Shobhit
Institute of Engineering & Technology
Deemed to-be-University
EDUCATION EMPOWERS

# SYLLABUS
# B.TECH. BIOTECHNOLOGY

**Approved and adopted in year 2018 (Board of Studies, August 3, 2018)**
**by 23rd Academic council (Agenda no-03)**

# Teaching Scheme (B. Tech. Biotechnology) 2019-2020

| Sl.No. | Course Work - Subject Area | Credits / Semester | | | | | | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | |
| 1 | Humanities and Social Sciences including Management courses (HSS) | | 3 | 3 | 3 | | | | | **9** |
| 2 | Basic Science Courses (BAS) | 9.5 | 9.5 | 6 | | | | | | **25** |
| 3 | Engineering Science Courses (BTE) | 8 | 8 | 3 | 3 | | | | | **22** |
| 4 | Professional core courses (BTC)/ Minor Project/ Lab. | | | 10 | 15 | 9 | 10 | 9 | | **53** |
| 5 | Professional Elective courses (BTD) | | | | | 6 | 6 | 6 | | **18** |
| 6 | Open Elective courses (..O) | | | | | 6 | 6 | 6 | | **18** |
| 7 | Seminar, Project Work and Internship (BTC) | | | | | | | | 15 | **15** |
| 8 | Mandatory Courses (MCC) | | | * | * | * | * | * | * | **0** |
| | **Total** | **17.5** | **20.5** | **22** | **21** | **21** | **22** | **21** | **15** | **160** |

**Changes:** Addition of Biology for engineers in III Sem; Entrepreneurship in IV Sem; IPR and Engineering Ethics in VII Sem;Addition of Minor Project from III-VII Semester; Addition of Mandatory courses (Essence of Indian Traditional Knowledge; Cyber Security; Indian Constitution)

## SCHEME OF TEACHING – B. TECH. (Biotechnology) II YEAR

| S.No. | Course | Course Code | Credit | L | T | P |
|---|---|---|---|---|---|---|
| **Semester III** | | | | | | |
| 1. | Management Concepts and Practices | HSS-308 | 3 | 3 | 0 | 0 |
| 2. | Biology for Engineers | BAS-311 | 3 | 3 | 0 | 0 |
| 3. | Biostatistics | BAS-313 | 3 | 3 | 0 | 0 |
| 4. | Biophysical Techniques | BTE-317 | 3 | 3 | 0 | 0 |
| 5. | Biochemistry | BTC-301 | 4 | 3 | 1 | 0 |
| 6. | Cell Biology | BTC-302 | 3 | 3 | 0 | 0 |
| 7. | Biochemistry Lab. | BTC-351 | 1 | 0 | 0 | 2 |
| 8. | Cell Biology Lab. | BTC-352 | 1 | 0 | 0 | 2 |
| 9. | **Minor Project** | BTC-361 | 1 | 0 | 0 | 2 |
| 10. | Essence of Indian Traditional Knowledge | MCC-301 | 0 | 2 | 0 | 0 |
| | | **Total** | **22** | | | |
| **Semester IV** | | | | | | |
| 1. | Entrepreneurship | HSS-403 | 3 | 3 | 0 | 0 |
| 2. | Chemical Engineering Principles | BTE-422 | 3 | 3 | 0 | 0 |
| 3. | Genetics | BTC-401 | 4 | 4 | 0 | 0 |
| 4. | Microbiology | BTC-402 | 4 | 4 | 0 | 0 |
| 5. | Molecular Biology | BTC-403 | 3 | 3 | 0 | 0 |
| 6. | Genetics Lab. | BTC-451 | 1 | 0 | 0 | 2 |
| 7. | Microbiology Lab. | BTC-452 | 1 | 0 | 0 | 2 |
| 8. | Molecular Biology Lab. | BTC-453 | 1 | 0 | 0 | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9. | **Minor Project** | BTC-461 | 1 | 0 | 0 | 2 |
| 10. | Environmental Sciences | MCC-401 | 0 | 2 | 0 | 0 |
| | | **Total** | **21** | | | |

## SCHEME OF TEACHING – B. TECH. BT III YEAR

| S.No. | Course | Course Code | Credit | L | T | P |
|---|---|---|---|---|---|---|
| **Semester V** | | | | | | |
| 1. | Plant and Animal Tissue culture | BTC-501 | 4 | 4 | 0 | 0 |
| 2. | Immunotechnology | BTC-502 | 3 | 3 | 0 | 0 |
| 3. | Enzyme Technology | BTD-501 | 3 | 3 | 0 | 0 |
| 4. | Genetic Engineering | BTD-502 | 3 | 3 | 0 | 0 |
| 5. | Biomaterials | BMO- 501 | 3 | 3 | 0 | 0 |
| 6. | Bioinformatics | BIO-501 | 3 | 3 | 0 | 0 |
| 7. | Plant and Animal Tissue culture Lab. | BTC-551 | 1 | 0 | 0 | 2 |
| 8. | **Minor Project** | BTC-561 | 1 | 0 | 0 | 2 |
| 9. | Cyber Security | MCC-501 | 0 | 2 | 0 | 0 |
| | | **Total** | **21** | | | |
| **Semester VI** | | | | | | |
| 1. | Animal Biotechnology | BTC-601 | 4 | 4 | 0 | 0 |
| 2. | Food Biotechnology | BTC-602 | 3 | 3 | 0 | 0 |
| 3. | Bioprocess Engineering | BTD-601 | 3 | 3 | 0 | 0 |
| 4. | Medical Biotechnology | BTD-602 | 3 | 3 | 0 | 0 |
| 5. | Agriculture Biotechnology | AIO-601 | 3 | 3 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6. | Genomics and Proteomics | BIO-601 | 3 | 3 | 0 | 0 |
| 7. | Animal Biotechnology Lab. | BTC-651 | 1 | 0 | 0 | 2 |
| 8. | Food Biotechnology Lab | BTC-652 | 1 | 0 | 0 | 2 |
| 9. | **Minor Project** | BTC-661 | 1 | 0 | 0 | 2 |
| **10.** | Indian constitution | MCC-601 | 0 | 2 | 0 | 0 |
| | | Total | **22** | | | |

## SCHEME OF TEACHING – B. TECH. BT IV YEAR

| S.No. | Course | Course Code | Credit | L | T | P |
|---|---|---|---|---|---|---|
| **Semester VII** | | | | | | |
| 1. | Plant Biotechnology | BTC-701 | 3 | 3 | 0 | 0 |
| 2. | Environmental Biotechnology | BTC-702 | 3 | 3 | 0 | 0 |
| 3. | Pharmaceutical Biotechnology | BTD-701 | 3 | 3 | 0 | 0 |
| 4. | Downstream Processing | BTD-702 | 3 | 3 | 0 | 0 |
| 5. | IPR and Engineering Ethics | BMO-701 | 3 | 3 | 0 | 0 |
| 6. | Drug Design | BIO-702 | 3 | 3 | 0 | 0 |
| 7. | Plant Biotechnology Lab. | BTC-751 | 1 | 0 | 0 | 2 |
| 8. | Environmental Biotechnology Lab. | BTC-752 | 1 | 0 | 0 | 2 |
| 9. | **Minor Project** | BTC-761 | 1 | 0 | 0 | 2 |
| 10. | Technical report writing | MCC-708 | 0 | 2 | 0 | 0 |
| | | **Total** | **21** | | | |
| **Semester VIII** | | | | | | |
| 1 | Seminar ,Project Work and Internship | BTC-871 | **15** | | | |

## Program Education Objectives (PEOs):

PEO 1. Successful professional career and/ or higher studies by gaining knowledge in fundamental mathematics and biological principles

PEO 2. Provide strong foundation in the core biotechnology courses to evaluate real life problems and to propose biotechnological solutions with economical and social viability

PEO 3. Sensitize on environmental, health and bioethical issues, Intellectual property rights, professional ethics and life-long learning through application orientated activities

## Program Objectives (POs) :

PO1. An ability to apply the knowledge of mathematics, science, and engineering fundamentals in the areas of biotechnology, such as Bioprocess engineering, Genetic Engineering, Bioinformatics, Downstream Processing etc.

PO2. An ability to identify and analyze the complex biotechnology-oriented problems and to nurture the issues by providing appropriate solution

PO3. An ability to design a bio-based system, component or process or protocol to address the essential issues related to public health, environment, society,culture and safety

PO4. An ability to design, analyze, interpret and conclude the biological data using broad research based knowledge

PO5. An ability to educate the appropriate selection and application of current/ modern engineering techniques/ tools in the area of biotechnology

PO6. An ability to inculcate awareness among the students about the impact of various biological issues related to society, ethics, health, culture and safety

PO7. An ability to understand and demonstrate the need for the development of sustainable biotechnological solutions for addressing the environmental issues aligned with society

PO8. An ability to realize, commit and apply professional ethics by means of technology practice

PO9. An ability to inculcate the habit among students to function efficiently as an individual or in multidisciplinary team

PO10. An ability to communicate effectively through verbal and written mode with technical audience

PO11. An ability to create competency in the engineering management, finance principles and its application in multidisciplinary projects

PO12. An ability to recognize the need for *life-long learning* for sustaining professional career.

## THIRD SEMESTER

## MANAGEMENT CONCEPTS AND PRACTICES

| HSS-308 | Cr. | L | T | P |
|---|---|---|---|---|
| | 3 | 3 | 0 | 0 |

Learning Objectives:

a. To understand ability and builds the confidence in the students.
b. To gain active listening and responding skills
c. To learn the style and organization in technical communication: Listening
d. To understand Politeness and Etiquette in communication; Cultural factors that influence communication
e. To learn Standard e-mail practices; Language in e-mail; Using internet for collecting information

**Unit-I** **[8 Hours]**

Definition of Management – Nature- Science or Art – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organisation.

**Unit –II** **[8 Hours]**

PLANNING -Nature & Purpose – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies & Planning Premises- Forecasting – Decision-making.

**Unit –III** **[8 Hours]**

Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process–Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations–De-Centralization and Delegation of Authority – Staffing – Selection Process - Techniques .

**Unit-IV** **[8 Hours]**

Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication.

**Unit-V** **[8 Hours]**

System and process of Controlling – Requirements for effective control–The Budget as Control Technique–Information Technology in Controlling – Use of computers in handling the information– Productivity –Problems and Management –Control of Overall Performance – Direct and Preventive Control–Reporting–The Global Environment–Globalization and Liberalization–International Management and Global theory of Management.

**REFERENCE BOOKS:**

1. Harold Kooritz & Heinz Weihrich "*Essentials of Management*", Tata McGraw-Hill, 1998.

2. Joseph L Massie "*Essentials of Management*", Prentice Hall of India, (Pearson) Fourth Edition, 2003.
3. Tripathy PC And Reddy PN, "*Principles of Management*", Tata McGraw-Hill, 1999. David, Robbin Stephen A, "*Personnel and Human Reasons Management*", Prentice Decenzo Hall of India, 1996
4. JAF Stomer, Freeman R. E and Daniel R Gilbert, *Management*, Pearson Education, Sixth Edition, 2004.
5. Fraidoon Mazda, " *Engineering Management*", Addison Wesley,-2000

**Course outcomes (COs):**

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

1. Develop and prepare for communications in a technical organization.
2. Develop skills for writing business letters and reports.
3. Participate in debates and interviews at global forum.
4. Communicate through phone and e-mail for business communication.
5. Coordinate meetings and projects in a technical organization.

## BIOLOGY FOR ENGINEERS

| BAS-311 | Cr. | L | T | P |
|---|---|---|---|---|
| | 3 | 3 | 0 | 0 |

**Learning Objectives;**

- To understand Biological concepts from an engineering perspective
- To understand the inter-connection between biology and future technologies
- To motivate technology application for biological and life science challenges

**Unit-I** **[8 Hours]**

**BASIC CELL BIOLOGY** -Introduction: Methods of Science-Living Organisms: Cells and Cell theory Cell Structure and Function, Genetic information, protein synthesis, and protein structure, Cell metabolism-Homoeostasis- Cell growth, reproduction, and differentiation.

**Unit-II** **[8 Hours]**

**BIOCHEMISTRY AND MOLECULAR ASPECTS OF LIFE** -Biological Diversity --Chemistry of life: chemical bonds--Biochemistry and Human biology--Protein synthesis—Stem cells and Tissue engineering.

