

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
**Scheme of Syllabi 3<sup>rd</sup> Semester**

| Course No.   | Subject                                     | L         | T        | P        | Marks |     | Total      | Duration of Exam. Hrs. |
|--------------|---|-----------|----------|----------|-------|-----|------------|------------------------|
|              |   |           |          |          | Int   | Ext |            |                        |
| BT-201       | Basic Life Sciences & Developmental Biology | 3         | 1        | -        | 40    | 60  | 100        | 3                      |
| BT-203       | Organic Chemistry                           | 3         | 1        | -        | 40    | 60  | 100        | 3                      |
| BT-205       | Bio-Chemistry                               | 3         | 1        | -        | 40    | 60  | 100        | 3                      |
| BT-207       | Concepts in Bio-Tech                        | 3         | 1        | -        | 40    | 60  | 100        | 3                      |
| BT-209       | Transfer Processes                          | 3         | 1        | -        | 40    | 60  | 100        | 3                      |
| BT-211       | Industrial Micro Biology                    | 3         | 1        | -        | 40    | 60  | 100        | 3                      |
| BT-213       | Organic Chemistry Practical                 | -         | -        | 2        | 30    | 20  | 50         |                        |
| BT-215       | Bio-Chemistry Practical                     | -         | -        | 2        | 30    | 20  | 50         |                        |
| BT-217       | Micro Biology Practical                     | -         | -        | 2        | 30    | 20  | 50         |                        |
| <b>Total</b> |   | <b>18</b> | <b>6</b> | <b>6</b> |       |     | <b>750</b> |                        |

**Contact Hours: 30**

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
**Scheme of Syllabi 4<sup>th</sup> Semester**

| Sr. no       | Course Code | Course Title                     | L | T | P | Contact Hour | Univ Exam Marks /+ | Sessional Marks/+ | Total Marks |
|--------------|-------------|----------------------------------|---|---|---|--------------|--------------------|-------------------|-------------|
| 1            | BT-202      | Cell & Molecular Biology         | 3 | 1 | - | 4            | 60                 | 40                | 100         |
| 2            | BT-204      | Food Microbiology                | 3 | 1 | - | 4            | 60                 | 40                | 100         |
| 3            | Ch-206      | Heat Transfer                    | 3 | 1 | - | 4            | 60                 | 40                | 100         |
| 4            | Ch-208      | Chemical Process Instrumentation | 3 | - | - | 3            | 60                 | 40                | 100         |
| 5            | Ch-212      | Engineering Materials            | 3 | - | - | 3            | 60                 | 40                | 100         |
| 6            | BT-210      | Cell & Molecular Biology Lab     | - | - | 4 | 4            | 20                 | 30                | 50          |
| 7            | BT-212      | Food Microbiology Lab            | - | - | 4 | 4            | 20                 | 30                | 50          |
| 8            | Ch-214      | Heat Transfer Lab.               | - | - | 4 | 4            | 20                 | 30                | 50          |
|              |             | General Fitness                  |   |   |   |              |                    |                   | 100         |
| <b>TOTAL</b> |             |                                  |   |   |   |              |                    |                   | <b>750</b>  |

**\*\* There should be industrial/institutional training of 6 weeks duration in the summer vacation after 4<sup>th</sup> semester**

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
 Scheme of Syllabi 5<sup>th</sup> Semester

| Course No.   | Subject                             | L | T | P | Marks |     | Total      | Duration of Exam. Hrs. |
|--------------|-------------------------------------|---|---|---|-------|-----|------------|------------------------|
|              |                                     |   |   |   | Int   | Ext |            |                        |
| BT-301       | Genetic Engg                        | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-303       | Immunology & Immunotechnology       | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-305       | Animal cell culture & Biotechnology | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-307       | Enzyme Engineering & technology     | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-309       | Bio-process Engg-I                  | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-311       | Bio-informatics                     | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-313       | Practical based on papers 301,305   | - | - | 2 | 30    | 20  | 50         |                        |
| BT-315       | Practical based on papers 307,309   | - | - | 2 | 30    | 20  | 50         |                        |
|              | Industrial Training                 |   |   |   | 60    | 40  | 100        |                        |
| <b>Total</b> |                                     |   |   |   |       |     | <b>800</b> |                        |

**Contact Hours: 30**

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
 Scheme of Syllabi 6<sup>th</sup> / 7<sup>th</sup> Semester

| Course No.   | Subject                                  | L | T | P | Marks |     | Total      | Duration of Exam. Hrs. |
|--------------|--|---|---|---|-------|-----|------------|------------------------|
|              |  |   |   |   | Int   | Ext |            |                        |
| BT-302       | Microbial bio-technology                 | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-304       | Plant cell culture & Biotechnology       | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-306       | Bio-Process Engg-II                      | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-308       | Bio-reactor Design & operation           | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-310       | Down stream Processing                   | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| CE-216       | Environmental Studies                    | 3 | 1 | - | 40    | 60  | 100        | 3                      |
| BT-312       | Practical –I based on papers 302,304,306 | - | - | 2 | 30    | 20  | 50         |                        |
| BT-314       | Practical II based on papers 308,310,312 | - | - | 2 | 30    | 20  | 50         |                        |
|              | General Fitness                          |   |   |   |       |     | 100        |                        |
| <b>Total</b> |  |   |   |   |       |     | <b>800</b> |                        |

**Contact Hours: 30**

**( 6<sup>th</sup> / 7<sup>th</sup> Semester )**

| Course No. | Subject             | Marks Int. | Marks Ext. | Total | Duration of Exam Hrs. |
|------------|---------------------|------------|------------|-------|-----------------------|
| BT-401     | Industrial Training | 500        | 500        | 1000  |                       |

**Total 1000**

**Punjab Technical University, Jalandhar**  
**B.Tech. Bio-Technology**  
**Scheme of Syllabi 8<sup>th</sup> Semester**

| Course No.   | Subject   | L | T | P | Marks Int. | Marks Ext. | Total      | Duration of Exam Hrs. |
|--------------|---|---|---|---|------------|------------|------------|-----------------------|
| BT-402       | Major Project   | - | - | 8 | 60         | 40         | 100        | 3 Hrs                 |
| BT-404       | Enzyme Catalysed Organic Synthesis                              | 3 | 1 | - | 40         | 60         | 100        | 3 Hrs                 |
| BT-406       | Project Management and Entrepreneurship                         | 3 | 1 | - | 40         | 60         | 100        | 3 Hrs                 |
| BT-408       | Modelling & Simulation of Bioprocesses                          | 3 | 1 | - | 40         | 60         | 100        | 3 Hrs                 |
| BT-410       | Bioanalytical Techniques  | 3 | 1 | - | 40         | 60         | 100        | 3 Hrs                 |
|              | Elective – I  | 3 | 1 | - | 40         | 60         | 100        | 3 Hrs                 |
|              | Elective – II   | 3 | 1 | - | 40         | 60         | 100        | 3 Hrs                 |
| BT-422       | Practical based on Papers 404, 406, 408                         | - | - | 2 | 30         | 20         | 50         | 4 Hrs                 |
| BT-424       | Practical based on Papers 410, 416 or 418 or 420 and 422 or 424 | - | - | 2 | 30         | 20         | 50         | 4 Hrs                 |
|              | General Fitness   |   |   |   | 100        |            | 100        |                       |
| <b>Total</b> |   |   |   |   |            |            | <b>900</b> |                       |

**Options in Electives:**

- BT-412 Biomaterials
- BT-414 Biomedical Engineering
- BT-416 Introduction to Microelectromechanical systems and Nanabiotechnology
- BT-418 Environmental and Occupational Toxicology
- BT-420 Advances in Drug design and drug delivery systems and Pharmacogenomics

**BT-201 Basic Life Sciences & Development Biology****Internal Marks: 40****External Marks: 60****Total Marks: 100****L T P****3 1 0**

**1. Introduction of life:** A hierarchy of organization, the cellular basis of life; the correlation of structure and functions; the inheritance of biological information.

