, crevice, dezincification, stress corrosion, corrosion fatigue, hydrogen embrittlement corrosion control methods, and material selection to reduce corrosion cost.
- To enable the ability to understand electrochemical fundamentals
- To enable the ability to understand corrosion preventing methods

Outcome:

- The student would know application of weight loss method
- The student would know application of cathodic protection, anodic ptotection
- At the end of this course, the student would know effective surface preparation of specimen can be done
- After completion of this course, the student would understand the causes and the mechanisms of various types of corrosion, including uniform corrosion, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion.
- The student would know application of Corrosion Processes and Evans Diagrams and application of electroplating, coatings and importance of inhibitors.

Syllabus:

Corrosion in selective environments: Marine, Acids (Sulfuric acid, Hydrochloric acid, Nitirc acid, Phosphoric acid) Biological and industrial gases (SO_2H_2S).

- Able to understand corrosion and its mechanism in marine atmosphere.
- Able to understand corrosion in acidic media like Sulfuric acid, Hydrochloric,etc.

Corrosion Testing - Purposes, Materials and specimen. Surface preparation, Measuring and weighing , Exposure Techniques - duration, Planned - Interval Tests, Aeration, cleaning specimens after exposure, Temperature, Standard expression for corrosion rates - Galvanic Corrosion, Erosion Corrosion, crevice Corrosion, Intergranular corrosion, test for stainless steels, warren test pitting, stress corrosion, Paint tests, Sea Water tests, Presenting and summarizing data - Nomo graph for corrosion rates and interpretation of results.

- Able to understand the importance of surface preparation.

- Able to understand the application of Standard expression for corrosion rates using weight loss method.
- Able to understand the application of different corrosion tests.

Cathodic and anodic protection, surface preparation for coatings and chemical conversions: Degreasing, Descaling , Polishing - Anodized coating : anodizing oxidizing, chromate coating, phosphate coatings - Metallic coatings : Hot dipping, cementation, vapor deposition of metallic coating; Sprayed coatings: flame spraying plasma spraying, Galvanizing - Electroplating : Nickel & chromium coatings, chromizing.- Organic coatings : paints, enamels, lacquers, resin mixtures.

- Able to understand the application of Cathodic and anodic protection.
- Able to understand the uses of Degreasing, Descaling , Polishing.
- Able to understand the importance of Hot dipping, cementation, vapor deposition of metallic coating.

Linings, laminates, reinforced plastic, fibre glass - Corrosion inhibitors: mechanism of inhibition, recirculating of water of water systems.

- Able to understand the importance of Corrosion inhibitors and mechanism of inhibition.

Measurement and testing of preventive coatings ; Thickness and Resistance tests for anodized, Painted, electroplated surfaces using polarization resistance, Linear polarization, curve fit analysis and Electrochemical impedance spectroscopy.

- Able to understand the Thickness and Resistance tests.
- Able to understand the linear polarization and curve fit analysis.

Reference books :

1. Mars G.Fontana - Corrosion Engineering
2. Burns, R.M., Bradley, W.W., 'protective coatings for Metals.' Chapters 2 to 18.

Reference Books :

Corrrosion Volumes 1 & 2 by L.L. Shrier, Newnes - Butter-worths, London.

BIO- 1.2.5 B - Elective-IV (Energy Engineering-II)
Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

Course objectives:

1. The student is provided with the fundamentals of renewable energy processes.
2. Basic information to comprehend the various non-conventional energy systems would be illustrated to the student.
3. Various ways of obtaining energy from ocean can be demonstrated to the student.
4. The methods of energy conservation and the opportunities for conservation would be emphasized.
5. Economics involved in the energy production processes would be enumerated to the student.

Course Outcomes:

1. Methods to be adopted to utilize biomass as an important energy source
2. Application of thermodynamics to obtain energy from various sources
3. Possible mechanism to draw energy from wind and other natural resources
4. Knowledge about energy conservation and storage
5. Emerging technologies to produce energy such as thermionics, thermoelectricity etc.