**Unit-III** **[8 Hours]**

**ENZYMES AND INDUSTRIAL APPLICATIONS** -Enzymes: Biological catalysts, Proteases, Carbonic anhydrase, Restriction enzymes, and Nucleoside monophosphate kinases—Photosynthesis

**Unit-IV** **[8 Hours]**

**MECHANOCHEMISTRY**MolecularMachines/Motors,Cytoskeleton,Bioremediation, Biosensors

**Unit-V** **[8 Hours]**

**NERVOUS SYSTEM, IMMUNE SYSTEM, AND CELL SIGNALING** -Nervous system--Immune system- General principles of cell signaling.

## Course Outcomes

CO 1: Understand the biological concepts from an engineering perspective
CO 2: Understand the concepts of biological sensing and its challenges
CO 3: Understand development of artificial systems mimicking human action
CO 4: Integrate biological principles for developing next generation technologies
CO 5: Understand the biological concepts in Human health

**REFERENCE BOOKS:**


1. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "*Biochemistry*," W.H. Freeman and Co. Ltd., 6th Ed., 2006.
2. Robert Weaver, "*Molecular Biology*," MCGraw-Hill, 5th Edition, 2012.
3. Jon Cooper, "*Biosensors A Practical Approach*" Bellwether Books**, 2**004.
4. Martin Alexander, "*Biodegradation and Bioremediation,"* Academic Press, 1994.
5. Kenneth Murphy, "*Janeway's Immunobiology*," Garland Science; 8th edition, 2011.
6. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, "Principles of Neural Science, McGraw-Hill, 5th Edition, 2012.
7. S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "*Biology for Engineers*," Tata McGraw-Hill, New Delhi, 2012.


## BIOSTATISTICS

**BAS-313**

| Cr. | L | T | P |
|---|---|---|---|
| 3 | 3 | 0 | 0 |

. Learning Objectives:

a. To understand the mathematical basis and foundations of probability and statistics.
b. To apply statistical methods to solve biological problems.
c. To apply the basic and modern statistical software for the analysis of the biological and clinical data.
d. To provide an in-depth understanding of various bio-statistical approaches, used for data analyses.
e. Also provides a perspective of research methodology and familiarizes students with the development of research tools and research proposal writing and publishing.

**Unit-I** **[9 Hours]**

Data type, classification and summarization of data, diagrams and graphs, measures of dispersion, Skewness and Kurtosis.

**Unit-II** **[8 Hours]**

Introduction to probability, Laws of probability, Bayer's theorem, Binomial distribution, Poison distribution.

**Unit-III** **[9 Hours]**

Positive and negative correlation, correlation coefficient, Non parametric tests, multiple regression, equation of line of regression, regression coefficient, Linear and Non linear regression.

**Unit-IV** **[8 Hours]**

Hypothesis tests, Chi square tests and F tests, Variant, One way and two way analysis of variants, ANOVA.

**Unit-V** **[6 Hours]**

Principles of experimental design and analysis.

**Course Outcomes (COs):**

a. Critically analyze research methodologies identified in existing literature.
b. Propose and distinguish appropriate research designs and methodologies to apply to a specific research project.
c. Use basic and modern statistical software to analyze the biological and clinical data.
d. Develop a comprehensive research methodology for a research question.
e. Apply the understanding of feasibility and practicality of research methodology for a proposed project

**REFERENCE BOOKS:**

Gurumani N. (2005) An Introduction to Biostatistics, MJP Publishers.
George W. and William G. Statistical Methods, IBH Publication

## BIOCHEMISTRY

| **BTC- 301** | **Cr.** | **L** | **T** | **P** |
|---|---|---|---|---|
| | **4** | **3** | **1** | **0** |

Learning Objectives:

a. To explains the sources of energy supply of the processes running in the living organisms and molecular mechanisms of the energy transformation in the cells.
b. To analyse, compares and critically evaluates the information related to this topic.
c. To desribes the thermodynamics of the biological (living) systems: exergonic and endergonic reactions, Gibbs (free) energy, spontaneous and nonspontaneous reactions, free energy changes of coupled reactions.

d. To desribes the biological oxidation-reduction reactions and mechanisms of electron transfer by transporters of respiratory chains.
e. To describes hypotheses of origin and evolution of energy-transforming biological systems.

**UNIT – I WATER, PH, & BIOLOGICAL BUFFERS [7Hrs]**

Important properties of water, the law of mass action, dissociation of water and its ionic product, pH, Bronsted acids, ionization of weak acids and bases. Henderson Haeselbatch equation, Titration curves, buffering action and physiological buffers.

**UNIT – II CARBOHYDRATES [7Hrs]**

Definition classification, Basic structure, properties and functions of saccacharides and related compounds, di-saccharides and poly- saccharides. Structural polysaccharides-cellulose and chitin, storage polysaccharides-starch, glycogen, peptidoglycan and glycosaminoglycans, proteoglycans and glycoproteins.

**UNIT – III AMINO ACIDS AND PROTEINS [7Hrs]**

Structure, properties, classification and functions of amino acids, amino acid sequence determination, structure and function of proteins. Protein denaturation and renaturation, folding pathways, folding accessory proteins, proteins purification procedures.

**UNIT – IV LIPIDS [7Hrs]**

Structure, nomenclature and physical and chemical properties of fatty acids. Classification of lipids, general structure and functions of triacylglycerole, Phospholipids, Sphingolipids, glycolipids, cholesterol & lipoproteins structure, properties and function of steroids.

**UNIT – V ENZYMES [8Hrs]**

Nomenclature and classification, co-enzymes and co-factors, reaction and derivation of Mchaelis-Menten equation, Line weaver-Burke, plot, inhibition kinetics and allosteric regulation of enzymes, isozymes, mode of catalysis.

**UNIT – VI VITAMINS [6Hrs]**

Definition and classification of vitamins, Biological role of Vitamins, diseases, visual cycle.

## Course Outcomes (COs):

a. Describe the daily requirement, digestion and absorption of carbohydrates, proteins and lipids.
b. Discuss the metabolic pathways of carbohydrates and metabolic disorders associated with item.
c. Explain the metabolic pathways of lipids and metabolic disorders associated with item.
d. Demonstrate the metabolic pathways of amino acids, nucleic acids and associated disorders.
e. Summarize the hormonal regulation of metabolic pathways.

**REFERENCE BOOKS:**


1. Nelson, D.L. and Cox, M.M. 2007. Lehninger Principle of Biochemistry (4th eds.). W. H. Freeman and Co.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. 2007. Biochemistry (6th eds.). W.H. Freeman and Co.
3. Voet, D.J., Voet, J.G. and Pratt, C.W. 2008. Fundamentals of Biochemistry (3rd eds.). John Wiley Sons Inc.
4. Satyanarayana, U. and Chakrapani, U. 2007. Essentials of Biochemistry (2nd eds.). Books and allied Pvt. Ltd.
5. Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's illustrated biochemistry (27th eds.) Mc Graw Hill, USA.
6. Hames, D. and Hooper, N. 2008. Instant notes on biochemistry (3rd eds.). Taylor and Francis.
7. Jain, J.L., Jain, S. and Jain, N. 2008. Fundamentals of biochemistry. S. Chand, Publishers, New Delhi.


## BIOCHEMISTRY LAB.

**BTC- 351**

| Cr. | L | T | P |
|---|---|---|---|
| 1 | 0 | 0 | 2 |

1. General guidelines for working in biochemistry lab.
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Preparation of different types of buffer.
4. Qualitative method for carbohydrates-distinguishing reducing from non-reducing sugar and keto- from aldo- sugar.
5. Quantitative and chromatographic method for amino acids estimation using ninhydrin reagent for distinguishing amino from imino acid.
6. Protein estimation by Biuret, Bradford and Lowry method.
7. Extraction of chloroplastic pigments, anthocyanin, carotenoids estimation and qualitative analysis by paper chromatography.
8. Estimation of sugars by anthrone method.
9. Determination of enzyme activity and effect of different factors.
10. Determination of permeability of β-cyanins across the membrane.
11. Determination of $K_m$ and $V_{max.}$

## Course Outcomes (COs):

a) Ability to understand fundamental concepts of biology, chemistry and biochemistry.

b) Ability to apply basic principles of chemistry to biological systems and molecular biology.

c) Ability to relate various interrelated physiological and metabolic events.

d) The student will get practical knowledge of Preparation of buffers and measurement of pH,

**e)** Qualitative tests of carbohydrates, Qualitative tests of proteins & Amino Acids, Comparative evaluation of different methods of protein analysis: UV, Lowry, Biuret, Bradford.

**CELL BIOLOGY**

**BTC-302**

| Cr | L | T | P |
|---|---|---|---|
| 3 | 3 | 0 | 0 |

Learning Objectives:

a) To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
b) To understand how these cellular components are used to generate and utilize energy in cells
c) To understand the cellular components underlying mitotic cell division.
d) Students will apply their knowledge of cell biology to selected examples of changes orlosses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

**UNIT – I THE CELL AND ORGANELLES [7Hrs]**

Introduction, definition and type of cell, cellular compartmentalization and different cell organelles (structure and functions), the nucleus: global structure of chromosomes, chromosomal DNA and its packaging, organization and evolution of the nuclear genome.

**UNIT – II BIO-MEMBRANES AND CYTOSKELETON [8Hrs]**

Introduction to bio-membranes, plasma membrane: organization and transport across the plasma membrane and epithelia, nature of the cytoskeleton, intermediate filaments, extracellular matrix (ECM), cell-cell junctions.

**UNIT - III CELL CYCLE [7Hrs]**

General strategy of the cell cycle, mechanics of cell division, cell-cycle control, programmed cell death (apoptosis), signals that trigger cell death, growth and proliferation

**UNIT – IV SIGNAL TRANSDUCTION [8Hrs]**

Mechanisms of cell signaling, Intracellular receptor and cell surface receptors, signaling via G-protein linked receptors and enzyme linked receptor signaling pathways.

**UNIT – V SYSTEMS BIOLOGY [9Hrs]**

Structure and function of epithelial system, muscular system, circulatory system, endocrine system and nervous system.

**Course Learning Outcome:** Upon successful of this course student will able to

a) Describe the cell structure, components of cell, enzymes to emphasize the importance of cell as the basic unit of an organism.

b) An understanding about the role of various cellular organelles in modifying the functions of the cells, especially, metabolism and protein synthesis.

c) The role of cytoskeleton and modes of cellular transport will be discussed.

d) Understanding the cellular regulation through various types of cell signaling, cell division, apoptosis and cell differentiation.

e) Provide an overall understanding of the epithelial cells and cancer with a focus on neurobiology and neurodegenerative diseases.

**REFERENCE BOOKS:**


1. Cooper, G.M. and Hausman, R.E. The Cell- A molecular approach (4th eds.). A S M Press, Sinauer Associate Inc.
2. Karp, G. Cell and Molecular Biology, Concepts and Experiments, John Wiley and Sons.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. 2008. Molecular Biology of Cell (5th eds.). Garland Sciences.
4. Benjamin Lewin. 2008. Genes IX. Oxford University Press.
5. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. 2008. Molecular Biology (6th eds.). W H Freeman and co.
6. Power, C.B. 2008. Cell Biology (3rd eds.). Himalaya Publishing House.
7. Gupta, P.K. 1999. Cell and Molecular Biology. Rastogi Publication, Meerut.


## CELL BIOLOGY LAB

**BTC-352** **Cr L T P**

1 0 0 2

1. Microscopy- Theoretical knowledge of Light and Electron microscope.

2. To study the following techniques through electron/ photomicrographs: fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching shadow casting, endocytosis and phagocytosis.

3. To explain mitosis and meiosis using permanent slides.

4. Cell fractionation through centrifugation.

5. Isolation of chloroplast and its identification.

6. To study the effect of isotonic, hypotonic and hypertonic solutions on cells.

**Course Learning Outcome**

a) The candidate would have gained knowledge about the morphology of the basic microorganisms.

b) Basic knowledge about the operation and sterilization procedures in the laboratories would have been gained.

c) Different staining techniques to visualize the live and dead microorganisms would have been practiced.

d) An overview about blood cells and its morphology would have been studied.

e) Knowledge about different stages of cells would have been gained.