**2. Matter:** Elements and compounds essential of life; various energy levels and energy flow in life; Cell; various organelles, their structure and functions.

**3. Plant Anatomy and Physiology:** Absorption; Nutrition; Reproduction; Control systems.

**4. Animal Anatomy and Physiology:** Nutrition; Circulation, Reproduction and development; Nervous systems, Chemical coordination.

**5. Evolution:** Origin of species; Gene pool; Genetic basis of variation.

**6. Ecology and Population:** Community; Ecosystems, Basic aspects of behavior.

**7. Genetics:** Mitosis; Meiosis; Inheritance; from gene to Protein; Recombinant DNA technology.

**Books Recommended:**

1. Biology by Neil A. Cambell, Benjamin/Commings Company (Latest Edition)
2. Biological Molecules: Smith and Wood Chapman and Hall (Latest Edition)
3. Molecular Biology and Biotechnology: Smith and Wood Chapman and Hall (Latest Edition)
4. Genetics by Hart, D.L. Jones and Bartlett (2001)
5. Biology by Kendall, Prentice Hall (5<sup>th</sup> Edition), 2001

**BT-203**  
**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

## Organic Chemistry

**L T P**  
**3 1 0**

**Alkanes**, Alkenes, alkyne, stereo selective and stereospecific reaction Alcohol, ethers and epoxides, aldehyde and ketones, carboxylic acids, amines & dizonium salts, heterocyclic compounds, spectroscopy & structure.

Study and description of organic reaction mechanism, aromaticity, photochemistry, concerted reactions, free radical reaction electrophilic addition to carbon-carbon multiple bonds, reactions of electron deficient intermediates, organometallic reagents.

### **Bio-organic chemistry:**

Introduction to bio-organic chemistry: Basic consideration, proximity effects and molecular adaptation, enzyme chemistry, mechanism of enzyme reaction. The concept of active site coenzymes.

### **Bio-energetic:**

Energy production in biological process, glycolysis. Introduction to metabolism, Anaboli and catabolic pathways. The TGA cycle and generation of ATP through aerobic breakdown of (pyruvic) acid.

**The structure of nucleic acids:** introduction of RNA and DNA, primary and secondary structures of these molecules and their biological functions.

The chemical basis of heredity. Replication of DNA, genetic code and biological synthesis of proteins. Chemical synthesis of proteins: Amino protective groups, carboxy protecting groups, peptide bond formation through the use of acetyl chloride, acylazides, active esters involving the use of carbodiimids. Woodward's reagent, solid phase synthesis.

### **Books recommended:**

1. R.T. Morrison & R.N. Boyd, Organic Chemistry 6<sup>th</sup> Ed. Allyn & Bacon, Inc (1992)
2. F.A. Carey & R.J. Sundberg, Advanced Organic Chemistry 3<sup>rd</sup> Ed. Part A & Part B, Plenum Press (1990).
3. Herman Dugas, Bioorganic Chemistry ( 3<sup>rd</sup> edition)

**BT-205**  
**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**BioChemistry**

**L T P**  
**3 1 0**

1. **Enzymes**  
 Historical Resume  
 Nomenclature and Classification  
 Isozymes  
 Biological Roles  
 Activation Energy  
 Michalois Menten Hypothesis  
 Allosteric Enzymes  
 Chemical Nature of Enzymes  
 Characteristics of Enzyme  
 3'D' Structure of Enzymes  
 Active Site  
 Modifiers of Enzyme Activity
  - Enzyme Activators
  - Enzyme Inhibitors
  
2. **Amino Acid Metabolism**  
 Intracellular Protein Degradation  
 De- amination  
 Urea Cycle  
 Breakdown of amino acids  
 Nitrogen Fixation  
 Biosynthesis of essential and non essential amino acids
  
3. **Carbohydrate Metabolism**  
**Glycolysis, Pentose Phosphate pathway & Gluconeogenesis**  
**Glyogen synthesis and Glycogenolysis**  
 Regulation of Carbohydrate metabolism
  
4. **Lipid Metabolism**  
 General reactions & functions of triglycerides, phospolipids and Cholesterol,  
 Phostraglandins  
 Beta-oxidation of Fatty acids  
 Biosynthesis & Catabolism of triglycerides, phospolipids, Cholestrol and  
 Prostraglandins  
 Metabolic disorders
  
5. **Inborn Errors of Metabolism**

**Recommended Books:**

Bio Organic Chemistry by Hermam Dugas (3<sup>rd</sup> edition)

**BT-207 Concepts in Bio-Technology****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

1. Biotechnology - an overview origin and definition, old and new Biotechnology and inter disciplinary activity, (strain choice, Mass culture, optimization of cell responses, process operations, product recovery, scope and importance, commercial potential, Bio-Technology in India.
2. Recombinant DNA and Gene Cloning: Cloning and expression vectors chimaeric DNA, Molecular probes and gene libraries polymerize chain. Reaction and gene amplification. Isolation sequencing and syntheses of genes.
3. Animal and Plant Biotechnology  
 Animal cell and Tissue Culture - History and scope of animal and tissue culture advantages and disadvantages, Lab facilities for tissue culture substrate on which cells grow, treatment of substrate surfaces; feeder layer on primary culture cell lines and cloning, tissue and organ culture.  
 Plant Cell and Tissue Culture  
 Cell culture, Laboratory requirements for plant tissue culture, application of cell culture cell and organ differentiation, colonal propagation or micro propagation, some colonal variation overcoming crossing barriers, other user of tissue culture. Production and uses of haploid, protoplast culture regeneration & hybridization.
4. Industrial and Microbial Biotechnology:  
 Enzyme Biotechnology protein engineering, immunotoxins and drug designing. Metabolic engineering for over production of metabolites, use of microbes in industry and agriculture.
5. Bio Technology and Environment:  
 Pollution control, environment and energy (renewable source of energy, energy and fuel using micro-organisms, conservation of energy). Restoration of degraded lands (reforestation through micro propagation, use of microbes for improving soil fertility) bio diversity and its conservation.
6. Biotechnology and Intellectual Property  
 Intellectual Property rights and protection (patents) trade secrets, copyright trademarks) IPR PGR, GATT and TRIPS patenting of Biological material.

**Recommended Books**

1. Swaminathen, MS ed (1991) Biotechnology in Agriculture. A Dialogue, Macmillan, Madras
2. Wiseman, A (1983). Principles of Biotechnology Chapman & Hall, New York.
3. Gupta P.K. (2001). Elements of Biotechnology. Rastogi Publications, Meerut.
4. Singh B.D. (2002) Biotechnology. Kalyani Publisher New Delhi.
5. Paul J (1975) cell and Tissue culture (5<sup>th</sup> edition) Living stone, Edinburgh.
6. Meyers, R.A (Ed 1995) Molecular Biology and Biotechnology, a comprehensive desk reference VCH publishers Inc., New York.

BT- 209

Transfer Processes

Internal Marks: 40

External Marks: 60

Total Marks: 100

L T P

3 1 0

1. **Fluid Mechanics:** Equation of state concept of pressure. Perfect and ideal fluid, perfect gas law, equation of continuity, energy and momentum.  
Pitot tube and venturimeter.  
Laminar and turbulent flow, Reynolds number  
Non dimensional parameters
  
2. **Heat Transfer:** Concept of temperature, heat entropy and enthalpy  
Conduction: Basic equations, steady and unsteady heat transfer in ID  
Convection: - Types of convections, heat transfer in flow  
Boiling condensation and evaporation. Theory of boiling heat transfer, latent heat, dropwise and film wise condensation, single and multi effect evaporation.  
  
Radiation emissivity absorptivity, white, grey and black body radiation laws of radioactive pyrometers.
  