Syllabus:

Fundamentals of energy science and technology: Introduction – Energy, economy and social development – Oil crisis of 1973 – classification of energy sources – consumption trend of primary energy resources – importance of non-conventional energy sources – energy chain – common forms of energy – advantages and disadvantages of conventional energy sources – salient features of non-conventional energy sources – energy densities of various fuels – environmental aspects of energy – The United Nations Framework Convention on Climate Change – Energy-environment-economy – World energy status – energy scenario in India. **Energy conservation and efficiency:** Introduction – important terms and definitions – important aspects of energy conservation – global efforts, achievements and future planning – energy conservation/efficiency scenario in India – energy audit – energy conservation opportunities – cogeneration – combined cycle plants. **Energy storage:** Introduction – necessity of energy storage – specifications of energy storage devices – energy storage methods.

Learning outcomes:

1. The student can identify the ways and means of conservation of energy once the student completes learning this unit.

2. The student can appraise the necessity of energy storage and recommend the methods for energy storage at the end of the unit.

Wind energy: Introduction – origin of winds – nature of winds – wind turbine siting – major applications of wind power – basics of fluid mechanics – wind turbine aerodynamics – wind turbine types and their construction – wind energy conversion systems – wind-diesel hybrid system – effects of wind speed and grid condition – wind energy storage – environmental aspects – wind energy program in India.

Learning outcomes:

1. By studying this unit, the students will be able to predict where the wind power plants can be located.
2. At the end of this unit, the students can recommend appropriate technology for obtaining geothermal energy in a given situation.

Biomass: Introduction – Photosynthesis process – usable forms of biomass, their composition and fuel properties – biomass resources – biomass conversion technologies – urban waste to energy conversion – biomass gasification – biomass liquefaction – biomass to ethanol production – biogas production from waste biomass – energy farming. **Geothermal energy:** Introduction – applications – origin and distribution of geothermal energy – types of geothermal resources – analysis of geothermal resources – exploration and development of geothermal resources – environmental considerations – geothermal energy in India.

Learning outcomes:

1. After completing this unit, the students will be able to choose appropriate biogas plant for a given location and able to provide dimensions of the same. .
2. At the end of this unit, the students will be able to recommend a process for utilizing the biomass for a given application.

Ocean Energy: Introduction: Tidal energy – wave energy – ocean thermal energy. **Small hydro resources:** Introduction – advantages and disadvantages of small hydro schemes – layout of a micro-hydroscheme - water turbines – turbine classification, characteristics and selection – generators – present status.

Learning outcomes:

1. At the end of this unit, the students can recommend appropriate technology for obtaining energy from ocean in a given situation.
2. Suitable scheme for generating electricity from small hydroresources can be suggested by the student after the completion of this unit.

Emerging technologies: Introduction – fuel cell – hydrogen as energy carrier. **Miscellaneous non-conventional energy technologies:** Introduction – magneto hydrodynamic power conversion – thermoelectric power generation – thermionic power conversion. **Financial and economic evaluation:** Introduction – basic terms and definitions – calculations for the case of single payment – calculation for uniform series of payments – calculations for uniform gradient series of payments – calculations for geometric gradient series of payments – effect of inflation on cash flows – comparative economic evaluation of alternatives – effect of depreciation and tax on cash flow.

Learning outcomes:

1. New technologies for obtaining energy from various renewable sources can be evaluated by the student.
2. Economic factor in the energy production by various technologies can be compared by the student at the end of this unit.

Text book:

Non-Conventional Energy Resources by B.H. Khan, 3/e, McGraw Hill (2017).

Reference book:

Fundamentals of Renewable Energy Processes by Aldo V. Da Rosa. Elsevier (2005).