## BIOPHYSICAL TECHNIQUES

**BTC-317**

| Cr. | L | T | P |
|---|---|---|---|
| 3 | 3 | 0 | 0 |

Learning Objectives:

a. To understand the origin of bio-potentials and their physical significance.

b. To compare different techniques of measuring blood pressure, blood flow and volume.

c. To interpret the principle and operation of therapeutic and prosthetic devices.

d. To differentiate between the various techniques for measurement of parameters.

**UNIT – I** **[9Hours]**

**MICROSCOPY** -Principle, working, sample preparation and biological applications of different microscopes light microscope (bright field and dark field, phase contrast, polarization, differential interference contrast), electron microscope (TEM, SEM), fluorescence microscope (simple and confocal) and Atomic force microscope.

**UNIT – II** **[7Hours]**

**CENTRIFUGATION** -Principle, construction, working of centrifugation and concept of RCF, types of instruments and rotors used in centrifugation, types of centrifugations- preparative, differential density gradient centrifugation and analytical ultracentrifuge.

**UNIT – III** **[8Hours]**

**ELECTROPHORESIS** -Principle & Working of zonal and continuous electrophoresis, types of electrophoresis- paper, cellulose acetate, gel and capillary electrophoresis, native and denaturing gels, isoelectric focusing, two dimensional gel electrophoresis, pulse-field gel electrophoresis.

**UNIT – IV** **[8Hours]**

**CHROMATOGRAPHY** -Principle, instrumentation and biological applications of paper and thin layer (TLC) chromatography, gel permeation (GPC), ion exchange chromatography, affinity chromatography, gas liquid (GC) and high pressure liquid chromatography.

**UNIT – V** **[8Hours]**

**SPECTROSCOPY**-Basic concepts of spectroscopy, beer lamberts law, principles, instrumentation and applications of UV-Visible spectroscopy, nephelometry, turbidometry, fluorescence spectroscopy, atomic absorption spectrophotometry. Basic concepts, instrumentation and biological applications of infra red spectroscopy and mass spectroscopy.

Course Outcomes (COs):

a. Explain the basic principles of analyses and detection systems involved in photometric, fluorometric and luminescence -based methods.
b. Explain principles of electrophoresis and immunochemical techniques and discuss how these techniques can be used in molecular medicine.
c. Discuss the use of enzyme kinetics in analytical methods.
d. Explain basic principles for chromatographic separation techniques.
e. Discuss quality control, error sources, documentation and storage of experimental data.

**REFERENCE BOOKS:**


1. Wilson, K. and Walker, J. 1994. Principles and Techniques Practical Biochemistry, Cambridge University Press, Cambridge.
2. Willard, H.H., Meritt, L.L., Dean, J.A. and Settle, F.A. 1986. Instrumental method of analysis ($7^{th}$ eds.). Wadsworth Pub. Co., USA.
3. Rana, S.V.S. 2006 and 07. Biotechniques– Theory and Practice ($2^{nd}$ eds.). Rastogi Publications.
4. Chatwal, G.R. and Anand, S.K. 2008. Instrumental methods of chemical analysis ($5^{th}$ eds.). Himalaya Publishing House.

5. Skoog, D.A., Holler, F.J. and Crouch, S.R. 2007. Instrumental analysis. Brooks/Cole Cengage Learning.
6. Upadhayay, A. and Upadhayay, K. 2008. Biophysical chemistry (4th eds.). Himalaya Publishing House.

## ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

| MCC-301 | Cr | L | T | P |
|---|---|---|---|---|
| | 0 | 0 | 0 | 0 |

**Unit I** **[8Hours]**

**Introduction to traditional knowledge**: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

**Unit II** **[8Hours]**

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

**Unit III** **[8Hours]**

**Legal frame work and TK**:**A:** The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); **B:** The Biological Diversity Act 2002 and Rules 2004, the protection of traditional Knowledge bill, 2016. Geographical indicators act 2003.

**Unit IV** **[8Hours]**

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

**Unit V** **[8Hours]**

Traditional knowledge in different sectors: Traditional knowledge and engineering,Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation andsustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

COURSE OUTCOMES:

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. Illustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

**REFERENCE BOOKS:**

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
4. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino

## MINOR PROJECT

**BTC-361**

**COURSE OUTCOMES:**

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs
e) The student may develop a tool to for the betterment of the society

## FOURTH SEMESTER

## ENTERPRENEURSHIP

**HSS-403**

| Cr. | L | T | P |
|---|---|---|---|
| 3 | 3 | 0 | 0 |

**UNIT I** **[8Hours]**

Concept and need of Entrepreneurship, Definition of Entrepreneur, Entrepreneurship innovation, Creativity, Business idea, Entrepreneurship as a career, Entrepreneurship as a style of management, the changing role of the entrepreneur, Entrepreneurial traits

**UNIT II** **[9Hours]**

Influences on entrepreneurship development, External influences entrepreneurship development, Socio-cultural, political, economical, personal entrepreneurial success and failure: reasons and remedies, women entrepreneurs, Challenge to women entrepreneurs, achievements of women entrepreneurs

**UNIT III** **[8Hours]**

The business plan as an entrepreneurial tool; elements of businessman ;objectives ;market analysis; development of product/idea; marketing, finance, organization and management ;ownership; critical risk contingencies of the proposal ;scheduling and milestones.

**UNIT IV** **[8Hours]**

Technical ,financial ,marketing personnel ,and management feasibility reports; financial schemes offered by various financial institution, like commercial Banks, IDBI, ICICI, SIDBI, SFCs.

**UNIT V** **[8Hours]**

Role of central government and state government in promoting entrepreneurship with various incentives, subsidies, grants, etc.

**Course Outcomes (Cos):** After the completion of the course, the students will be able to:

a. Have the ability to discern distinct entrepreneurial traits.
b. Know the parameters to assess opportunities and constraints for new business ideas.
c. Understand the systematic process to select and screen a business idea.
d. Design strategies for successful implementation of ideas.
e. Write a business plan.

**REFERENCE BOOKS:**


1. Khanka,S.S.,*Entrepreneurial Development,*S.Chand, New Delhi.
2. Hisrich D.robert ,Michael P.Peters, dean A.Shepherd, *Entrepreneurshipand Small Business Management* ,PHI,4th Ed .
3. Patel ,V.G.,*The Seven Business Crises and How To Beat Them* ,Tata McGraw-Hill, New Delhi, 1995.
4. Holt H. David, *Entrepreneurship : New Venture Creation*, Prentice –Hall of India, New Delhi


## CHEMICAL ENGINEERING PRINCIPLES

**BTE-422**

| Cr. | L | T | P |
|---|---|---|---|
| 3 | 3 | 0 | 0 |

Learning Objectives:

a. To apply the fundamental principles of chemical reaction kinetics and thermodynamics to problems involving mass and energy balances & reaction.

b. To design different types of chemical reactors (Batch, Tube, CSTR).

c. To assess the advantages and disadvantages of each reactor type.

d. To analyze experimental kinetic data to determine reaction mechanisms.

e. To use numerical methods to design a chemical reactors.

**Unit-I** **[8Hours]**

**Basic introduction to Chemical Engineering:** Chemical engineering discipline, chemical equation stoichiometry calculation, Units, dimensions and conversions, conventions in methods of analysis and measurement.

**Unit-II** **[8Hours]**

**Material balance:** Gas-liquid and vapor-liquid systems, Phase rule, Henry's law, Rault's law and their applications, material balance for non-reacting and reacting systems, recycle, by pass and purge calculation.

**Unit-III** **[8Hours]**

**Energy balance:** Heats of solution, mixing and reactions, types of energy and first law of thermodynamics, energy balance for non-reacting and reacting systems, reversible process and the mechanical energy balance.

**Unit-IV** **[8Hours]**

**Fluid mechanics:** Nature of fluid, viscosity, flow field, flow of a fluid past a solid surfaces, conservation of mass and energy, Hagen–poiseulle equation, fanning equation, pressure drops in flow through porous media, fluidization, cavitation, pumping of fluid.

**Unit-V** **[8Hours]**

**Fundamentals of mass transfer:** Molecular diffusion in fluids and solids, concept of mass transfer coefficient, equilibrium stage, multistage and continuous contactors with applications to gas absorption.

Course Outcomes (COs):

a. To classify the biological basics and bioprocessing.
b. Discuss the difference between bioprocesses and chemical processes.
c. Bioprocess design and operation Choice of bioreactor Heat & mass transfer considerations and scale up of bioprocesses.
d. Recall the role of animoacids in enzyme catalysis
e. Introduction to bioprocess monitoring/control.

**REFERENCE BOOKS:**


1.McCabe W.L., Smith J.C. and Harriott P.1993. *Unit Operations of Chemical Engineering* ($5^{th}$eds), McGraw Hill International Edition.

2.Coulson J.M., Richardson J.F. and Butterworth Heinemann. 1999. *Chemical Engineering*, ($6^{th}$ eds). Vol. 1, Oxford.

3. Douglas J.F., Gasiorek J.M. and Swaffield, J.A., 1995. *Fluid Mechanics* ($3^{rd}$ eds.). Addison-Wesley Longman.

4.Himmelblau D.M. 1999. *Basic Principles of Calculations in Chemical Engineering* ($6^{th}$ eds.). Prentice Hall.

5.Ghosal, S.K., Sanyal, S.K. and Datta, S. 2003. *Introduction to Chemical Engineering*. Tata McGraw-Hill Publishing Co.

## GENETICS

**BTC- 401** **Cr L T P**
**4 4 0 0**

Learning Objectives:

a. To discuss the structure of nucleic acids & proteins and their interactions.

b. To describe the mechanisms of central dogma of life.

c. To study the molecular mechanisms of gene regulation in prokaryotes and eukaryotes.

d. To demonstrate Mendelian inheritance

e. To calculate recombinant frequencies and construct pedigree analysis.

f. To study chromosomal aberrations in humans.

**UNIT – I PHYSICAL BASIS OF HEREDITY [6Hrs]**

Basic law of inheritance, deviations of Mendel's ratios due of gene interaction, concept of alleles, complementation test, multiple factors of inheritance. genes and environment interaction. probability and statistical testing.

**UNIT – II CELL DIVISION, LINKAGE, RECOMBINATION AND GENE MAPPING METHODS [8Hrs]**

Mitosis, meiosis, chromosomal inheritance, concept of linkage, crossing over and mapping to genes by recombination frequency , three point test cross, tetrad analysis, mitotic crossing over, sexuality and recombination in bacteria and viruses, molecular mechanism of genetic recombination.

**UNIT – III SEX DETERMINATION AND SEX LINKAGE [7Hrs]**

Mechanism of sex determination in animals and plants, sex linked, sex influence and sex limited traits, sex linked disorders in human beings.

**UNIT – IV CYTOGENETIC, MUTATION AND EXTRA CHROMOSOMAL INHERITANCE [7Hrs]**

Chromosome aberrations, polyploidy. Mutation: type, cause and detections, application of mutants. Maternal inheritance: inheritance of mitochondrial and chloroplast genes, Transposable elements, transpositions of transposons in genome.

**UNIT – V MOLECULAR AND HUMAN GENETICS [8Hrs]**

Identification of genetic materials, the genetic code, gene regulation and gene expression. Pedigree analysis, genetic disorders, inborn errors of metabolism (Phenylketonuria and Galactosemia), neurogenetic disorders (Alzheimer's and Parkinson's), muscle genetic disorders (Muscular Dystrophy), cancer genetics and genetic counselling.

Course Outcomes (COs):

a. Discuss the basic organization of the human genome.
b. Explain the Mendelian inheritance patterns in humans and the associated complications.
c. Describe the Mitochondrial inheritance, X-inactivation.
d. Learn in detail about the chromosomal basis of human diseases and genetics of pregnancy.
e. Describe the different types of mutations and their relevance for diseases and basic concepts in molecular pathology.