3. **Mass Transfer:** Theories of mass transfer, individual, local and overall mass transfer coefficients  
Momentum transfer analogy. Convective mass transfer as absorption diffusion
  
4. Simultaneous mass and heat transfer.

**Book Recommended**

1. Skell- and AHP Diffusional mass Transfer by John Wiles & Sons NY
2. Sherwood Thomas K, Dittord Robert L. and Wilke Charles  
Mass Transfer (Tata) McGraw Hill
4. Kern, Process Heat Transfer (Tata) McGraw Hill
5. Holman JP, Heat Transfer (Tata) McGraw Hill
6. Treybal Robert E, Mass Transfer Operations (Tata) McGraw Hill

|                           |                                |              |
|---------------------------|--------------------------------|--------------|
| <b>BT-211</b>             | <b>Industrial Microbiology</b> |              |
| <b>Internal Marks: 40</b> |                                | <b>L T P</b> |
| <b>External Marks: 60</b> |                                | <b>3 1 0</b> |
| <b>Total Marks: 100</b>   |                                |              |

1. Scope from IIT syllabus
2. Type of Industrial fermentation's; Submerged and surface fermentation, continuous fermentation. Bubble cap fermentation.  
Isolation, genetic modification and preservation of Industrial microorganisms.
3. Fermentation equipment and its use. Design of fermenters, types of fermenters take construction materials, sterilization of fermenters, agitation, and aeration during fermentation, use of antifoam.  
Fermentation Media: Design preparation and sterilization media synthetic and crude media. Common substrates used in industrial fermentation's like molasses, cornsteep liquor, sulphite waste liquor, hydro etc.
4. Methods for removal of insolubles: Gravitational, mechanical surface actions and electrical methods.  
Production of health care products: Isolation of organisms producing antibiotics, fermentation technology and manufacture of different types of antibiotics.

#### **PART- B**

5. Production of foods, beverages and other products: Bakers' Yeast single cell proteins, amino acid like glutamic acid lysine, phenylalanine, tryptophan treecnine, aspartic acid vitamins like thiamine riboflavin. B-carotene.
6. Production of Industrial Chemical, biochemical and fuel: ethanol, beer wine acetic acid (vinegar) citric acid lactic acid, acetone and butanol.

#### **BOOKS:**

1. Industrial Microbiology Prescott & Dumm
2. Comprehensive Biotechnology Vol I, II, III Ed. Moo Young
3. Industrial Applications of Microbiology – J. Riviere.
4. Industrial Microbiology Casida.

**BT-213****Organic Chemistry Practical**

**Internal Marks: 30**  
**External Marks: 20**  
**Total Marks: 50**

**L T P**  
**0 0 2**

1. Detection and identification of organic functional groups present in given compound.
2. Determination of melting point by Electrically heated melting point apparatus.
3. Preparation of organic compounds such as aspirin, acetanilide, p-nitro acetanilide.
4. To prepare rayon threads from filter papers using cuprammonium process.
5. To study the quantity of casein present in different samples of milk.
6. To detect the presence of adulterants in fat, oil and butter.

**BT-215****Bio-Chemistry Practical****Internal Marks: 30****External Marks: 20****Total Marks: 50****L T P****0 0 2**

1. Quantitative estimates of following in biological samples.
  - i) Sugar in biological samples
  - ii) Extraction and separation of lipids
  - iii) Estimation of proteins
  - iv) Estimation of DNA / RNA
2. Assay of enzyme activity
3. Kinetic study on enzyme. Immobilization of enzymes.
4. Chromatographic methods for separation of macromolecules.
5. Carbohydrate determination and percent analysis.
6. Centrifugation
7. LDH determination
8. Identification and quantification of urea.

**BT-217**

**Microbiology Practical**

**Internal Marks: 30**  
**External Marks: 20**  
**Total Marks: 50**

**L T P**  
**0 0 2**

1. Preparation of media, cotton plugging and sterilization.
2. Personal hygiene-microbes from hands, tooth scum and other body parts.
3. Isolation of microorganisms from air, water & soil samples. Dilution and pour plating. Colony purification.
4. Enumeration of microorganisms. Total vs viable counts.
5. Identification of isolated bacteria. Gram staining, other staining methods, metabolic characterization (e.g. IMVIC test)
6. Growth curve of microorganisms.
7. Antibiotic sensitivity of microbes, use of antibiotic discs.
8. Separation of cell types (from blood)

**BT-202 CELL AND MOLECULAR BIOLOGY****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

**Introduction :** Basic fundamentals of cell and molecular molecular biology its importance. History of cell and molecular biology, development of cell theory. Biological heredity- Mendelian inheritance and laws.

**Cell Organization:** Organization of prokaryotic and eukaryotic cell, different organelle-their structure and function, Differences between prokaryotic and eukaryotic cell.

**Chromosome structure and chromatin:** Normal chromosomes, special chromosome structures, molecular aspects of chromosome structure, nucleosomes, higher order chromatin organization, molecular structure of the bacterial nucleiod. Cell division, meiosis and mitosis, Bacterial cell cycle, eukaryotic cell cycle.

**Nucleic Acid structure and replication :** Nucleic acids- DNA, RNA, structure, different types, replication of DNA-initiation of replication, regulation of replication, mechanism and different enzymes involved, primers and priming, termination of replication. genetic code.

**Transcription :** Principles of transcription, transcription initiation and regulatory components, transcriptional regulation in bacteria and eukaryotes, transcriptional elongation and termination.

**Protein Synthesis and its regulation :** Fundamental concepts, components of protein synthesis, mechanism of protein synthesis, initiation in bacteria, initiation in eukaryotes, elongation cycle, termination, regulation of protein synthesis.

**Reference Books**

| <b>Author</b>    | <b>Title</b>               | <b>Publishers</b>             |
|------------------|----------------------------|-------------------------------|
| Benjamin Lewin   | Gene-VII                   | Oxford Univ Press, UK         |
| RM Twyman        | Advanced Molecular Biology | Viva Books Pvt. Ltd, N, Delhi |
| E.D. De Robertis | Cell and Molecular Biology | Lea and Febiger, USA          |
| D. Galder        | Molecular Biology          | Narosa Pub. , N. Delhi        |

**BT-204 FOOD MICROBIOLOGY**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

**Introduction :** Definition., importance and historical developments in food microbiology, Morphology and reproduction of Bacteria, Morphology and reproduction of Yeast and Mold.

**Techniques of pure culture:** Pure culture Concept, Methods of culture selection, enrichment culture. Techniques used for estimation of SPC from food samples, Serial Dilution, pour plate, streak plate, spread plate, Methods for the preservation of pure cultures.

**Microbial growth:** Definition, Growth curves-lag, log, stationary and death phase, Synchronous growth, doubling/generation time, Relationship between number of generations and total number of microbes.

**Microbiology of Food Products:** Microbiology of raw milk and fermented milk products-dahi, yoghurt, acidophilus milk, cultured buttermilk, cheese, koumiss and kefir, Fermented cereals products- bread, beer, idli, dosa; Fermented fruits and vegetable products- saurkraut, pickles; Meat product, Egg and fish.

**Food spoilage:** Bacterial food spoilage, food poisoning, food borne infection, food borne intoxication, fungal food spoilage, aflatoxins.

**Microbial Control:** Sources of microorganisms, Different physical and chemical agents used for microbial control & their action, Disinfected agents and its dynamics

**Reference Books**

| <b>Author</b>        | <b>Title</b>               | <b>Publishers</b> |
|----------------------|----------------------------|-------------------|
| W.C. Frazier<br>Hill | Food Microbiology          | Tata McGraw       |
| Casida               | Industrial Microbiology    | AVI               |
| J. Heritage          | Introductory Microbiology  | Cambridge         |
| K.S. Bilgrami        | Essentials of Microbiology | CBS               |

**H.J.Pleczar**  
**Microbiology**  
**Tata McGraw Hill**

**Ch-206 HEAT TRANSFER**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

**Modes of Heat Transfer:****Conduction:**

Review of Fourier's law, one dimensional heat conduction through composites having plane wall, spherical & cylindrical geometry. Steady state heat flow with heat source through plane wall and Cylindrical surface. Thermal conductivity of materials. Insulating materials and critical thickness of insulation. Unsteady-state conduction; Lumped heat capacity system, semi-infinite solid and Heisler chart.