BIO- 1.2.5 C - Elective-IV (Reaction Engineering-II)
Common for M.Tech (Chemical, MPE, IPCE, CACE & Biotechnology)

Syllabus:

UNIT - I

Laboratory Reactors - Interpretation of Experimental Data - Interpretation of Laboratory Kinetics Data - Homogeneous and Heterogeneous Laboratory Reactors. Calculation of Global Rate - The structure of Reactor Design.

(Scope: Chapter 12 of J.M Smith 3rd Edition)

UNIT - II

Design of Heterogeneous Catalytic Reactors Isothermal and Adiabatic Fixed Bed Reactors Non-isothermal, Non-adiabatic Fixed Bed Reactors.

(Scope: Chapters 13.1 - 13.9 of J.M Smith 3rd Edition)

UNIT - III

Design of fluidized bed Reactors - Two -Phase Fluidized Bed model - Operating characteristics - Slurry Reactors - Trickle - Bed Reactors - Optimization.

(Scope: Chapter 13.10 - 13.13 of J.M Smith 3rd Edition.)

UNIT - IV

Fluid - Solid Noncatalytic Reactions - Design concepts - Single Particle Behavior - Reactor Models.

(Scope: Chapter 14 of J.M Smith 3rd Edition)

UNIT - V

Short notes from the portions of all the above four units. Four bits are to be answered out of 7 bits (Not more than 2 bits to be given from any one Unit).

Text Book: Chemical Engineering Kinetics by J.M Smith, McGraw - Hill Book Company , 1980, 3rd Edition.

BIO 1.2.6: AUDIT COURSE -2
BIO 1.2.6 A : DISASTER MANAGEMENT (Audit Course -2)
Common for M.Tech (Chemical, MPE, CACE, IPCE, Biotechnology)

Introduction to Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types and Magnitude.

Repercussions Of Disasters And Hazards: Economic Damage, Loss of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Disaster Prone Areas in India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental And Community Preparedness.

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies for Survival

Disaster Mitigation Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.

3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi.

BIO 1.2.6 B: ENTREPRENEURSHIP (Audit Course -2)

Common for M.Tech (Chemical, MPE, CACE, IPCE, Biotechnology)

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.

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.

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.

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.

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.

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,

III Semester

BIO -2.1.1- Elective-V

BIO -2.1.1 A- Elective-V (Enzyme Engineering)

Course Objectives:

1. Understand the importance of enzymes, their classification, sources, extraction and purification of enzymes.
2. Understand the mechanism of enzyme action, their kinetics and types of enzyme inhibitions.
3. Study the various types of Inhibitions.
4. Study the various sources of Enzymes.
5. Learn the methods of extraction and purification.
6. Know about the advantages of immobilization of enzymes, methods of immobilization.
7. Acquaint with the applications of enzymes in solution as well as immobilized enzymes.

Course Outcomes:

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

1. Able to appreciate the importance of enzymes and know about their sources and extraction.
2. Analyze the kinetics of enzyme reactions.
3. Identify the type of enzyme inhibition.
4. Assess the sources of enzymes.
5. Describe the various methods of extraction and purification of enzymes.
6. Differentiate different immobilization techniques.
7. Recall different enzymes and their applications used in various industries.

Syllabus:

INTRODUCTION TO ENZYMES: Importance of enzymes in Biotechnology, Nomenclature and classification of enzymes, enzyme specificity, coenzymes, enzyme units and turnover number, factors affecting enzyme activity (pH, temperature, chemical agents and irradiation), mechanism of enzyme catalysis.

Learning Outcomes:

1) List the importance of enzymes

2) Differentiate the enzymes on the type of reaction they catalyze.

ENZYME KINETICS: Simple enzyme kinetics, Michaelis-Menten equation, Quasi-steady-state kinetics and Briggs –Haldane approach, Evaluation of parameters in Michaelis-Menten equation.

Learning Outcomes:

1) Study the enzyme kinetics.
2) Evaluate the parameters of Michaelis-Menten equation.

ENZYME INHIBITION: Inhibition of enzyme reactions-Competitive, non-competitive, uncompetitive, substrate and product inhibition, deactivation kinetics, derivations of M-M form of equations for various inhibitions.