**REFERENCE BOOKS:**


1. Gardner, E.J., Simmons, M.J. and Snustad, P.D. 2007. Principles of Genetics (8th eds.). Wiley's India, New Delhi.
2. Gupta, P.K. 1999. Cell and molecular biology (1st ed.). Rastogi Publications
3. Hartl, D.R. and Jones, J. 2008. Genetics, Analysis of Genes and Genomes (5th eds.). Johns and Barttlett Publishers.
4. Tamarin, R.H. 2006. Principles of Genetics (7th eds.). TMH Publications.
5. Strickberger, M.W. 2007. Genetics (3rd eds.). Prentice Hall of India.
6. Prasad, S. 2004. Elements of biostatistics (1st eds.). Rastogi Publication.
7. Russell, P.J. 2006. *i*Genetics: a molecular approach (2nd eds.). Pearson Benjamin Cummings.


## GENETICS LAB

**BTC-451** **Cr L T P**
**1 0 0 2**

1. Chi Square Test for Monohybrid and dihybrid crosses
2. Probability and Pedigrees analysis.
3. Study of chromosome morphology at different stages of cell division.
4. Study of multiple allele's inheritance by ABO blood genotyping.
5. Study genetic material transfer in two different strain bacteria by conjugation method
6. Study of genetic markers in bacteria.
7. Study of genetic polymorphism from diverse populations.
8. Study Allele Frequency Distributions in Pooled DNA Samples.
9. Identification dominant F1 hybrid by DNA based markers.

**Course Outcomes (COs):**

## MICROBIOLOGY

**BTC-402** **Cr L T P**
**4 4 0 0**

Learning Objectives:

a. To explain the diversity of microorganisms.
b. To demonstrate the interaction of microorganisms with their environment
c. To analyze how microorganisms cause diseases
d. To select appropriate methods for control of the growth of microorganisms
e. To describe the principles of bacterial genetics

**Unit I:** **[8Hours]**

**Basics in Microbiology:**Brief history and scope of microbiology, Classification of micro-organisms, culture techniques, methods of isolation and identification of microbes.Staining of microbes

**Unit II:** **[8Hours]**

**Microorganisms**– Bacteria:Morphology and structure of bacteria. Structural organization of bacterial cell wall, gram positive and gram negative bacteria, archaebacteria, actinobacteria.Nutritional requirement and growth curve, autotropic and heterotropic bacteria

**Unit III:** **[8Hours]**

**Microorganisms**- Fungi:Characteristic feature, morphology, structure, nutrition, metabolism and reproduction of economically important fungi.

**Unit IV:** **[8Hours]**

**Microorganisms- Viruses:** Isolation, cultivation of viruses, Bacterial viruses, animal viruses, plant viruses,Viroids, prions.

**Unit V:** **[8Hours]**

**Medical Microbiology:** Diseases caused by bacteria, mycoplasma, fungi, virus and their symptoms.Biotechnological methods to deal with diseases caused by microorganisms.

**Course Outcomes (COs):**

a. Basic information regarding the microbes, types, their importance and the development of Microbiology.
b. Understand the advanced microscopic techniques in the morphological identification of microorganisms along with the microbial structural information.
c. Describe the information about the microbial metabolism and the nutritional requirements.
d. Basics of microbial growth, isolation and quantification methods and how the energy is being utilized to synthesis the biomolecules.

e. The basic characteristics, and reproduction of fungi, mold and bacteriophages together with industrial applications explained in detail.

**REFERENCE BOOKS:**


1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7th eds.). Mc Graw Hill, USA
2. Subbarao, M.S. 2007. Soil Microbiology (4th eds.). Oxford and IBH, New Delhi.
3. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2008. Microbiology (5th eds.). Tata Mc Graw Hill, New Delhi
4. Dubey, R.C. and Maheswari, D.K. 2008. A text book of Microbiology (2nd eds.). S. Chand Publications
5. Stanier, R.Y. 2008. General Microbiology (5th eds.). Mac Millan Press, Replica Press Pvt. Ltd.
6. Sullia, S.B. and Shantaram, S. 2005. General Microbiology (2nd eds.). Oxford and IBH Publications.
7. Nicklin, J. Instant Notes- Microbiology (2nd eds.). Viva Books Pvt Ltd.
8. Waites, M.J., Morgan, N.L. and Rocky, J.S. 2007. Industrial Microbiology (An Introduction), Indian eds., Backwell Publishers.
9. Kannan, N. 2002. Laboratory manual in general microbiology (2nd eds.). Panima Publishers.
10. Frazier. 2008. Food Microbiology (4th eds.), Mc Graw Hill, USA.


## MICROBIOLOGY LAB

**BTC-452**

| Cr | L | T | P |
|---|---|---|---|
| 1 | 0 | 0 | 2 |

1. Laboratory rules and safety practices.
2. Microscopy and micrometry.
3. Identification of molds and yeast by simple staining.
4. Identification of bacteria by simple staining, differential staining (Gram staining, acid fast staining) and special staining (negative and endospore staining).
5. Sterilization of equipments, glass wares, media and other accessories used in microbiology laboratory.
6. Preparations of culture media: nutrient broth and nutrient agar
7. Culturing of micro organisms: liquid culture, solid culture in slants and plates (streak plate and pour plate cultures)
8. Isolation and identification of micro organisms from different sources – air, soil, water and milk.
9. Growth curve observations and growth characteristics of bacteria and yeast.
10. Effect of different parameters of bacterial growth, pH, temperature, antibiotics, carbon and nitrogen sources
11. Quantitation of fungi by dry weight method.
12. Test for degrading enzymes (cellulose, pectolytic enzyme, urease)
13. Testing of microbiological qualities of milk and water.
14. Anti-microbial sensitivity test.

**Course Outcomes (COs):**

1. Student will be well versed in culture media preparation and sterilization techniques.
2. Students will be familiar with microscopic methods in the study of microorganisms by various staining techniques.
3. Students would have learnt different methods to quantify microbes
4. Students would gain knowledge about antibiotic sensitivity assay and effects of various disinfectants on microbes.
5. At end of this course, students would have learnt the effect of different parameters on bacterial and yeast growth.

## MOLECULAR BIOLOGY

**BTC-403**

| Cr | L | T | P |
|---|---|---|---|
| 3 | 3 | 0 | 0 |

Learning Objectives:

a. To describe the structure of nucleic acids & proteins and their interactions.
b. To explain the mechanisms of central dogma of life.
c. To study the molecular mechanisms of gene regulation in prokaryotes and eukaryotes.
d. To demonstrate Mendelian inheritance
e. To calculate recombinant frequencies and construct pedigree analysis.

To study chromosomal aberrations in humans

**UNIT – I DNA STRUCTURE REPLICATION AND REPAIR [10Hrs]**

Nucleic acids and their structure, nucleic acid as genetic material, types of DNA, DNA replication in prokaryotes and eukaryotes, model of DNA replication, DNA repair: types and

mechanism DNA repair in prokaryotes and eukaryotes.

**UNIT – II ORGANIZATION OF GENETIC MATERIAL [7Hrs]**

Packaging of DNA as nucleosides in chromosome, repetitive and unique DNA sequences, split genes, overlapping genes and pseudo genes.

**UNIT – III TRANSCRIPTION IN PROKARYOTES AND EUKARYOTES [8Hrs]**

Central dogma concept, transcription in prokaryotes: initiation, elongation and termination.

Transcription in eukaryotes: RNA polymerase, transcription factors and initiation RNA synthesis, elongation and termination of RNA synthesis. Transcription in mitochondria and chloroplast.

**UNIT – IV RNA PROCESSING [6Hrs]**

Ribosome- Structural features of prokaryotic and eukaryotic ribosome. Types of RNA, processing of RNA and RNA Splicing, mRNA transport, mRNA synthesis in prokaryotes and eukaryotes.

**UNIT – V TRANSLATION IN PROKARYOTES AND EUKARYOTES [7Hrs]**

Initiation and elongation of polypeptide, formation of peptide bond, termination of polypeptide, modification, folding and transport of released polypeptide, protein sorting or protein trafficking, protein folding.

**UNIT – VI REGULATION OF GENE EXPRESSION [6Hrs]**

Regulation of gene expression in bacteria- operon concept, inducible and repressible operons (lac and trp), catabolite repression of lac operon in *E.coli*. Control of gene expression in eukaryotes. enhancers, silencers and other upstream controlling elements. DNA methylation. Chromatin remodelling.

Course Outcomes (COs):

a. Exhibit a knowledge base in genetics, cell and molecular biology, and anatomy and physiology.
b. Demonstrate the knowledge of common and advanced laboratory practices in cell and molecular biology.
c. Exhibit clear and concise communication of scientific data.
d. Engage in review of scientific literature in the areas of biomedical sciences.
e. Critique and professionally present primary literature articles in the general molecular biology field.

**REFERENCE BOOKS:**


1. Cooper, G.M. and Hausman, R.E. The Cell- A molecular approach (4th eds.). A S M Press, Sinauer Associate Inc.
2. Karp, G. Cell and Molecular Biology, Concepts and Experiments, John Wiley and Sons.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. 2008. Molecular Biology of Cell (5th eds.). Garland Sciences.
4. Benjamin Lewin. 2008. Genes IX. Oxford University Press.
5. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. 2008. Molecular Biology (6th eds.). W H Freeman and co.
6. Power, C.B. 2008. Cell biology (3rd eds.). Himalaya Publishing House.
7. Gupta, P.K. 1999. Cell and Molecular biology. Rastogi Publication. Meerut.
8. Russell, P.J. 2006. *i*Genetics: a molecular approach (2nd eds.). Pearson Benjamin Cummings.


## MOLECUAR BIOLOGY LAB

**BTC-453**

| Cr | L | T | P |
|---|---|---|---|
| 1 | 0 | 0 | 2 |

1. Estimation of DNA content by diphenyl amine method.
2. UV quantitation of DNA by UV absorbance spectrophotometry.
3. Estimation of RNA content by orcinol method.
4. Isolation of plant cell genomic DNA.

5. Isolation of bacterial/fungal genomic DNA.
6. SDS-PAGE for proteins.
7. Regulation of prokaryotic gene expression (Lac Operon)

Course Outcomes (COs):

1. By the end of this course, students should be able to demonstrate knowledge and understanding of the principles underpinning DNA isolation from various sources.
2. By the end of this course, students should be able to demonstrate knowledge and understanding of restriction digestion.
3. By the end of this course, students should be able to demonstrate the ability to carry out competent cell preparation and transformation.
4. By the end of this course, students should be able to demonstrate the ability to carry out phage titration.
5. By the end of this course, students will be aware of the hazardous chemicals and safety precautions in case of emergency.

## ENVIRONMENTAL SCIENCES

**MCC-401** **Cr L T P**
**0 0 0 0**

Learning Objectives:

a. To discuss the natural environment and its relationships with human activities to Integrate facts.
b. To describe the concepts and methods from multiple disciplines and apply to environmental problems.
c. To explain types of pollution- Air, water.
d. To learn methods of environmental protection, biological indicators, biosensors.
e. To discuss Climate change- Reasons, Greenhouse effect, Global warming.

**UNIT I:**
**Natural Resources-** Renewable and Non-renewable Resources, Forests, water, minerals, Food and land (with example of one case study
**UNIT II:**
**Biodiversity and its conservation-**Biodiversity at global, national and local levels; India as a mega-diversity nation; Threats to biodiversity (biotic, abiotic stresses), and strategies for conservation.
**UNIT III:**
**Environmental Pollution-**Types of pollution- Air, water (including urban, rural, marine), soil, noise, thermal, nuclear; Pollution prevention.
**UNIT IV:**
**Environmental Biotechnology-** For environmental protection, biological indicators, biosensors, bioremediation, phytoremediation, biopesticides, biofertilizers.
**UNIT V:**

**Social Issues and Environment-** Climate change- Reasons, Greenhouse effect, Global warming. Legal issues- Environmental legislation (Acts and issues involved), Environmental ethics.

**Course outcomes (COs):**

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

a. Understand the environmental issues pertaining to day-to-day living; gain awareness for need of environmental education vis-à-vis education for sustainable development.
b. Understand and be aware of the management of natural resources; importance of the conserving energy and environmental resources.
c. Understand the need for intellectual property associated with endemic and valuable biological resources.
d. Understand about global issues associated with climatic changes and international protocols.
e. Aware of the diverse variety of social issues associated with environmental deterioration involving human component such as population, rights, ethics.