**Convection:**

Free and forced convection, Concept of thermal boundary layer, concept of overall heat transfer coefficient for laminar and turbulent flow, Heat transfer inside & outside tubes with significance of Nusselt, Prandlt, Reynold, Biot, Fourier and Peclet number. Modeling of convective heat transfer coefficient by using dimensional analysis.

**Radiation:**

Distribution of radiant energy, Definition of emissivity, absorptivity, Reflectivity and Transmissivity, concept of Black and Grey bodies, Planck's law of monochromatic radiation, Kirchhoff's law, Wein's displacement law, Stefan-Boltzmann law, definition of intensity of radiation. Radiation formula for radiation exchange between simple bodies, two parallel surfaces and between any source and receiver.

**Theory and correlations in Boiling Heat Transfer**

Dropwise and Filmwise condensation of pure and mixed vapors, Nucleate & Film boiling, Theory and design of double pipe heat exchanger, 1-2, 2-4 Shell-and-Tube heat exchangers, Temp. correction factor for shell & tube exchangers, Theory of plate type heat exchanger, Fins and their applications, Reboiler and Condensers counter current dry contact Condenser, parallel current-wet contact Condenser.

**Evaporators:**

Theory and design of single effect evaporators. Various types of evaporators: Standard vertical tube evaporator, basket type vertical evaporator, forced circulation evaporator and horizontal tube evaporators. Evaporation under vacuum.

**Recommended books:**

| <b>AUTHOR</b>    | <b>TITLE</b>                  | <b>PUBLISHERS</b> |
|------------------|-------------------------------|-------------------|
| Holman           | Heat Transfer                 | McGraw Hill       |
| McAdams          | Heat Transmission             | McGraw Hill       |
| McCabe & Smith   | Unit Operation of Chem. Engg. | McGraw Hill       |
| Kern             | Process Heat Transfer         | McGraw Hill       |
| Kreith           | Principles of Heat Transfer   | Harper & Row      |
| Incopera & Dewit | Heat and Mass Transfer        | John Wiley        |

**Ch-208 CHEMICAL PROCESS INSTRUMENTATION****Internal Marks: 40****L T P****External Marks: 60****3 0 0****Total Marks: 100**

**Introduction:** Importance of instruments in Chemical Process industries, Classification of instruments, Static and Dynamic characteristics of instrument.

**Instruments for Pressure Measurement :** Use of manometers, Bourdon gauge, bellow type gauge, Measurement of vacuum and pressure Transducers

**Temperature Measurement:** Thermocouples, resistance thermometers, thermistors, optical and radiation pyrometers.

**Flow & level measurements :** Liquid level measurement-Direct and differential method and Flow measuring devices, Use of obstruction type meters, Variable area meters. Pressure probes, positive displacement type meters

**Instruments for Miscellaneous Measurements :** Measurement of Nuclear Radiation, Viscosity, Conductivity, Humidity and pH value, Industrial weighing and feeding systems, Instrument for gas analysis, gas chromatography, mass spectroscopy, Industrial weighing and feeding systems.

Process instrumentation, Recording instruments, indicating and signaling instruments, Transmission of instrument reading, control centre, Instrumentation diagram, Instrumentation in modern plant.

**Controls :** Concept of Automatic process control and it's classifications, Types of controllers, instrumentation and control of typical units like Reactors and Evaporators.

**Recommended books:**

| <b>AUTHOR</b>    | <b>TITLE</b>  | <b>PUBLISHER</b> |
|------------------|---|------------------|
| Harriott & Peter | Process Control                                     | Tata McGraw Hill |
| Eckman           | Industrial Instrumentation                          | Wiley Eastern    |
| Coughanour       | Process System Analysis & Control                   | McGraw Hill      |
| Pollard          | Process Control for Chemical and Allied Industries. | Heinemann        |
| Weber            | Introduction to Process Dynamics & Control.         | John Wiley       |

**Ch-212 ENGINEERING. MATERIALS****Internal Marks: 40****L T P****External Marks: 60****3 0 0****Total Marks: 100**

**Ferrous Metals:** Important varieties of iron ores. Cast iron: types, properties and uses of cast iron. pig iron: Types of pig iron. Wrought iron: properties and uses of wrought iron. Steel: factors affecting physical properties of steel and uses of steel (No manufacturing process).

**Non Ferrous Metals:** Aluminium, cobalt, copper, lead, magnesium, nickel, tin and zinc their properties and uses.

**Alloys:** Introduction to Phase-Diagrams of metals and its alloys; Fe-Fe<sub>3</sub>C; Cu-Ni, Cu-Zn, Al-Cu equilibrium diagrams, methods of improving strength, and applications of metals and alloys.

**Ceramics:** Definition of ceramic, clay: properties of clay, earthen wares and stonewares, uses of stonewares.

**Glass:** Definition, classification, composition, types and properties of glass.

**Refractories:** Definition of refractory, classification of refractories, properties of refractories. Common refractory bricks like silica bricks, fire clay bricks, dolomite bricks, high alumina bricks and carbon bricks.

**Polymers:** Nylon-66, nylon-6, polyesters, polycarbonates, polyurethanes, PVC, polypropylene, rubber

**Mechanical, Thermal and Electrical Properties :** Tensile strength, compressive strength, shear strength, ductility and malleability. Methods of improving strength; specific heat, glass transition temperature, crystalline melting temperature, thermal conductivity; dielectric strength, dielectric constant, power loss and electrical diffusivity.

**Corrosion:** Principle of corrosion, types of corrosion, mechanism of wet or electro chemical corrosion, galvanic corrosion, atmospheric corrosion, pitting corrosion, wet like corrosion, microbiological corrosion, method of corrosion control, cathodic and anodic control, Inhibition and other precautionary measures

**RECOMMENDED BOOKS**

1. Materials in Industry by W J Patton, Prentice Hall Publication.
2. Introduction to Engineering Materials by Aggrawal, Tata McGraw Hill Publication.
3. Material Science by Narula, Tata McGraw Hill Publication.
4. Elements of Metallurgy by HS Bawa, Tata McGraw Hill Publication.
5. Materials Sci & Engg. by William D. Callister, Jr, An introduction by Willy International

**BT- 210      CELL & MOLECULAR BIOLOGY LAB**

**Internal Marks: 30**

**External Marks: 20**

**Total Marks: 50**

**L T P**

**0 0 4**

1. To study the morphology of bacterial cell
2. To study the morphology of plant cell
3. Identification of different types of bacteria.
4. To study the various types of blood cells.
5. To perform the staining of cells.
6. To enumerate total number of cells in a sample.
7. Isolation of plasmid from bacteria.
8. Isolation chromosomal DNA from bacteria.
9. Isolation chromosomal DNA from animal cell.
10. Isolation and purification of proteins.

**BT- 212**

**FOOD MICROBIOLOGY LAB**

**Internal Marks: 30**

**External Marks: 20**

**Total Marks: 50**

**L T P**

**0 0 4**

1. To study the working of various equipments related to Microbiology.
2. Preparation of culture media for cultivation of microbes.
3. To isolate pure culture using pour plate and spread plate technique.
4. To measure the size of given microbial cell using micrometry.
5. To enumerate total viable count in a culture.
6. To perform Gram staining technique of bacteria.
7. To study the growth curve of microorganisms.
8. Quantitative analysis of milk by standard plate count (SPC) method.
9. To study quality of milk by methylene blue reeducate (MBR) test.
10. Production of fermented milk products.