Learning Outcomes:

1) Evaluate the type of inhibition for a given reaction.
2) Assess the inhibition.

SOURCES OF ENZYMES: Plant, animal and microbial sources and their advantages and disadvantages.

Learning Outcomes:

1) Investigate the various sources of enzymes.
2) Apply the appropriate source of enzyme for maximum production.

ENZYME EXTRACTION AND PURIFICATION: Methods of production of enzymes, cell disruption, extraction of enzymes, purification of enzymes.

Learning Outcomes:

1) Justify the extraction methods to use.
2) Discuss the purification methods of enzymes.

ENZYME IMMOBILIZATION: Methods of immobilization- physical and chemical (covalent binding, cross-linking, adsorption, matrix entrapment and microencapsulation), advantages and disadvantages of different immobilization techniques, kinetics of immobilized enzymes, mass transfer effects in immobilized enzyme systems.

Learning Outcomes:

1) Recommend the type of immobilization method for the production.
2) Study the kinetics of immobilized enzymes.

ENZYME APPLICATIONS: Application of enzymes in various industries (brewing, detergent, starch, baking, dairy, food, leather, wool, animal feed, textile, paper and pulp, pharmaceutical).

Learning Outcomes:

1) Construct the various enzymes used in the industries.
2) Apply the enzymes produced in industries.

APPLICATION OF IMMOBILISED ENZYMES: Immobilized enzyme processes, HFCS, production of amino acids, antibiotics.

Learning Outcomes:

1) Sort the different immobilized enzymes used in various industries.
2) Apply the immobilized enzymes in industries.

Text books:

1. Enzyme Technology by Chaplin, M.F and Bucke, C Cambridge University Press,1990.
2. Enzyme Technology 2nd Ed S.Shanmugan, T.Sathish Kumar, M.Shanuga Prakash I.K.International Publishing House Pvt. Ltd.
3. Biochemical Engineering Fundamentals. J.E.Bailey and David F Ollis 2nd Edition 1986, McGraw Hill.

References books:

1. Enzyme Engineering. L.B.Wingard, J.Inter Science, New York 1972.
2. Enzymes Trevor Palmer East West Press Pvt. Ltd. New Delhi.

BIO -2.1.1 B- Elective-V (Stem Cells in Health Care)

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.

BIO -2.1.1 C- Elective-V (Environmental Biotechnology)

(Common with IPCE)

Objectives:

- Student to learn and understand environmental problems locally as well as global issue and consequencies.
- To learn about xenobiotics and their effect on ecosystem. To learn about biodiversity available.
- To learn about alternative and noval methods like biosorption of metals and bioleaching.

Outcome:

- Students have enough skills to identify the environmental problems and control measures.
- Students are in a position to plan to treat various industrial effluent using biotechnological methods

Syllabus:

Unit-1 Ecosystem

Environment, types of Environment, Environment and Development, Environmental management, environmental education, principles of ecology, ecosystems, types of ecosystems, ecosystem structure and functioning, food chains, food webs, Ecological pyramids, nutrient cycling, microbial associations.

Learning Outcomes:

On completion of this topic, the student will be able to

i. Understand various types of ecosystems, association of components of ecosystems

ii. Have an idea about food chains, food webs, ecological pyramids etc.

Unit-2 Pollution control

Source, effects and control aspects of various pollutants: Air (Particulate matter, SOx, NOx, COx, CHx, noise), water (primary, secondary and advanced treatment techniques), solids (recycling, incineration and bioconversion) Global environmental problems: global warming, ozone depletion and acid rain. Industrial effluent treatment: case studies of paper and pulp, tannery, pharmaceutical, fertilizer and petroleum industries.

Learning Outcomes:

On completion of this topic, the student will be able to

i. Have an ability to discuss various types of pollution & its control.

ii. Identify Global environmental problems and treatment if necessary.