**REFERENCE BOOKS:**


1. Gilbert M. Masters, (2004),Introduction to Environmental Engineering and Science, 2nd Ed., Pearson
2. Benny Joseph, (2006), Environmental Science and Engineering, Tata McGraw Hill, New Delhi
3. Rajagopalan.R., (2005), Environmental Studies – from crisis to cure, Oxford University Press
4. DarmendraS.Senger., (2007), Environmental Law, Prentice Hall of India (P) Ltd, New Delhi
5. Hans-JoachinJoerdening and Josef Winter., (20 05)), Environmental Biotechnology; Concepts and Applications, Willy-VCH Verlag


## MINOR PROJECT

**BTC-461**

**COURSE OUTCOMES:**

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs
The student may develop a tool to for the betterment of the society

## FIFTH SEMESTER

## PLANT AND ANIMAL TISSUE CULTURE

**BTC-501** **Cr L T P**
**4 4 0 0**

**Unit I:**

**Laboratory requirement :**Laboratory requirement for plant tissue culture, laboratory space, space for washing and sterilization, inoculation, incubation. Media formulation and preparation, MS, White's, Schenk's and B5 media. Sterilization of inoculation room, incubation room, media, explant, personal, instruments and glassware.

**Unit II:**

**Plant cell and tissue culture: Technology:** Callus culture and cell suspension culture, different explants (meristems, cell), callus induction and organogenesis, somatic embryogenesis, regeneration, acclimatization and hardening. Applications of plant tissue culture, production and uses of haploids, embryo rescue, production of rare hybrids, protoplast isolation, culture, uses, somatic hybridization, micro-propagation parks, somaclonal variation, gametoclonal variation, production of secondary metabolites.

**Unit III:**

**Molecular Farming:** Expression of heterologous genes for commercial products using plant cells, concept of plant based edible vaccines antibodies, peptides and proteins of pharmaceutical value.

**Unit IV:**

**Animal cell: Laboratory requirement:** Laboratory requirement for animal tissue culture, culture vessels, different methods of tissue culture.Media, serum free media, protein free media, preparation and sterilization of media.

**Unit V:**

**Animal cell and tissue culture:** Characterization of cultured cells, plating efficiency, cell synchronization, scaling-up, cell cloning, assays for cell viability and cytotoxicity, primary cell culture, development and maintenance of cell lines, organ and histotypic culture,

**Course Outcomes (COs):**

a. An ability to apply knowledge of mathematics, science, and engineering.
b. Ability to design and conduct experiments, as well as to analyze and interpret data.
c. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, societal, political, ethical, health and safety, manufacturability, and sustainability.
d. Ability to function on multidisciplinary teams.
e. Ability to identify, formulate, and solve engineering problems.

**REFERENCE BOOKS:**

1. Bhojwani, S.S. and Razdan, M.K. 2004. Plant tissue culture: Theory and Practice (2nd eds.). Panima Pub.

2. Hartmann, H.T. and Kester, D.E. 2002. Plant propagation principles and practices (6th eds.). Prentice Hall India.
3. Ramawat, K.G. 2008. Plant biotechnology (3rd eds.). S. Chand Publications, New Delhi.
4. Singh, B.D. 2008. Biotechnology- Expending Horizons (2nd eds.). Kalyani Publications.
5. Gupta, P.K. Elements of Biotechnology. Rastogi Publications.
6. Chawla, H.S. 2009. Introduction to Plant biotechnology. Special Indian edition. Oxford and IBH Publishers.
7. Freshney, R.I. 2000. Culture of animal cell (4th eds.). Wiley-Liss Publishers, New York.
8. 8. Masters, J.R.W. 2000. Animal cell culture (3rd eds.). Oxford University Press.
9. 9. Razdan, M.K. 2003. Introduction to plant tissue culture (2nd eds.). Oxford and IBH Publishers.

## PLANT AND ANIMAL TISSUE CULTURE LAB.

**BTC-551**

| Cr | L | T | P |
|---|---|---|---|
| 1 | 0 | 0 | 2 |

1. Sterilization techniques, membrane filtration.
2. Preparation of media, preparation of primary culture, maintenance of secondary culture.
3. Evaluation of culture dynamics.
4. Surface sterilization of field grown tissue.
5. Callus induction, initiation in suspension culture.
6. Role of hormones in plant morphogenesis.
7. Regeneration of shoot and roots from callus culture.
8. Hardening of plantlets.
9. Trypan blue dye exclusion assay for cell viability in animals.
10. Cell fusion with PEG.
11. Identification of anatomical organs of mouse/rat.
12. Extraction of secondary metabolites.

**Course Outcomes (COs):**

a) Students will acquire knowledge about differentially expressed genes
b) Students will acquire knowledge about the structure and function of chloroplast and mitochondria
c) Students will acquire knowledge about secondary metabolites synthesis
d) Students will acquire knowledge about agrobacterium and plant viruses
e) Students will acquire knowledge about molecular pharming

## IMMUNOTECHNOLOGY

**BTC-502**

| Cr | L | T | P |
|---|---|---|---|
| 3 | 3 | 0 | 0 |

Learning Objectives:

a. To understand innate and adaptive immune responses.
b. To understand the role of primary and secondary lymphoid organs.
c. To understand antigen and antibody interactions.
d. To understand the mechanism of immunization.
e. To understand the role of immune system in organ transplantation, autoimmune disorders and Cancer.

**Unit I:**

. **Introduction to Immunology:** History and terminology, innate and acquired immunity, active and passive immunity, immune responses, cells (T-cells, B-cells) and organs of immune system, cell mediated and humoral immunity, cytokines, toll-like receptors.

**Unit II:**

. **Antibody:** Classification, isotypes, fine structure**,** biosynthesis of immunoglobulin, rearrangement of genes and class switching, complement system.
**Antigen:** Nature of antigens, haptens, adjuvants, vaccines.

**Unit III:**

**MHC complex:** Function, structure and MHC restriction.

**Unit IV:**

**Principles of virulence and pathogenicity**: Host-parasite interactions.
**Transplantation and tumor immunology**: Tumor cell immunity, transplantation of tissues and organs, relationship between donor and recipient, role of MHC molecules in allograft rejection, bone marrow and haematopoietic stem cell transplantation, tumor antigen, tumor immunoprophylaxis.

**Unit IV:**

**Applied immunotechnology**: Antigen-antibody interaction, affinity and avidity, agglutination and precipitation reactions, immunoflourescence, fluorescence activated cell sorting analysis.
**Antibody engineering**: Hybridoma and monoclonal antibody (Mab), recombinant antibody molecules, human and humanized antibodies, uses of Mab.
**Antigen engineering**: ELISA, RIA, immunodiffusion, immunoelectrophoresis, immunoblotting, antibody for diagnosis, antibody for therapy, cytokine therapy

**Course Outcomes (COs):**

a. Relate the formation and phases of active and passive immune reactions with immunotherapeutic products.
b. Describe agents producing immune reaction
c. Compose the pharmaceutical design and application fields of immunological agents
d. Relate the formation and phases of active and passive immune reactions with immunotherapeutic products
e. compose the pharmaceutical design and application fields of immunological agents

**REFERENCE BOOKS:**


1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7th eds.). Mc Graw Hill, USA.
2. Playfair, J. and Bancroft, G. 2007. Infection and Immunity (3rd eds.). Oxford University Press.
3. Chakravarty, A.K. 2008. Immunology and Immunotechnology (3rd eds.). Oxford University Press.
4. Tizard. 2008. Immunology: An introduction (4th eds.). Cengege learning.
5. Rao, C.V. 2008. Immunology: A text book. Narosa Publishing House.


## ENZYME TECHNOLOGY

**BTD- 501** **Cr L T P**
**3 3 0 0**

Learning Objectives:

a. To sketch a process flow diagram for the production of bioproducts.
b. To identify the process and critical unit operations involved in the production of beer, vinegar, SCP, Yeast and insecticides.
c. To review the manufacturing processes for industrial alcohols and organic acids.
d. To understand importance of enzymes and the principles of enzyme technology.

**UNIT – I INTRODUCTION TO ENZYMES [6Hrs]**

Historical aspects, nomenclature and their classification. cost effective production, purification and characterization of enzymes.

**UNIT – II APPLICATIONS OF ENZYMES [7Hrs]**

Commercial applications of enzymes in food, pharmaceutical and other industries, enzymes for analytical and diagnostic applications.

**UNIT – III MECHANISMS AND KINETICS OF ENZYME ACTION [8Hrs]**

Mechanisms of enzyme action, concept of active site and energetics of enzyme substrate complex formation, specificity of enzyme action, kinetics of single substrate reactions, turn over number, estimation of Michaelis-Menten parameters.

**UNIT – IV ENZYMES INHIBITION AND MULTI-SUBSTRATE ENZYME KINETICS [7Hrs]**

Multi substrate reaction mechanisms and kinetics, types of inhibition, allosteric regulation of enzymes, deactivation kinetics.

**UNIT – V ENZYME IMMOBILISTION [8Hrs]**

Physical and chemical techniques for enzyme immobilization, adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., examples advantages and disadvantages of different immobilization techniques.

**UNIT – VI ENZYME BASED BIO SENSORS [7Hrs]**

Overview of applications of immobilized enzyme systems. Applications of enzymes in analysis, design of enzyme electrodes and their application as biosensors in industry health care and environment.

Course Outcomes (COs):

a. Understand the relationship between properties and structure of the enzymes, their mechanism of action and kinetics of enzymatic reactions.

b. Skilled to characterize the enzymes in each enzymatic class, examples of such enzymes and their application in practice.

c. Have knowledges in the field of biosensors and immobilized systems.

d. Skilled with the use of enzymes in medicine, food, organic synthesis, genetics and other areas sectors.

e. Discuss the applications of enzymes in different industries

**REFERENCE BOOKS:**

1. Price, N. and Stevens, L. 2003. Fundamentals of enzymology - The cell and molecular biology of catalytic protein (3rd eds.). Oxford University Press.
2. Palmer, T and Bonner, P. 2008. Enzymes Biochemistry, Biotechnology, Clinical chemistry. Affiliated East-West Press Private Ltd.

## GENETIC ENGINEERING

**BTD- 502**

| Cr | L | T | P |
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Learning Objectives:

a. To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology as well as to create understanding and expertise in wet lab techniques in genetic engineering.
b. Design process equipment, plants, biosensors and recombinant molecules for biotechnological and allied processes.
c. Apply research based knowledge and biotechnological methods to investigate complex biological problems.

To apply Recombinant DNA Technology for the human welfare

**UNIT – I** **[8Hrs]**

Gene cloning and need to clone a gene; Isolation and purification of plasmid, chromosomal and genomic DNA from bacterial, plant and animal cells.

**UNIT – II** **[8Hrs]**

Different cloning vectors like plasmids, cosmids, phagemids, shuttle vectors, and other vectors for plant and animals; enzymes used in recombinant DNA technology like restriction

endonucleases, ligases, polymerases, kinases and phosphatases.

**UNIT – III** **[8Hrs]**

Cloning of a specific gene; studying gene location and structure; studying gene expression; expression of foreign genes in research and biotechnology; maximization of recombinant proteins; brief introduction to sequencing and site directed mutagenesis, different types of PCR and applications; safety measures and regulations for recombinant DNA work

**UNIT – IV** **[8Hrs]**

A brief introduction to the followings: phage display system, Yeast two hybrid system, and RNAi technology.

**UNIT – V** **[8Hrs]**

Applications of recombinant DNA technology in the fields of Medicine, Agriculture, Forensic and Environment.

**Course Learning Outcomes (COs)**:

a. Learn about the vectors and their ideal characteristics.
b. Understand different methods of recombinant DNA techniques like labeling DNA, PCR and gene sequencing.
c. Gain knowledge about prokaryotic and mammalian expression vectors and cloning in plants.
d. Learn about preparation of genomic and cDNA libraries, mutagenesis, and cloning techniques for altering gene expression.
e. Learn about various applications of rDNA technology and how to handle the genetically modified organisms.

**REFERENCE BOOKS:**

1. Primrose, S.B. and Twyman, R.M. 2006. Principles of gene manipulation and genomics (7th eds.). Blackwell Publishing.
2. Winnacker, Ernst-L. 2003. From Gene to Clone Introduction to gene technology. Panima publishing Corp., New Delhi.