**Ch-214****HEAT TRANSFER LAB****Internal Marks: 30****External Marks: 20****Total Marks: 50****L T P****0 0 4**

1. Determination of heat transfer coefficient for different types of heat transfer equipments.
2. Wilson Plots. Unsteady state heat transfer in jacketed vessels.
3. Correlation of instantaneous heat transfer, coefficients with time for steady deposition of scale on a heating surface.
4. Heat losses from insulated pipes.
5. Performance characteristics of a shell and tube heat exchanger and an induced draft cooling tower.
6. Study and operation of long tube, forced circulation and multiple effect evaporators.
7. Duhring's plot for solutions involving non-volatile solutes.
8. To find the heat transfer coefficient of heat loss by vertical cylinder by natural convection.
9. To find heat transfer coefficient for parallel flow and counter flow for double pipe heat exchanger.
10. To find heat transfer coefficient losing heat by forced convection to air flowing through it for different air flow rates & heat flow rates.

**SEMESTER FIVE****BT-301- GENETIC ENGINEERING****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

Introduction

Milestones in Genetic Engineering

Molecular tools and their applications Restriction enzymes, modification enzymes. DNA and RNA markers.

Gen Cloning Vectors. Plasmids, bacteriophages, phagemids, cosmids, Artificial chromosomes.

Restriction Mapping of DNA fragments and Map Construction, Nucleic Acid Sequencing.

Cdna synthesis and Cloning. mRNA, enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening.

Alternative strategies of gene cloning. Cloning interacting genes-Two and three hybrid systems, cloning differentially expressed genes. Nucleic acid microarray arrays.

Site-directed Mutagenesis and Protein Engineering.

How to Study Gene Regulation ? DNA transfection, Northern blot, primer extension, SI mapping. RNase protection assay. Reporter assays.

Expression Strategies for Heterologous Genes. Vector Engineering and codon optimisation, host engineering. In vitro transcription and translation, expression in bacteria, expression in Yeast, expression in insects and insect cells., expression in mammalian cells, expression in plants.

Processing of Recombinant Proteins Purification and refolding, characterization of recombinant proteins, stabilization proteins

Phage Display

T-DNA and Transposon Tagging. Role of gene tagging in gene analysis. T-DNA and transposon tagging, identification and isolation of genes through R-DNA or transposon.

Transgenic and Gene Knockout Technologies, targeted gene replacement, chromosome engineering.

Gene Therapy Vector engineering, Strategies of gene delivery, gene

replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

Books :

- 1 Molecular Biology and Biotechnology by Walker and Gingold, 1991 Royal Society of Chemistry, London.
- 2 Molecular Biology of Gene by Watson.J. et. Al ( 4<sup>th</sup> cd), 1994, Benjamin/Cummings. California, USA.
- 3 Molecular Biology of Cell by Alberts, B.et.al 1994, Garland Publishers Inc.
- 4 Recombinant DNA by Watson.J.D. et al, 1993, Scientific American Books, New York.
- 5 Principles of Gene Manipulation by Old, R.W. and Primorose, S.B. 1994, Blackwell, U.K.
- 6 Recombinant Microbes for Industrial and Agricultural Applications by Murroka, I.I. 1994, Mercel Dekker, Inc, New York.
- 7 Methods in Gene Technology by Date, J.N., 1994, Jai Press Ltd, London, England.
- 8 Gene Cloning and Manipulation by Christopher Howe, 1995, Combridge University Press.
- 9 Manual of Industrial Microbiology and Biotechnology A.L. Demain and J.E. Davis. 1999 ASM Press Washington DC.
- 10 Principles of gene manipulation by old R.W and Pimorse S.B. 1994: Blackwell U.K.

**BT-303 : Immunology and Immunotechnology****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

Phylogeny of Immune System  
 Innate and acquired immunity.  
 Clonal nature of immune response  
 Organization and structure of lymphoid organs  
 Nature and Biology of antigens and super antigens  
 Antibody structure and function  
 Antigen-antibody interactions  
 Major histocompatibility complex  
 BCR & TCR, generation of diversity  
 Complement system  
 Cells of the immune system: Hematopoiesis and differentiation, lymphocyte trafficking B-lymphocytes, T-Lymphocytes, Macrophages, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast Cells.  
 Regulation of immune response-Antigen processing and presentation, generation of humoral and cell mediated immune responses  
 Activation of B- and T- lymphocytes,  
 Cytokines and their role in immune regulation, T-cell regulation, MHC restriction,  
 Immunological tolerance  
 Cell mediated cytotoxicity : Mechanism of T cell and NK cell mediated lysis. Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity.  
 Hypersensitivity  
 Autoimmunity  
 Transplantation  
 Immunity to infectious agents ( intercellular parasites, helminthes and viruses)  
 Tumor immunology  
 AIDS and other immunodeficiencies.  
 Hybridoma Technology and Monoclonal antibodies  
 ELISA, RIA etc.

**Books :**

Immunology by Kuby.J. 2003, W.H. Freeman & Co., New York.  
 Cellular and Molecular Immunology by Abbas A.H. and Lichtman, A.H. and Pober, J.S. 1994  
 W.B. Saunders and Co. Philadelphia 2<sup>nd</sup> ed USA.  
 Monoclonal Antibodies by Ritter, M.A. 1995, Combridge University Press , New York

**BT-305 ANIMAL CELL CULTURE AND BIOTECHNOLOGY**

**Internal Marks: 40**

**External Marks: 60**

**Total Marks: 100**

**L T P**

**3 1 0**

Introduction, historical

Animal Cell metabolism, regulation and nutritional requirements;

Animal cell growth characteristics and kinetics;

Primary and secondary cultures.

Cell culture in continuous, perfusion and hollow-fibre reactor.

Mass transfer in mammalian cell culture ; Scale-up of cell culture processes; case studies.

Gene transfer in animal cells and its applications.

Contamination and cryo preservation

Transgenesis and transgenic animals including live stock.

Transgenics as bioreactors.

Biotechnology of aquaculture, silkworm, pest control.

Biodiversity characterization, conservation

In vitro fertilization

Embryo transfer technology

Stem cell Biology and Cloning.

Books :

Animal Biotechnology Vol I and II by Griffith and Smith

Animal Cell Culture by Freshney

**BT-307: ENZYME ENGINEERING AND TECHNOLOGY**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

**Introduction and Scope**

General distinctive features and industrial applications.

Enzyme kinetics: single , substrate steady state kinetics

King-Altman's method

Inhibitors and activators: multi-substrate systems, effect of pH and temperature.

Allosteric enzymes.

Immobilization of enzymes, advantages, carriers, adsorption , covalent coupling., cross linking and entrapment methods; micro-environmental effect.

Mass transfer in enzyme reactors.

Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

**Books**

- 1 Biotechnology By W.F. Guger and Ginger , 2003 ( Text Book of Industrial Microbiology)
- 2 Biochemical Engineering Fundamentals by J.E. Bailey and P.F. Ollis McGraw Hill Publication.
- 3 Biotechnology Vol 7 by H.J.R. Rehen and H.G. Reed; Beelar Publihers
- 4 Industrial Microbiology and Biotechnology by A.L. Demain and J.E. Davis 1999; ASM Press Washington DC.

**BT-309 BIOPROCESS ENGINEERING-I**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Kinetics of microbial growth  
Substrate utilization and product formation kinetics, simple structured models.  
Design and optimisation of fermentation media#  
Media sterilization , air sterilization  
aseptic transfer  
aeration and agitation  
rheology of fermentation fluids  
cell cultivation strategies  
batch, fed-batch and continuous processes  
scale up and scale down concepts

**Books:**

1. Principles of fermentation Technology : By Stainbury and Whitabar, Orgamon Press
2. Mannual of Industrial Microbial and Biotechnology A.L. Deermain; J.E. Davis ,  
19999 ASM Press; Washington D.C.

**BT 311 BIOINFORMATICS**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Introduction, internet, intranet and extranet  
Networking protocols  
Database management system  
Commercial application packages  
Internet resources  
Biomednet  
Medicine  
Protein/Nucleic acid sequence  
Hybridoma  
Electronic journals  
Web Designing operating systems  
Current trends in information technology

Books :

Bioinformatics : Methods and Protocols by S., Misener and S.A. Krawetz 2000 Humana Press  
Totona, New Jersey.