Unit-3 Biological Activities in the Environment

Biodegradation of Xenobiotics: Xenobiotic compounds in the environment, persistent compounds, degradation mechanisms.

Bioremediation: Bioremediation by microorganisms, bioremediation process and technologies, measuring bioremediation in the field, monitoring and efficacy of bioremediation.

Biosorption of metals: Microorganisms and metal absorption, factors affecting bioabsorption, bioreactors and bioabsorption, phytoremediation.

Bioleaching: Types of bioleaching, advantages and disadvantages of bioleaching, methods for bioleaching.

Learning Outcomes:

On completion of this topic, the student will be able to

i. Understand various biological activities like biodegradation, bioleaching, biosorbtion of metals, bioremediation etc, occurring in the Environment.

ii. advantaged & disadvantages of above biological activities.

Unit-4 Biodiversity: Levels of biodiversity, value of biodiversity, global biodiversity, hotspots of biodiversity, threats to biodiversity, conservation of biodiversity.

Learning Outcomes:

On completion of this topic, the student will be able to

i. Have an idea of Biodiversity, its value & levels.

ii. Understand threats & hotspots and conservation of biodiversity.

Unit-5 Environment and energy: Biomass sources, biomass production and utilization for energy, biomass conversation routes, energy crops, biofuels, biodiesel, hydrogen Production, conservation of energy. Biofertilizers, biopesticides, biofilters, biosensors, biopolymers and bioplastics.

Learning Outcomes:

On completion of this topic, the student will be able to

i. Have an ability to understand Environment & its energy conservation.

ii. To identify & utilize biofertilizers, biopesticides, biosensors, biofilters, biopolymers & bioplastics, etc

TEXT BOOKS:

1. Environmental Pollution Control Engineering by C. S. Rao. Wiley Eastern Limited
2. Waste Water Treatment: Rational Methods of design and industrial practices by M. Narayana Rao and Amal K. Datta. Oxford & IBH publishing Co. Pvt. Ltd.
3. Environmental Biotechnology: Basic concepts and applications by Indu Shekhar Thakur. 1. K. International Pvt. Ltd.

REFERNCE BOOKS:

1. Microbial Ecology: A conceptional approach by Lunch, 1. M. Oxford Black N.S.D.
2. Environmental Biotechnology by Geetha Bali. APH Publishing Corporation.

BIO-2.1.2: Elective –VI (Open Elective)
BIO-2.1.2 A : Elective-VI (Nanotechnology)
Common for M.Tech (Chemical, MPE, CACE, IPCE, Biotechnology)

Objectives:

Nanotechnology may be treated as **Green technology**. It is one of the most advanced technologies now-a-days. It leads to have revolutionary changes in the fields of medical, Bio-medical, and fabrication of materials. Technologists are able to prepare ageless materials with the help of nano-techniques. Main objectives of the subject nanotechnology are :

1. To define green technology properly
2. To expose the students with new techniques of the nanotechnology.
3. To make them to learn the importance of quantum technology
4. To learn the procedure ageless materials to avoid wear-tear.
5. To learn the importance of nano –robots, machines
6. To know about the latest microscopes such as SEM, TEM
7. To know the importance of nanotechnology in the dawn of optical instruments

Outcome:

1. Application of nanotechnology in the development of energy
2. Application of nanotechnology in the development of solar panels, Fuel cells
3. Knew the importance of atoms manipulation
4. Knew that the applications of nanoparticles in the development of DVD, LEDs etc.
5. Biomedical applications in terms of preparing artificial, drug delivery, encapsulation, addition to that pharmaceuticals.

Syllabus:

1. Introduction to nanotechnology, molecular and atomic size, surface and dimensional spaces. Molecular nanotechnology: atoms by inference, electron microscopes, nanomanipulator, nanotweezers, atom manipulation, nanodots, nanolithography.

Learning Outcomes:

- Define the term nanotechnology to understand in a better way the subject basics

- Demonstrate the different types of Electron Microscopes and their uses.