3. Old, R.W. and Primrose, S.B. 1985. Principles of gene manipulation: An introduction to genetic engineering. Blackwell Science Publication.
4. Brown, T.A. 2008. Gene Cloning and DNA analysis (5th eds.). Blackwell Sciences LTD.
5. Gupta, P.K. 2008. Biotechnology and Genomics (1st ed.). Rastogi Publication.

# BIOMATERIALS

**BMO-501**

| Cr | L | T | P |
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**UNIT 1:** Biomaterials: Definition, Classification, properties and biocompatibility. Biological responses (extra and intra-vascular system). Controlling and Assessing Cell–Biomaterial Interactions at the Micro and Nanoscale. Surface properties of materials, physical properties of materials, mechanical and thermal properties.

**UNIT 2:** Metallic Biomaterials, Ceramic Biomaterials, Polymeric Biomaterials, Composite Biomaterials, Biodegradable Polymeric Biomaterials, Tissue-Derived Biomaterials (Collagen and Chitin-based biomaterials), Polymeric hydrogels, Soft Tissue Replacements, Hard Tissue Replacements, Standards of implant materials,

**UNIT 3:** Types of implants in surgical uses and probability of implant failures. Characterization of biomaterials, drug delivery applications, tissue engineering from both orthopaedic and vascular perspective. Definition of biocompatibility, blood compatibility and tissue compatibility.

**UNIT 4:** Toxicity tests: acute and chronic toxicity studies, sensitization, carcinogenicity, mutagenicity and special tests.ETO, gamma radiation, autoclaving. Effects of sterilization on material properties. *In vitro* testing (Mechanical testing), *In-vivo* testing (animals) and *Ex-vivo* testing: *in vitro* testing simulating the *in vivo* conditions.

**UNIT 5:**Artificial Organs: Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis and Dental Implants

**Course Learning Outcomes (COs)**:

a) Students would have learnt the different types of biological buffers and biomolecules with their significant functions.

b) Students would have knowledge about the structure and the chemical reactions involved in different biochemical pathways towards the energy generation processes.

c) Students will be able to understand the sources and types of proteins, enzymes, vitamins, hormones etc involved in wide range of biochemical reactions.

d) Students will be able to understand the biochemical values of metabolic pathways in relation to metabolic clinical disorders.

e) Students would have learnt the key principles involved in bioenergetics of various pathways.

**Suggested Readings:**


1. J. B. Park**,** *Biomaterials Science and Engineering***,** Plenum Pub. Corp., New York, London, 1984.
2. B. D. Ratner, A. S. Hoffman, FJ. Schoen, JE. Lemons. *An Introduction to Materials in Medicine*, 2nd edn., Elsevier Academic Press, London, 2004.
3. T. S. Hin, *Engineering Materials for Biomedical Applications*, World Scientific Publishing Co. Pte. Ltd. 2004
4. D. V. Rai, R. C Sobti and R. Bahadur, *Emerging Trends in Biomedical Science and Health*. I.K. International, Chandigarh, India, 2009.
5. B. Basu, D.S. Katti, and A. Kumar, *Advanced Biomaterials: Fundamentals, Processing, and Applications*, Wiley-American Ceramic Society, 2009.


## BIOINFORMATICS

**BIO-501**

| Cr | L | T | P |
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Learning Objectives:

a. To provide a national bio-information network designed to bridge the inter-disciplinary gaps in biotechnology information.

b. To establish link among scientists in organizations involved in R & D and manufacturing activities in biotechnology.

c. To build up information resources, prepare database on biotechnology and to develop relevant information handling tools and techniques.

**UNIT – I INTRODUCTION [7Hrs]**

Introduction to strings, edit distance strings, string similarity, elementary commands and protocols, Scope of Bioinformatics.

**UNIT – II SEQUENCE DATABASES AND THEIR USE [8Hrs]**

Introduction to databases, database search, algorithms issues in database search, sequence

database search, parametric sequence alignments, sub optimal alignments, dynamic programming global and local alignment gaps, multiple alignment, common multiple alignment methods. FASTA and BLAST. Amino acid substitution matrices PAM and BLOSSOM.

**UNIT – III EVOLUTIONARY TREES AND PHYLOGENY [7Hrs]**

Ultrasonic trees, parsimony, ultrametric problem, perfect phylogeny, phylogenetic alignment, connection between multiple alignment and tree constructions.

**UNIT – IV PROTEIN CLASSIFICATION AND STRUCTURE VISUALIZATION [9Hrs]**

Overview of the protein structure, protein structure visualization, visualization tools and databases, protein structure alignment, protein classification approaches, tools for plotting

Protein - ligand interaction.

**UNIT – V PROTEIN STRUCTURE PREDICTION [9Hrs]**

Protein identification and characterization, primary structure analysis and prediction, secondary structure analysis and prediction, *Ab initio* method for protein prediction, protein function prediction.

**UNIT – VI APPLICATIONS OF BIOINFORMATICS [8Hrs]**

DNA mapping and sequencing, gene predictions, molecular predictions with DNA strings, role of bioinformatics in drug design.

Course Outcomes:

a. Infer the biological problems using appropriate in silico approaches.

b. Select the suitable tools or servers to solve the specific biological issue and curate experimental data.

c. Perform and analyze database similarity search and sequence alignment.

d. Construct and analyze phylogenetic trees.

e. Use appropriate tools and packages to analyze varied range of biological problems.

**REFERENCE BOOKS:**

1. David W. Mount. 2005. Bioinformatics: Sequence and Genome analysis, Cold Spring Harbor Laboratory Press.
2. Jones, N.C. and Pevzner, P. A. 2004. An Introduction to Bioinformatics Algorithms. The MIT Press.

## CYBER SECURITY

**MCC- 501**

| Cr. | L | T | P |
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**UNIT-1**

Introduction to information systems, Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

**UNIT-2**

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce-Electronic Payment System, eCash,Credit/Debit Cards. Digital Signature, public Key Cryptography.

**UNIT-3**

Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control,CCTV and intrusion Detection Systems, Backup Security Measures.

**UNIT-4**

Security Policies, Why Policies should be developed, WWW policies, Email Security policies, Policy Review Process-Corporate policies-Sample Security Policies, Publishing and Notification Requirement of the Policies. Information Security Standards-ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; ITAct 2000 Provisions,Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law.

**REFERENCE BOOKS:**


1. Charles P. Pfleeger, Shari Lawerance Pfleeger, "Analysing Computer Security ", Pearson Education India.
2. V.K. Pachghare, "Cryptography and information Security", PHI Learning Private Limited, Delhi India.
3. Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen kumar Shukla ,"Introduction to Information Security and Cyber Law" Willey Dreamtech Press.
4. Schou, Shoemaker, " Information Assurance for the Enterprise", Tata McGraw Hill.
5. CHANDER, HARISH**,"** Cyber Laws And It Protection **"** , PHI Learning Private Limited ,Delhi ,India


**COURSE OUTCOMES:**

a) Describe network security services and mechanisms.
b) Symmetrical and Asymmetrical cryptography
c) .Data integrity, Authentication, Digital Signatures.
**d)** Various network security applications, IPSec, Firewall, IDS, Web security, Email security, and Malicious software etc.

## MINOR PROJECT

**BTC-561**

**COURSE OUTCOMES:**

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs
e) The student may develop a tool to for the betterment of the society

## SIXTH SEMESTER

## ANIMAL BIOTECHNOLOGY

**BTC-601** **Cr L T P**

***4 4 0 0***

Learning Objectives:

a. To understand the basics of animal cell culture
b. To characterize the animal cell using biochemical and molecular biology techniques
c. To apply the principles of genetic engineering to modify animal cell for research and industrial use.
d. To understand the concept of transgenic animal and animal breeding.

**UNIT – I INTRODUCTION OF ANIMAL CELL CULTURE [7Hrs]**

Basic principles of animal cell culture, biology of cells in culture and their characteristics, basic requirements for setting up of a animal cell laboratory- space, equipments, asptic techniques. Safety, ethical issues, norms and guidelines for handling animal cells.

**UNIT – II CELL CULTURE MEDIA, NUTRITION AND TYPES [8Hrs]**

Media for culturing cells and tissues; natural and defined media, effect of their physicochemical characteristics such as pH, temperature, gases, osmolality, etc on cell culture, balanced salt solutions, serum free and serum based media, advantages and disadvantages of serum free media, primary and secondary cell cultures, steps in establishing primary cell culture, characteristics of continuos cell lines, development and their maintenance of cell lines, scaling-up of cell cultures.

**UNIT - III CRYOPRESERVATION, QUANTITATION AND CYTOTOXICITY [8Hrs]**

Need of cryopreservation, cell banks, transporting cells, steps involved in cryopreservation of cell culture, thawing of frozen cell culture. Various methods of cell quantitation-hemocytometer, electronic cell counting, quantitation by measuring total DNA and protein content, cytotoxicity assessment in cell cultures- viability assessment by dye exclusion and dye uptake test, MTT based cytotoxicity assay, clonogenic survival assay.

**UNIT – IV MICROMANIPULATION OF EMBRYOS [7Hrs]**

Introduction, basics and methodology of micromanipulations. Composition of IVF media, steps involved in IVF, fertilization by micro-insemination.

**UNIT – V TRANSGENIC ANIMALS [7Hrs]**

Concept of transgene and transgenic animals, gene transfer approaches for producing transgenic animals- pronuclear microinjection method, embryonic stem cell method, retroviral vector method, homologous recombination for producing knock-in and knockout mice, sperm mediated DNA transfer. Importance and applications of transgenic animals, study of model transgenic animals.

**UNIT – VI INDUSTRIAL APPLICATION OF ANIMAL CELL CULTURE [6Hrs]**

Market existing cell culture product, different medical applications for cell culture including expression system, therapeutics etc.

Course Outcomes (COs):

a. Upon completion of the course the students will learn about the production of regulatory proteins
b. Upon completion of the course the students will learn about different viral vectors
c. Upon completion of the course the students will learn about hybridoma technology
d. Upon completion of the course the students will learn about gene therapy and probes
e. Upon completion of the course the students will learn about assisted reproductive techniques

**REFERENCE BOOKS:**


1. Singh, B.D. 2008. Biotechnology-Expending horizons (2nd eds.). Kalyani Publications.
2. Gupta, P.K. 2008. Biotechnology and Genomics (1st ed). Rastogi Publications.
3. Brown, T.A. 2008. Gene cloning and DNA analysis (5th eds). Blackwell Sciences Ltd.
4. Dubey, R.C. 2007. A textbook of biotechnology (4th eds.). S. Chand and Company Ltd.
5. Satyanarayana, U. 2008. Biotechnology. Uppala Author Publisher Interlink.
6. Balasubramanian, D., Bryce C.F.A., Dharmalingam, K., Green, J. and Kunthala Jayaraman. Concepts in Biotechnology.Revised edition.Universities press.
7. Srivastava, A.K., Singh, R.K. and Yadav, M.P. 2006. Animal Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.


**ANIMAL BIOTECHNOLOGY LAB**

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**BTC-651**

1. To prepare the materials required for various cell culture practices in sterile condition.

2. To prepare desired medium for the given Animal cell culture.
3. To prepare serum from the given blood sample.
4. To perform primary cell culture technique using chick embryo under aseptic condition.
5. To develope secondary growth or established cells from primary culture by repeated subculture.
6. To ensure the population of cells required for the culture works by cell counting method and its viability by vital staining methods
7. To ensure the differentiation of live cells from dead cells by giemsa stain method.
8. To preserve the cells in viable condition for future works by using proper preservative.
9. To adapt and propagate New castle disease virus in chicken embryo.

Course Outcomes (COs):

a. Explain the significance difference between plant cell culture and basics of animal cell culture.

b. Characterize the animal cell using biochemical and molecular biology techniques.

c. Apply the principles of genetic engineering for the modification of animal cell for research and industrial use.

d. Apply animal biotechnology for the commercial bio-products.

## FOOD BIOTECHNOLOGY

**BTC-602** **Cr L T P**

**3 3 0 0**

Learning Objectives:

a. To train students about Quality Control and Food Safety, Nutrition and Food Science.

b. To ensure the quality of training for students, to link training with research and practical application.

c. To integrate fundamental and applied research across dairy, seafood, wine, beer, fruit, and vegetable categories to provide value-added solutions to current and future problems encountered by food and beverage processing industry.

d. To provide service to the profession and society by interpreting science-based knowledge to assist policymakers and regulators in formulating informed policies, regulations, and decisions.