**Semester-VI**

**BT-302 MICROBIAL BIO-TECHNOLOGY**

**Internal Marks: 40**

**L T P**

**External Marks: 60**

**3 1 0**

**Total Marks: 100**

Introduction

Microbial diversity and its applications

NaO-bacteria : characterization and applications.

Microbes as source of macromolecules

Novel approaches for antibacterial drug discovery i.e. drug targeting.

Manipulation of microbes for the production of enzyme. Insecticides. Polysaccharides

Pathogenic islands in bacteria

Microorganism in plant biotechnology

Microorganisms for bio energy

Microbial production and importance of

i) Bio-Surfactants

ii) Oilgenous microbes

Metabolic pathway engineering for the production of Antibiotics, alcohol and organic synthesis

Environmental applications for sewage management, degradation of Xenobiotics mineral recovery , removal of heavy metals for aqueous effluent.

**BT-304 : Plant Cell Culture and Biotechnology****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

Conventional Plant Breeding

Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids

Tissue culture media ( composition and preparation)

Initiation and maintenance of callus and suspension culture : single cell clones.

Organogenesis : somatic embryogenesis; transfer and establishment of whole plants in soil.

Hoot-up culture ; rapid clonal propagation and production of virus-free plants

Embryo culture and embryo rescue

Protoplast isolation, culture and fusion : selection of hybrid cells and regeneration of hybrid plant. Symmetric and asymmetric hybrids. Cybrids.

Anther, pollen and ovary culture for production of haploid plants and homozygous lines.

Cryopreservation, slow growth and DNA banking for germ plasm conservation.

Plant Transformation Technology : basis of tumour formation, hairy root , features of TI and RI plasmids mechanisms of DNA transfer , role of virulence genes, use of TI and RI as vectors, binary vectors . Use of 35S and other promoters, genetic markers, reporter genes, use of scaffold.

Methods of nuclear transformation , viral vectors and their applications

Multiple gene transfers. Vectors less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots.

Transgene stability and gene silencing.

Application of Plant Transformation for productivity and performance herbicide resistance.

Phosphinothricin, glyphosate, sulfonyl urea, atrazine, insect resistance. Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, viroin resistance, coat protein mediated nucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, RIP antifungal proteins , thionins, PR proteins, nematode resistance, abiotic stress, post-harvest losses, long shelf life of fruits and flowers. use of ACC synthase. poly galacturonase. ACC oxidase, male sterile lines, bar and barnase systems carbohydrate composition and storage. ADP glucose pyrophosphatase.

Chloroplast Transformation : advantages vectors, success with tobacco and potato

Metabolic Engineering and Industrial Products; Plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway alkaloids, industrial enzymes biodegradable plastics, polyhydroxybutyrate, therapeutic proteins , lysosomal enzymes, antibodies, edible vaccines, purification strategies , olcosin portioning technology.

Molecular Marker-aided Breeding : RFLP maps , linkage analysis, RAPD markers, STS, Microsatellites, SCAR ( sequence characterised amplified regions). SSCP ( single strand conformational polymorphism), AFLP, QTL, map based cloning , molecular marker assisted selection. Arid and semi-arid plant biotechnology

Green House and Green-Home technology.

Books :

1. J.Hammond, P. McGarvey and V.Yusibov (Eds) Plant Biotechnology Springer Verlag, 2000.
2. T-J Fu. G. Singh and W.R. Curtis (Eds) : Plant Cell and Tissue Culture for the production of Food Ingredients kluwer Academics/Plenum Press 1999.
3. H.S. Chawla : Biotechnology in crop Improvement . International Book Distributing Company, 1998
4. R.J. Henry; Practical Application of Plant Molecular Biology, Chapman and Hall, 1997.
5. P.K. Gupta ; Elements of Biotechnology , Rastogi and C. Meerut , 1996

**BT – 306 BIOPROCESS ENGINEERING-II**

**Internal Marks: 40**

**L T P**

**External Marks: 60**

**3 1 0**

**Total Marks: 100**

Analysis of multiple interacting microbial populations.

Stability of recombinant cells

Physiology of immobilized cells

Growth and product formation by recombinant cells

Sensors for monitoring bioprocess parameters and biosensors, thermodynamics and stoichiometric aspects of microbial processes.

Engineering analysis of metabolic pathways.

Books :

Principles of Fermentation Technology by P.F. Stainbury and Whitaker 1995, Pergamon Press

Biochemical Engineering Fundamental by J.E. Bailey and D.F. Ollis McGraw Hill Publications.

**BT-308 BIOREACTOR DESIGN AND OPERATION.**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

Introduction to bioreactors, modelling of bioreactors.  
 Concept of ideal and non-ideal bioreactor,  
 Residence time distribution  
 Stability analysis.  
 Homogeneous and heterogeneous reactions.  
 Kinetic analysis of bioreactors; fluidised bed, plug flow reactor, airlift, bubble column,  
 continuous stirred tank reactor,  
 Unconventional bioreactors; hollow fibre reactor, membrane bioreactor, perfusion reactors.  
 Practical aspects regarding design and operation bioreactors.  
 Control of bioreactor ; physical , chemical and biological environment of the bioreactor.  
 PID controllers, Kilman filter stranded kilman filter, software sensor, fuzzy and neuro fuzzy  
 controllers.

Books :

- 1 Bioprocess Engineering Principles-P.M. Doran , 5<sup>th</sup> ed
- 2 Baily and Olis-Biochemical Engineering
- 3 Chemical Reactor Engineering-Olavin Spiel
- 4 Principles of Microbe and cell cultivation-S.Hohn Prit
- 5 Chemical Engineering Vol 5 & 6 – Coulson & Richardson
- 6 Perr's Chemical Engineering Handbook, 7<sup>th</sup> ed, R.H. Perry and D.W.  
Green
- 7 Bioreactor Design and Product Yield Biotol. Mijnbeck, Oosterhuis Siebel  
Oths, Butterworth publications.
- 8 Biochemical Engineering Fundaments by J.E. Bailey and D.F. Ollis  
McGraw Hill Publication, 1986

**CE-216 ENVIRONMENTAL SCIENCE**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

**Unit 1 : The Multidisciplinary nature of environmental studies**

Definition, scope and importance

(2 Lectures)

Need for public awareness.

**Unit 2 : Natural Resources :****Renewable and non-renewable resources :**

Natural resources and associated problems.

- a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b) Water resources : Use and over-Utilization of surface and ground water, floods, drought, conflicts and water, dams-benefits and problems.
- c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
- f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
  - Role of an individual in conservation of natural resources.
  - Equitable use of resources for sustainable lifestyles.

**Unit 3 : Ecosystems**

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.

- Introduction, types, characteristic features, structure and function of the following ecosystem :-
  - a. Forest ecosystem
  - b. Grassland ecosystem
  - c. Desert ecosystem
  - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

**Unit 4 : Biodiversity and its conservation**

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-spots of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity : In-situ conservation of biodiversity.

**Unit 5 : Environmental Pollution****Definition**

- Causes, effects and control measures of :-
  - a. Air pollution
  - b. Water pollution
  - c. Soil pollution
  - d. Marine pollution
  - e. Noise pollution
  - f. Thermal pollution
  - g. Nuclear hazards
- Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management : floods, earthquake, cyclone and landslides.

(8 lectures)

**Unit 6 : Social Issues and the Environment**

- From Unsustainable to Sustainable development

- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people ; its problems and concerns. Case studies.
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
  
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

(7 lectures)

**Unit 7 : Human Population and the Environment**

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV / AIDS
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

**Unit 8 : Field work**

- Visit to a local area to document environmental and river forest grassland hill mountain.
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

**BT-310 Down Stream Processing****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

**Introduction:** Characteristics of biosphere, An overview of Biosphere  
Separation of cells and other insoluble from fermented broth, filtration and centrifugation(batch, continuous). Designing of centrifuges for desired product of desired capacity.