2. Nanopowders and nanomaterials: preparation, plasma arcing, chemical vapor deposition, sol-gels, electrodeposition, Ball milling, applications. Carbon nanotubes: types, formation, assemblies, purification, properties and uses.

Learning Outcomes:

- Summarize the nanomaterials used for the preparation of nanopowders
- Apply and selection of the different methods to prepare nanopowders
- Classify the carbon nanotubes and purification process.

3. Molecular mimics: Catenanes and rotaxanes, various molecular switches, synthesis of rotaxanes and catenanes, molecular computers, chemical rotors, prodders, flippers, atom shuttles, actuators, contacts.

Learning Outcomes:

- Categorize the molecular switches and synthesis of rotaxane and catenanes
- Examine the function of molecular computers

4. Nanobiometrics: Lipids as nano-bricks and mortar, self – assembled monolayers, proteins, 3-D structures arising from amines acids, nanoscale motors, Biological Computing, ion channels as sensors, Information in DNA structure, using DNA to build nano-cubes, hinges, smart glue, wire template.

Learning Outcomes:

- Evaluate the importance of nanobiometrics as self-assembled monolayers and nanoscale motors.
- Explain the process of biological computing and using DNA as hinges, smart glue, wire template

5. Optics, photomics and solar energy: Properties of light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, Imaging, New low cost energy efficient windows and solar absorbers based on nanoparticles, Photonic crystals, surface wave guides and control of light paths.

Learning Outcomes:

- Discuss about the optics, photomics and solar energy with reference to light properties.
- Chose a technique using nanoparticles to manufacture solar absorber, photonic crystals and change the light path.

6. Nanoelectrons: birth of electrons, semiconductors, transistor, integrated circuits, the tools of micro and nanofabrication, quantum electronic devices, quantum information and quantum computers, experimental implementations of quantum computers.

Learning Outcomes:

- Appraise different phased in the development of nanoelectornics tools.
- Construction of quantum computers and its experimental implementations.

7. Future applications: microelectomechanical systems, nano-robots , ageless materials, invisible mending of atomic dislocations inside damaged materials, nanomechanics and nanoelasticity, nanoparticle coatings, nanoelectronic and magnetic devices and new computing systems, optoelectronic devices, environmental applications.

Learning Outcomes:

- Assess the future application of nanotechnology in various fields
- Create new tools with nanotechnology to prepare new devices

Text-book:

1. M.Wilson, K.Kannangara, G. Smith, M. Simmons and B. Ragues, **Nanotechnology**, Overseas press (India) Private Ltd; New Delhi, 2005.

Reference books:

1. G. Ali Mansoori*, **Principles of Nanotechnology**, World Scientific Publishing Company, 2005.
2. G. Timp, Nanotechnology, Springer-Verlag, Network, 1999.
3. P. Poole and F.J. Owens, Introduction to Nanotechnology, John Wiley, 2003.
4. D.Ratner and M.Ratner, Nanotechnology: A Gentle Introduction, Pearson Education,2003.
5. B. Bhusan, Handbook of Nanotechnology, Springer, 2004

BIO-2.1.2 B: Elective-VI (POLLUTION CONTROL)
Common for M.Tech (Chemical, MPE, CACE, IPCE, Biotechnology)

Objectives:

- Focus on classification of air pollutants, water pollutants and solid waste –causes, effects and control methods, need of environmental Legislation.

Outcome:

- Enables the students to adopt the preventive measures for the control of air pollutants, waste water treatment methods, and solid waste management methods in domestic, municipal waste.
- Enables the students to understand the control measures of pollutants emitted from different industries like Paper and pulp, fertilizer, sugar and alcohol, petrochemical and petroleum refinery, pharmaceutical and metal finishing industries.