**e.** To provide leadership and support for professional organizations and related activities that advance food science.

**UNIT – I INTRODUCTION [7Hrs]**

Historical highlights, important genera of food borne microorganisms, factors affecting the growth and survival of microorganisms in food.

**UNIT – II MICROBIOLOGICAL EXAMINATION OF FOOD [7Hrs]**

Direct examination, culture techniques, MPN count, dye reduction assay, immunological methods and advance techniques.

**UNIT – III FOOD PRESERVATION [8Hrs]**

Principles of food preservation, asepsis, anaerobic conditions, removal of microorganisms, low temperature, high temperature, radiation, drying, chemical preservatives and miscellaneous methods, canning.

**UNIT – IV FOOD SPOILAGE [6Hrs]**

Microbial spoilage of food, common food borne diseases, bacterial agents of food borne illness, non-bacterial agents of food borne illness.

**UNIT – V FERMENTED FOODS [8Hrs]**

Fermented milk, cheese, sauerkraut, fermented meat, beer, vinegar, fish products, products of baking, oriental foods. Role of enzymes in different food products (bakery, cheese, beverage production and cereal products) and industries, utilization of food waste for production of valuables.

**UNIT – VI QUALITY CONTROL USING MICROBIOLOGICAL CRITERIA [6Hrs]**

Cleaning and disinfection code for good manufacturing practices, microbial and chemical safety of food products, indicator organisms, ISO, hazard analysis and critical control points, sterility testing.

## Course Outcomes:

a) Students will acquire knowledge about intentional food additives and enzymes in food processing
b) Students will acquire knowledge about food fermentation and intoxication
c) Students will acquire knowledge about processing food
d) Students will acquire knowledge about various food preservation techniques
e) Students will acquire knowledge about dairy and milk products

**REFERENCE BOOKS:**

1. Adams, M.R. and Moss, M.O. Food Microbiology (2nd eds.). Royal Society of Chemistry, Cambridge U.K.
2. Doyle, M.P., Beuchat, L.R. and Montville, T.J. Food Microbiology: Fundamentals and Frontiers (2nd eds.). ASM Press, USA.
3. James, M.J. 2000. Modern Food Microbiology (6th eds.). Aspen Publications, USA.
4. Robinson, R.K., Batt, C.A. and Patel, P. Encyclopedia of food microbiology (3 Volume set), ASM Press, USA.
5. James, M.J. 1986. Modern Food Microbiology. Van Nostrand Reinhold Company, New York.

## FOOD BIOTECHNOLOGY LAB

**Cr. L T P**
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**BTC-652**

1.MBRT of milk samples and their standard plate count.
2.Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3.Isolation of any food borne bacteria from food products.
4.Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5.Isolation of spoilage microorganisms from bread.
6.Preparation of Yogurt/Dahi.
7.Staining methods of bacteria

Course Outcomes:

a. Understanding the various causes of food deterioration and food poisoning. Identification of appropriate processing, preservation, and packaging method.
b. Analyze product quality and effect of processing technique on it.
c. Identify important species of pathogenic microbes and describe factors that affect their growth in various types of food.
d. Analysis of food related hazards and Hazard Analysis Critical Control Point (HACCP) method.

## BIOPROCESS ENGINEERING

**BTD-601**

**Cr L T P**
**3 3 0 0**

Learning Objectives:

a. To understand the roles and responsibilities of a bioprocess engineer.
b. To understand sterilization techniques and estimate the sterilization time
c. To understand the rheology of fermentation fluids and determine the power requirement in bioreactors

d. To develop the design equations for bioreactors and calculate the oxygen demand for cell growth.
e. To understand the scale up concepts for bioprocesses.
f. To identify sensors and instruments needed for measurement and control.

**Unit I:**
**Introduction to bioprocess engineering:** Biotechnology and bioprocess engineering, outlines of integrated bioprocess engineering, historical development of bioprocess engineering, range of various bioprocesses, microbial biomass, microbial enzymes, and recombinant proteins.

**Unit II:**
**Strain improvement and development:** Isolation of industrially important microorganisms, metabolic regulation, feed back inhibition and repression, isolation of auxotrophic mutant, selection of induced mutant synthesizing improved level of primary and secondary metabolites, use of recombinant system for improvement of industrial microorganism.

**Unit III:**
**Microbial growth and sterilization kinetics:**
**Growth Kinetics:** Batch culture, quantifying cell concentration, growth pattern and kinetics in batch culture, quantifying growth kinetics, continuous culture, ideal chemostat, multistage system, fed batch culture, variable volume and fixed volume fed batch culture. Sterilization: media design for industrial bioprocesses, medium sterilization, design of batch and continuous sterilization process

**Unit IV:**
**Engineering principles for bioreactor design and operation:** types of bioreactors, mass transfer in biochemical processes, factors affecting mass transfer in a bioreactor, effect of aeration and agitation on mass transfer, measurement of mass transfer coefficient (KLa), determination of oxygen transfer rate, product formation in batch, plug flow and chemostat culture, control of bioreactor, manual and automatic control, PID controllers, scale up and scale down.

**Unit V:**
**Recovery and purification of products:** Strategies to recover and purify products, separation of insoluble products, filtration, centrifugation, coagulation and flocculation, cell disruption, separation of soluble products, liquid-liquid extraction, aqueous two phase extraction, precipitation, adsorption, membrane based separation processes, ultra and micro filtration , reverse osmosis, chromatography, finishing steps for purification, crystallization and drying.

**Course Outcomes (COs):**

a. Define process control terminologies and identify suitable mode of controlling a given process.
b. Develop suitable control equations for bioprocess dynamics.
c. Examine the closed loop control system and select suitable control action.

d. Analyze the stability of control system in Laplace and frequency domain.

**REFERENCE BOOKS:**


1. Shuler, M.L. and Kargi, F. 2002. Bioprocess Engineering (2nd eds.). Prentice-Hall of India, New Delhi.
2. Doran, P.M. 2009. Bioprocess Engineering Principles. Academic Press Elsevier.
3. Waites, M.J., Morgan, N.L. and Rocky, J.S. 2007. Industrial Microbiology (An Introduction), Indian eds., Backwell Publishers.
4. Casida Jr, L.E. 2007. Industrial microbiology. New Age International (P) Ltd. Publishers.
5. Bailey, J.E. and Ollis, D.F. 1986. Biochemical Engineering Fundamentals. Mc Graw Hill Publications.


## MEDICAL BIOTECHNOLOGY

**BTD-602** **Cr L T P**
**3 3 0 0**

Learning Objectives:

a. To understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market.
b. To Undertand the novel formulation approaches for better delivery of biotechnology derived drugs , such as reverse micelles, liposomes, microemulsions and microencapsulation will be addressed.
c. To know the delivery of peptides and proteins by the parenteral, oral, transdermal and nasal routes of administration.
d. To understand the novel biotechnology products and their use in therapeutics and diagnostics will be discussed.

**UNIT – I INTRODUCTION OF MEDICAL BIOTECHNOLOGY [8Hrs]**

Value and scope of Medical biotechnology, Applications of Biomedical technology, Noninvasive diagnostic instrumentation Biomedical Instrumentation, Clinical Enzymology and their diagnostic and prognostic importance. Application of nanoparticles in Medical Biotechnology.

**UNIT – II METABOLISM OF XENOBIOTICS [8Hrs]**

Biomedical Importance of xenobiotics, Cytochrome 450, Phase I and Phase II reaction, Reacting oxygen species and Endogenous exogenous Antioxidant defence system. Role free radical in health and diseases.

**UNIT – III CELLULAR THERAPY [8Hrs]**

Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells; Role of adult and embryonic stems cells, Difference in progenitor and stem cells, biomedical applications of stem cells.

**UNIT – IV DRUG DEVELOPMENT AND REGULATION [8Hrs]**

Methods involved in the development of new drugs. Preclinical toxicological studies. Calculation of LD50 & ED50. Acute, subacute and chronic toxicity studies Drugs and Cosmetics Act. Application for Investigational New Drug (IND), Application for New Drug Discovery (NDD) according to Indian Control Authority & USFDA guidelines.

**UNIT – V ETHICS IN MEDICAL BIOTECHNOLOGY [8Hrs]**

Rationale for making ethical decisions, review of existing guidelines, considerations of the use of adult and embryonic stem cells, Ethical guidelines in utilizing animals for experimental purposes, conflict of interest and misconduct in research and business. Ethical considerations in utilizing human subjects for drug discovery process.

Course Outcomes (COs):

a. Demonstrate a systematic knowledge of medical biotechnology at the forefront of research.
b. Have a critical awareness of applications to biomedical science, disease and diagnosis.
c. Demonstrate a comprehensive understanding of the practical, professional and/or research skills necessary for working as a Biotechnologist with the medical sphere.
d. Demonstrate the intellectual skills of handling complex issues systematically and creatively enabling originality in problem solving.
e. Exhibit postgraduate generic skills of initiative and personal responsibility, enabling independent decision making.
f. Independent learning skills allowing continuing professional development. Effective communication and numerical skills.

**REFERENCE BOOKS:**


1. Primrose, S.B. and Twyman, R.M. 2006. Principles of gene manipulation and genomics (7th eds.). Blackwell Publishing.
2. Winnacker, Ernst-L. 2003. From Gene to Clone Introduction to gene technology. Panima publishing Corp., New Delhi.
3. Old, R.W. and Primrose, S.B. 1985. Principles of gene manipulation: An introduction to genetic engineering. Blackwell Science Publication.
4. Brown, T.A. 2008. Gene Cloning and DNA analysis (5th eds.). Blackwell Sciences LTD.
5. Gupta, P.K. 2008. Biotechnology and Genomics (1st ed.). Rastogi Publication.


## AGRICULTURE BIOTECHNOLOGY

**AIO-601**

| Cr | L | T | P |
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Learning Objectives:

a. To equip in both the traditional ‘pure’ disciplines and in the domains of agricultural and food sector.

b. To understand the natural environment and its relationship with human activities to integrate facts, concepts, and methods from multiple disciplines and apply to agricultural problems.
c. To understand the aspects of Agrobiotechnology problems and their potential impacts on global inhabitants.
d. To understand how to cope up with these various agricultural issues using advanced technologies.

**UNIT – I SUSTAINABLE AGRICULTURE [8Hrs]**

An introduction, role of biofertilizers and bio-pesticides in sustainable agriculture. Mass cultivation of microbial inoculants, plant growth promoting rhizobacteria, Free living and symbiotic nitrogen fixing microbes, Molecular basis of legume r*hizobium* symbiosis.

**UNIT – II MOLECULAR FARMING [8Hrs]**

Molecular farming, use of plants and animals for production of nutraceuticals, organic farming and sustainable use of natural and bioresources, integrated pest management, world food security.

**UNIT – III SOIL MICROBIOLOGY [8Hrs]**

Soil as a habitat for microorganisms, rhizosphere: concept, rhizospheric effect and microorganisms, factors affecting microbial community in soil, organic matter decomposition, carbon assimilation and immobilization.

**UNIT – IV AGRICULTURE BIOTECHNOLOGY AND LAWS [7Hrs]**

Plant variety protection act, TRIPS and WTO, patenting of life forms−plant and products, Plant breeders rights.

**UNIT – V AGRICULTURAL BIOTECHNOLOGY AND SOCIETY [7Hrs]**

Commercial status and public acceptance, bio-safety guidelines for research involving GMO's, benefits and risks, socio-economic impact and ecological considerations of GMO's.

**Course Outcomes (COs):**

a. Apply in vitro techniques for plant breeding and propagation.
b. Analyze problems of agrobiotechnology.
c. Compare effectiveness of different genetic methods.
d. Impart the knowledge to create own business

## GENOMICS AND PROTEOMICS

**BIO-601**

| Cr | L | T | P |
|---|---|---|---|
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Learning Objectives:

a. Understand organization and structure of prokaryotic, eukaryotic and organellar genomes.
b. Study molecular markers, DNA sequencing and bioinformatic tools for genome analysis.
c. Analyse gene expression using northern blotting, RT-PCR and micro array.
d. Comprehend the techniques of protein separation, sequencing, identification and protein-protein interactions.
e. Understand the clinical and biomedical applications of proteomics.