**Cell Distraction: Physical methods-** osmotic shock, grinding with admmissive solid shear, liquid shear.

**Chemical Methods:** Alkali Reagents, enzymatic Methods.

**Product Isolation:** Adsorption- desorption process, liquid-liquid extraction, aqueous two plane extraction, precipitation methods using ammonium sulphate organic solvents.

**Membrane base separation:** Microfiltration, Ultrafiltrationdialysis, reverse osmosis.

Electrophoresis and chromatography principles of product purification: different electrophoresis techniques viz. isoelectric focusing, charomatographic techniques viz paper gel filtration, ion exchange, hydrophobic interaction, affinity, GLC, HPLC, Product Polishing crystallisation and drying.

**Books:**

1. Bailly & Ollis Biochemical Engg. – Academics Press.
2. H.Gunzler- Handbook of Analytic Techniques – Wiley publications
3. H.J. Rehm and G.Reed, Biotechnology- Vol, 3,4,5 verlar Publishers
4. Humphrey, Aiba and Miller, Biochemical Engg. – Academics Press.
5. Murray Moo- young comprehensive biotechnology, Vol. LI latest ed, Pergan Publishers.
6. Product Recovery in Bioprocc. Technology, Heinemann, Butterworth Publication.
7. Stanbury and Whitteker, Principles of Fermentation Technology, Pergamon Press
8. Westermier- Electrophoresis in Practice, Wiley Publications
9. Willard e. al, International Methods of Analysis- CBS publication
10. Wilson and Golding, A Biologist's Guide to Principles and techniques of Practical Biochemistry Cambridge university Press.
11. Principles of Fermentation Technology by P.F. Stanbury, A Whitekar and S. J Hall, 1997, Aditya Books (p) Ltd. New Delhi.
12. Biotechnology by Rehm and Reed Vol. 7(a)
13. Comprehensive Biotechnology By Murray Moo Young.

**BT-402 Major Project**

**Internal Marks: 60**  
**External Marks: 40**  
**Total Marks: 100**

**L T P**  
**0 0 8**

**BT 404 Enzyme Catalysed Organic Synthesis**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Biocatalysis- Definition of biocatalysis; chirality and biological activity advantages and disadvantages of biocatalysis over chemical catalysis.
2. Different types of biocatalysis; microbial, enzymatic and immobilized system of biocatalysis; current industrial biocatalysis with different enzymes.
3. Stereoselective biocatalysis for synthesis of chiral pharmaceutical intermediates such as synthesis of ACE inhibitors; definition, mode of action of inhibitors; recent developments, synthesis of anticholesterol drugs by biocatalytic routes, calcium channel blocking drugs, potassium channel openers, antiviral etc.
4. Immobilized enzymes for biocatalysis.
5. Industrial processes: comparing different approaches.

**Practical:**

Use of microorganisms/ enzymes for the synthesis of chirally pure compounds (drug/drug intermediates). Optimization of the reaction conditions. Product identification using different analytical techniques.

**Text Books**

1. Andreas S. Bommarius, Bettina R. Riebel. *Biocatalysis: Fundamentals & Applications*, Wiley VCH, 2004.
2. Lawrence P. Wackett and C. Douglas Hershberger *Biocatalysis and Biodegradation: Microbial Transformation of Organic Compounds*. ASM Press, Washington DC, 2001.
3. Stanley M. Roberts, Nicholas J. Turner, Andrew J. Willets, Michael K. Turner. *Introduction to Biocatalysis: Using Enzymes and Microorganisms*, Cambridge University Press, 1995.
4. Sheldon, R.A., Porskamp, P., and Ten Hoeve, W. Advantages and Limitations of Chemical Optical Resolution, in *Biocatalysis in Organic Synthesis*, Tramper, J., Van der Plas, H.C., and Linko, P. (Eds.) Elsevier, Amsterdam, 1985.

**BT-406 Project Management and Entrepreneurship**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Forms of Project Organization, project planning, project control, human aspects of project management, pre-requisites for successful project implantation, project management, international project management.
2. Network techniques for project management, development of project network, time estimation, determination of critical path, scheduling when resources are limited, PERT and CPM models, network cost-system.
3. Brief outline of social cost benefit analysis: rationale, UNIDO and Little Mirrlees approaches, UNIDO-IDCAS Manual, shadow prices and conversion factors.
4. Entrepreneurship: Need, scope and philosophy, Creativity and Entrepreneurship.
5. Entrepreneurship competencies and traits, factors affecting Entrepreneurship development.
6. Entrepreneurship- a function of innovation, the achievement motive in economic growth, theory of social change, family structure, migration & enterprise entrepreneurship.
7. Introduction to entrepreneurship and intrapreneurship. Barriers to entrepreneurship community and entrepreneurship function of entrepreneurship, classification of entrepreneurship.

**Text Books**

1. Peter F Drucker. Innovation and Entrepreneurship. Harper & Row, 1985.
2. Prasana Chandra- Projects: Preparation Appraisal and Superimplementation. Tata McGraw-Hill Co. Ltd.
3. J.D.West & F.K. Levy. A management guide to PERT/CPM, Prentice Hall, India.

**BT-408 Modelling and Simulation of Bioprocesses**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Types of kinetic model; Data smoothing and analysis.
2. Mathematical representation of bioprocess; parameter estimation; numerical integration techniques; parameter sensitivity analysis; statistical validity.
3. Discrimination between two models. Physiological state markers and its use in the formulation of a structured model.
4. Development of compartment and metabolic pathway models for intracellular state estimation.
5. Dynamic simulation of batch, fed-batch steady and transient culture metabolism; Numerical optimization of Bioprocesses using Mathematical models.

**Practicals:**

To design mathematical models from the provided data.

**Text Books**

1. John Ingham, Irving J. Dunn, Elmar Heinzle & J.E. Prenosil. Chemical Engineering Dynamics: Modelling with PC Simulation (2<sup>nd</sup> Edition). Wiley-VCH, 2000.
2. Jonathan B. Snape, Irving J. Dunn Ingham & J.E. Prenosil. Dynamics of Environmental bioprocesses: Modelling and Simulation. Wiley-VCH, 1995.
3. Dieter Behrens & P. Kramer (Eds.). Bioreactors, Downstream Processing, Process and Reactor Modelling and Bioprocesses. Wiley-VCH, 1988.
4. Dunn. Biological Reaction Engineering. John Wiley & Sons Inc

**BT-410 Bioanalytical Techniques**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Spectrophotometry (UV & Visible) and spectrofluorimetry, atomic absorption Spectrophotometry
2. Infrared and Raman spectroscopy. ORD and circular dichroism, Nuclear magnetic Resonance and Electron Spin Resonance spectroscopy, Magnetic Resonance Imaging.
3. Electron Microscopy: transmission and scanning electron microscopy, Tunneling electron microscopy, Atomic Force microscopy.
4. Crystallography and X-Ray diffraction, Electron diffraction, Neutron diffraction.
5. Radioisotope techniques: radiotracers GM Counter, Proportional and Scintillation counters, autoradiography, Mass spectrometry-GCMS and LCMS.

**Practical**

Identification of the provided sample using some of the spectroscopic techniques. Sample preparation for electron microscopy. Practical demonstration of the above mentioned techniques.

**Text Books:**

1. Keith Wilson & John Walker (Eds.). Principles and Techniques of Practical Biochemistry (5<sup>th</sup> Edition). Cambridge University Press, 2000.
2. P. Carmona, R. Navarro, A. Hernanz (Eds.). Spectroscopy of Biological Molecules: Modern Trends (1<sup>st</sup> Edition). Kluwer Academic Publishers, 1997.
3. Bernard Valeur. Molecular Fluorescence: Principles and Application (1<sup>st</sup> Edition). Wiley-VCH, 2001.
4. N. Rama Krishna, Lawrence J. Berliner (Eds.) Protein NMR for the Millennium (Biological Magnetic Resonance) (1<sup>st</sup> Edition). Plenum US, 2003.