Syllabus:

Kinds of ecology, environment and ecofactors, types of ecosystems, sulphur cycles, phosphorous cycle, Nitrogen cycle and hydrological cycle

Sources for water, Air and solid pollution, Analysis and effects of the pollutants in air, in water, Solids(particulate matter, SOx, NOx, Cox, CHx).

Limits of pollutants, Environmental Legislation.

Control aspects of various pollutants Air (Particulate matter, SOx, NOx, COx, CHx, Noise) water (primary, secondary and territory treatment techniques) Solids (recycling, incineration,bio-conversion).

Case studies of Industries: Paper and pulp, petrochemical, Fertilizer, Pharmaceuticals, tannery, sugar and alcohol industries, metal finishing industries.

Learning Outcomes:

- Describe different ecosystems
- Explains the bio-geochemical cycles
- classify the main types of pollution and their effects
- Describe the sources of pollution and their characteristics
- Describe the effects of air and water pollution on the environment and on human health
- Explain the importance of Environmental Legislation for pollution prevention and control
- Evaluate the preventive measures for the control of air pollutants – SPM
- Select the most appropriate technique to control SOx, NOx, COx, CHx
- Describe the primary, secondary and territory treatment techniques waste water treatment methods
- Propose control measures of pollutants emitted from different industries like paper and pulp

- Plan to select most appropriate technique to control pollutants from petrochemical and refineries
- Explain the control aspects of pollutants from Fertilizer, Pharmaceuticals
- Elucidate the control aspects of pollutants from tannery, sugar and alcohol industries, metal finishing industries

Text books:-

1. S.P.Mahajan., Pollution control in process Industries, Tata McGraw hill publishing company.
2. Arcadio P. Sincero and Georgia Sincero., Environmental Engineering
3. Environmental Pollution Control., by C.S.Rao, wiely eastern ltd.

BIO-2.1.2 C: Elective-VI (Corrosion Engineering)
Common for M.Tech (Chemical, MPE, CACE, IPCE, Biotechnology)

Course Objectives:

- Basic aspects of electrochemistry relevant to corrosion phenomena,
- Importance and forms of corrosion.
- Knowledge on corrosion rate expressions and measurement techniques.
- Basic knowledge on remedial measures for corrosion.

Course Outcomes:

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

- Identify various forms of corrosion.
- Determine corrosion rates for metals from their polarization curves
- Analyze corrosion rate characteristics from electrochemical impedance spectroscopy
- Select suitable corrosion resistant coatings, oxide layers for various applications

Syllabus

Introduction and scope: Corrosion definition, wet and dry corrosion, mechanism, electro-chemical principles and aspects of corrosion, Faradays laws, resistance, specific resistance, conductance, specific conductance, transport numbers, ionic mobility, corrosion rate expressions, calculation of corrosion rates, thermodynamic aspects of corrosion, equilibrium potential, Nernst equation for electrode potential, EMF series, over voltage, application of Nernst equation to corrosion reactions,

Polarisation and corrosion potentials: References electrodes for corrosion measurements, types of polarisation, concentration, activation and resistance polarizations, Tafel constant, Evans diagrams, anodic control, cathodic control, mixed control, Pourbaix-diagram for Fe-H_2O system,

Various forms of corrosion: Uniform attack, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, selective leaching (dezincification), cavitation damage, fretting corrosion, erosion corrosion, and stress corrosion and remedial measures,

Prevention techniques: Modification of the material by alloying, appropriate heat treatment, chemical and mechanical methods of surface treatment, metallic, non-metallic linings, inhibitors, passivity, Cathodic protection and anodic protection.

TEXT BOOKS:

1. 'Corrosion Engineering' by Mars G. Fontana, Tata McGraw Hill Publishing Company, New Delhi
2. 'Corosion and Corrosion Control' by H.H.Uhllg, John Wiley & Sons Inc., America

REFERENCE BOOKS:

1. 'Electrochemistry' by Samuel Glasstone, Litton Educational Publishing Company
2. 'Electrochemistry, Principles & Applications' by Edmond C.Potter, Cleaver Hume Press Limited