**BT-412 Biomaterials**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Molecular Design & Synthesis of biomaterials : Biodegradable Solid Polymeric Materials
2. Degradable materials with biological Recognition
3. Programmed/ Pulsed drug delivery & Drug Delivery in tissue Engg.,  
Biodegradable Polymers for Tissue Engg.
4. Hydrogel Biomaterials: Structure & Physical Chemistry & Gel Swelling calcs,  
Physical Hydrogels, Polyelectrolyte hydrogels
5. Brannon Peppas theory of Swelling in Ionic Hydrogels, Ionisation calcs
6. Bioengg Applications of Hydrogels: Molecular imprinting & Drug Delivery,  
Hydrogels in drug delivery
7. Inorganic Biomaterials & Organic templating of inorganic materials & Bone Biomimesis
8. Molecular Devices - Molecular Switches in the cell – fibronectin as mechanical switch
9. Nano & Micro Particle Carriers
10. PEGylated surface model

**BT-414 Biomedical Engineering**

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

**L T P**  
**3 1 0**

1. Introduction to biomedical engineering.
2. Dimensions, units and introduction to engineering analysis.
3. Forces, free-body diagrams & biomechanics.
4. Biomechanics, stress/strain. Biomechanics and pressure in the body.
5. Osmosis and the kidney.
6. Introduction to cell and tissue engineering & basic fluid dynamics. Blood, blood flow and the heart.
7. Bioinstrumentation and biosignals.
8. Biosignals and medical imaging. Basis of imaging: Neuroengineering : application of computed tomography, application , Fundamental of MRI, Optical biomedical diagnostics introduction to PET and SPECT, Imaging of gene expresses molecular imaging cardiac bioelectric.
9. Biomaterials, Ethics and professionalism in biomedical engineering.

**Text Books**

1. "Physics of the Body", JR Cameron, JG Skofronick, RM Grant, 2nd Edition, Medical Physics Publishing 1999.
2. "Introduction to Engineering Analysis", KD Hagen, Prentice Hall, 2001.
3. "Spreadsheet Tools for Engineers Using Excel", BS Gotfried, McGraw Hill, 2002.
4. "Introduction to Biomedical Engineering", J Enderle, S Blanchard, J Bronzino, Academic Press, 2000.

**BT-416. Introduction to Microelectromechanical systems and Nanobiotechnology****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100****A. Microelectromechanical systems**

1. Introduction and Overview
2. Biosignal Transduction Mechanism
3. Electromagnetic Transducers : Basic Sensing Mechanisms, Basic Actuating Mechanisms, Case Studies in Biomagnetic Sensors
4. Mechanical Transducers : Basic Sensing Mechanisms, Basic Actuating Mechanisms, Case Studies in Microfluidic Devices
5. Chemical Transducers : Basic Sensing Mechanisms, Basic Actuating Mechanisms
6. Optical Transducers: Basic Sensing Mechanisms, Basic Actuating Mechanisms
7. Ultimate Limits of Fabrication and Measurement, Recent Developments in BioMEMS

**B. Nano-biotechnology**

1. Overview of Nanotechnology : definition, history the new technological revolution, industrial and economic impact.
2. Introduction of Nanoscale physics : quantum mechanics, infinite potential well, energy, quantization, electron wave function, quantum confined Stark effect.
3. Low Dimensional Systems: Quantum Wells, Quantum Wires, and Quantum Dots, and their applications.
4. Properties of individual nanoparticles : optical properties, electronic properties
5. Carbon Nanostructures : Carbon Nanotubes and Buckey balls, their fabrication and applications
6. Magnetic Nanoparticles : properties and applications, spin valves, spintronics.
7. Nanofabrication Techniques: Self-Assembly and Catalysis, electron-beam, lithography, Template based fabrication.
8. Nanobiotechnology : Nanoscale biological materials, DNA detection, applications of nanoparticles in diagnosis and therapy.

**Text Books**

1. David S. Goodsell. Bionanotechnology: Lessons from Nature. (1<sup>st</sup> Edition) Wiley-Liss. 2004.
  2. Bharat Bhushan. Handbook of Nanotechnology (1<sup>st</sup> Edition). Springer Verlag, 2004.
- Christof M. Niemeyer & Chad A. Mirkin (Eds.). Nanobiotechnology: Concepts, Applications and Perspectives, 2004

**BT-418 Environmental and Occupational Toxicology**

**Internal Marks: 40**

**External Marks: 60**

**Total Marks: 100**

**L T P**

**3 1 0**

1. Dose-Response
2. Absorption
3. Distribution
4. Biotransformation
5. Excretion
6. Toxicokinetics
7. Biochemical Mechanisms of Toxicity
8. Mechanism of Signal Transduction
9. Cell Death & Apoptosis
10. Carcinogenesis
11. Genetic Toxicology Introduction, Short term assays for detecting genetic toxicology(in vitro and in vivo with examples of AMES, SOS, Cytogenetic Dominant lethal assays)
12. Toxicogenomics
13. Ecogenetics/Env Epidemiology
14. Role of Proteomics in toxicology
15. Role of Metabonomics in toxicology
16. Risk Assessment Handouts
17. Biotech/Regulatory Toxicology

**Text Books**

The Basic Science of Poisons: Casarett and Doull's Toxicology 2003 CD Klaassen, 6th Edition,

**BT-420 Advances in Drug design and drug delivery systems and Pharmacogenomics****Internal Marks: 40****L T P****External Marks: 60****3 1 0****Total Marks: 100**

1. Cell culture basics: cell lines, media, growth and culture characteristics, scale-up.
2. Animal cell culture products and their therapeutic potential: human biologicals, recombinant proteins, viral vaccines, monoclonal antibodies, importance of glycosidation for bioactivity.
3. Toxicity testing by in vitro assays.
4. The pharmaceutical use of metal ion chelating drugs.
5. An evaluation of the effectiveness of EDTA Chelation therapy@ as judged by the current scientific literature and a comparison with claims that are popularly made for this therapy.
6. The Newtonian basis of molecular modeling as it applies to the design of new drugs.
7. The design of several HIV protease inhibitors in treating AIDS and their interaction with their protein targets using molecular modeling.
8. Seeking bioactive moieties from natural sources.
9. Structure modification of natural therapeutic agents.
10. Modifying natural responses.
11. Chemical approaches to site-specific delivery of therapeutic entities.
12. Pharmacognosy for the 21<sup>st</sup> century. Pharmacogenomics Genomics & Proteomics: Concepts DNA Microarray Technology, Statistical Analysis of DNA Microarrays Bioinformatics, Cluster Analysis MIAME & LIMS, Development of genomic and proteomic based Individualized drugs.
13. Biotechnological Pharmaceutical products : FDA approved, marketed, and in clinical trial
14. Professional and legislative issues related to therapeutic biotechnology.
15. Pharmacokinetics/ Pharmacodynamics in Drug Development.
16. HPLC Application in Drug Design and Development
17. Rational design of novel and optimized dosage forms: influence of physicochemical and biological factors.
18. Oral controlled release: formulation/technology design and development.
19. Transdermal drug delivery.
20. Formulation Development for Peptide and Protein Candidates.
21. Drug delivery technologies like – nanoparticles, microspheres and liposomes and Future Directions

**Text Books**

1. Burger's Medicinal Chemistry, John Wiley & Sons, Inc., New York, 1994, Vols. 1-3.
2. *Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry*, 10<sup>th</sup> Edition, Delgado and Remers WA, Eds. New York, Lippincott-Raven, 1998.
3. Applied Biopharmaceutics and Pharmacokinetics 4<sup>th</sup> Edition Leon Shargel and Andrew Yu, Appleton & Lange, Stamford CT, 1999 Clinical Pharmacokinetics 3<sup>rd</sup> Edition, M. Rowland and T. Tozer, Williams and Wilkins,
4. Problems associated with delivery of larger molecules, delivery consideration of peptide and protein through various routes of drug administration
5. Gene therapy and gene delivery
6. Drug targeting and biotechnology.