**UNIT - I BASICS OF RECOMBINANT DNA TECHNOLOGY [8Hrs]**

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

**UNIT – II DNA LIBRARIES [8Hrs]**

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

**UNIT – III SEQUENCING AND AMPLIFICATION OF DNA [8Hrs]**

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

**UNIT – IV [8Hrs]**

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies , Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

**UNIT - V [8Hrs]**

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE,

TOGA, Yeast Two hybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.

**Course Outcomes (COs):**

a. Recall and relate the role of genes, genetic code, recombinant methods in rDNA technology.
b. Describe the role of various enzymes in genetic manipulation.

c. Make use of the techniques involved in isolation, purification and separation of nucleic acids.
d. Apply rDNA technology in various fields using suitable methodology.
e. Appraise the use of genetic engineering principles for gene therapies.

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## INDIAN CONSTITUTION

**MCC- 601**

| Cr. | L | T | P |
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Learning Objectives:

a. To enable students to understand the basic concepts of Indian constitution and its development.
b. A student therefore, learns about fundamental rights and fundamental duties.

**Unit-I** **[5Hrs.]**

Constitutional developments since 1858 to 1947, Making of the Indian Constitution, Nature and special features of the Constitution. Equality &Social Justice , Gender justice.

**Unit-II** **[5Hrs.]**

Speech and expression, media, press and information, Freedom of Speech and contempt of court, Personal Liberty.

**Unit-III** **[5Hrs.]**

Fundamental Rights & Directive Principles - inter relationship - judicial balancing. Constitutional amendments -to strengthen Directive Principles. Reading Directive Principles into Fundamental Rights.

**Unit-IV** **[5Hrs.]**

The need and status in constitutional set up, Interrelationship with fundamental rights and directive principles.

**COs:** At the end of the course, learners should be able to

a. Identify and explore the basic features and modalities about Indian constitution.
b. Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
c. Differentiate different aspects of Indian Legal System and its related bodies.
d. Discover and apply different laws and regulations related to engineering practices.
e. Correlate role of engineers with different organizations and governance models.

**REFERENCE BOOKS:**

1. G. Austin, History of Democratic Constitution: The Indian Expenditure (2000) Oxford
2. D. D. Basu, Shorter Constitution of India, (1996), Prentice Hall of India, Delhi
3. Constituent Assembly Debates Vol. 1 to 12 (1989) 4. H. M. Seervai, Constitution of India, Vol. 1-3 (1992), Tripathi, Bombay
4. S. C. Kashyap, Human Rights and Parliament (1978) Metropolitan, New Delhi

## MINOR PROJECT

**BTC-661**

**COURSE OUTCOMES:**

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs

The student may develop a tool to for the betterment of the society

## SEVENTH SEMESTER

## PLANT BIOTECHNOLOGY

**BTC-701** **Cr L T P**
**3 3 0 0**

Learning Objectives:

a. To comprehend the concepts of plant tissue culture techniques
b. To learn the In vitro study of plant secondary metabolites.
c. To understand the technology of plant transformation
d. To study of conventional and molecular marker breeding techniques.

**UNIT- I PLANT TISSUE CULTURE LABORATORY AND MEDIA [6Hrs]**

Introduction to plant cell and tissue culture, historical perspectives, laboratory organization, tissue culture media- composition and preparation.

**UNIT – II CELL CULTURE, ORGANOGENESIS, EMBRYOGENESIS AND PRODUCTION OF HAPLOID [8Hrs]**

Callus formation, organogenesis, protoplast isolation, culture and fusion; selection of hybrid cells and production of somatic hybrid, somatic embryogenesis; somaclonal variation, and application in crop improvement. Production of haploid and homozygous diploid lines through embryo culture, anther and pollen culture.

**UNIT - III REGENERATION, PRODUCTION, PRESERVATION AND SELECTION OF PLANT CELLS [7Hrs]**

Plant regeneration, production of "synthetic seeds. Cryopreservation for germplasm conservation, clonal and micropropogation. Production of pathogen free plant. Production of plant cell line and its applications.

**UNIT – IV GENETIC ENGINEERING IN PLANT [9Hrs]**

Gene constructs and vector for the production of transgenetic plant. Techniques for plant transformation: *Agrobacterium* mediated transformation, physical methods of gene transfer, production of human protein in plant cell (planti bodies) and pharmaceutically useful proteins in plants. Biosafety regulations relating to transgenic plants.

**UNIT – V PRODUCTION OF TRANSGENETIC PLANT [8Hrs]**

The genetic manipulation of herbicide tolerance, insect resistance, weedicides resistance plant Genetic modification of plant for biotic and abiotic resistance. Improvement, yield and quality in crop plant.

## Course Outcomes (COs):

a. Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components,
b. Explain the various steps taken to establish and optimise media for particular purposes in particular species, without the aid of texts.
c. Explain and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting.
d. Establish and maintain plants in tissue culture and micropropagation, including morphogenesis.
e. Investigate and define a protocol to establish an unknown species and test its response.

**REFERENCE BOOKS:**


1. Primrose, S.B. and Twyman, R.M. Principles of gene manipulation and genomics ($7^{th}$ eds.). Blackwell Publishing.
2. Henry, R.J. 2005. Practical applications of plant molecular biology ($3^{rd}$ eds.). Chapman and Hall.
3. Ramawat, K.G. 2008. Plant biotechnology ($3^{rd}$ eds.). S Chand and Co. Ltd.
4. Kaushik, A. and Kaushik, C.P. Plant Genetic Engineering. New Age International Publishers.
5. Arora, J.K. Biotechnology in Agriculture Environment, Mc Millan India Limited.


**PLANT BIOTECHNOLOGY LAB.**

**BTC-751**

| Cr | L | T | P |
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| 1 | 0 | 0 | 2 |

1. Selection, preparation and sterilization of explant and laboratory wares.

2. Aseptic culture techniques for establishment and maintenance of cultures.
3. Preparation of stock solutions of MS (Murashige and Skoog) basal medium and plant growth regulator stocks.
4. Production Callus from different tissues of plant.
5. Isolation and culture of protoplasts.
6. Plant regeneration by embryo/ anther /pollen culture.
7. Performance of *Agrobacterium* mediated gene transformation in plant.
8. Performance of gene transfer by physical delivery method.
9. Isolation of plant genomic DNA by modified CTAB method.

## Course Outcomes (COs):

a) To understand the fundamentals of plant cells, their structure and functions.
b) To learn the nitrogen fixation mechanism and significance of viral vectors.
c) To gain knowledge about the plant tissue culture techniques.
d) To use the gained knowledge for the development of therapeutic products.
e) To learn about the transgenic plants, their production and applications

### ENVIRONMENTAL BIOTECHNOLOGY

**BTC-702** **Cr L T P**
**3 3 0 0**

Learning Objectives:

a. To explain the importance of microbial diversity in environmental systems, processes and biotechnology.
b. To describe existing and emerging technologies that are important in the area of environmental biotechnology.
c. To describe biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling.
d. To analyse case-studies representative of key areas of environmental biotechnology.
e. To understand the practical approaches relevant to environmental microbiology and biotechnology and record.

**UNIT – I INTRODUCTION TO ENVIRONMENT [8Hrs]**

Ecology and ecosystem, environmental pollution (water, soil and air) noise and thermal pollution, their sources and effects.

**UNIT – II SEWAGE AND WASTE TREATMENTS [8Hrs]**

Anaerobic and aerobic treatment, conventional and advanced treatment technology, methanogenesis, methanogenic, acetogenic, and fermentative bacteria, waste water treatment. Landfills, composting, vermicomposting, recycling and processing of organic residues.

**UNIT – III MICROBIAL INTERACTIONS AND BIOGEOCHEMICAL CYCLES [8Hrs]**

Microbial interactions, carbon, sulphur and nitrogen cycles, microbial leaching.

**UNIT – IV BIOREMEDIATION [8Hrs]**

Biodegradation of xenobiotic compounds, organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants and microbial treatment of oil pollution.

**UNIT V. EMERGING TECHNOLOGIES [8Hrs]**

Use of biomarkers, bioreporters, bioprobes and biosensors for environmental monitoring.

**UNIT – VI BIORESOURCE TECHNOLOGY, DEVELOPMENT AND ISSUES [8Hrs]**

Microbial leaching and mining, microbial polymer production and bio-plastic technology biofertilizers and microbial inoculants, biofuel, environmental laws and policies.

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**Course Outcomes (COs):**

a) This course aims to introduce fundamentals of Environmental Biotechnology.

b) The course will introduce major groups of microorganisms tools in biotechnology and their most important environmental applications.

**c)** On completion of course, students will be able to understand the use of basic microbiological, molecular and analytical methods, which are extensively used in environmental biotechnology.

d) Evaluate the significance and the main technologies used in environmental biotechnoogy.

e) Describe methods used to detect and identify microorganisms in the environment.

**REFERENCE BOOKS:**


1. Gray, N.E. 1989. Biology of wastewater treatment. Oxford University Press, Oxford.
2. Hall, E.A.H. 1990. Biosensors. Open University Press, Milton Kenynes.
3. Head, I.M., Singleton, I. and Milner, M. 2003. Bioremediation: A critical review. Horizon Scientific Press, Norfolk.
4. Satyanarayana, U. 2008. Biotechnology. Uppala Author Publisher Interlink
5. Scragg, A. 2008. Environmental Biotechnology. Oxford University Press.


**ENVIRONMENTAL BIOTECHNOLOGY LAB.**

**BTC-752** **Cr L T P**

**1 0 0 2**

1. Introduction to environmental biotechnological tools and techniques: Use of microscope, autoclave, spectrophotometer, colony counter.
2. Isolation and characterization of microbes from water/waste water samples.
3. Bacterial plate count.
4. MPN test for coliforms.
5. Staining techniques for microbial identification.
6. Physico-chemical and biological characterization of waste water.
7. Determination of total solids, total suspended solids, ash content in solid waste and wastewater.
8. Determination of sludge volume index and microbial food.
9. Determination of inorganic phosphates.
10. Determination of nitrogen by Kjeldahl method.
11. Determination of BOD, DO and COD of wastewater samples.
12. Enumeration of contaminating pathogenic organisms

**Course Outcomes (COs):**

a. Evaluate the significance and the main technologies used in environmental biotechnoogy.
b. Describe methods used to detect and identify microorganisms in the environment.
c. Describe and solve problems relating to basic concepts in biological nutrient removal.
d. Use of various approaches to anaerobic digestion of wastes and solve related problems**.**

## PHARMACEUTICAL BIOTECHNOLOGY

**BTD-701** **Cr L T P**
**3 3 0 0**

Learning Objectives:

a. To understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market.
b. To Undertand the novel formulation approaches for better delivery of biotechnology derived drugs , such as reverse micelles, liposomes, microemulsions and microencapsulation will be addressed.
c. To know the delivery of peptides and proteins by the parenteral, oral, transdermal and nasal routes of administration.
d. To understand the novel biotechnology products and their use in therapeutics and diagnostics will be discussed.

**UNIT – I INTRODUCTION: [7Hrs]**

Development of drug and pharmaceutical Industry, therapeutic agents, their use and economics, regulatory aspects.

**UNIT – II DRUG METABOLISM AND PHARMACOKINETICS [7Hrs]**

Drug metabolism-physico chemical principles, radio activity-pharmacokinetic action of drugs on human bodies.

**UNIT – III MANUFACTURING PRINCIPLES [7Hrs]**

Compressed table, wet granulation, dry granulation or slugging, direct compression, tablet presses, coating of tablets, capsules, sustained action dosage forms, parental solution, oral liquids, injections, ointment-topical applications.

**UNIT – IV PRESERVATION [6Hrs]**

Preservation, analytical methods and test for various drug and pharmaceuticals, quality management, GMP.

**UNIT – V PHARMACEUTICAL PRODUCT AND THEIR CONTROL [6Hrs]**

Therapeutic categories such as vitamins, laxatives, analgesics, non-steroidal contraceptives, antibiotics, hormones.

**UNIT – VI APPLICATION [7Hrs]**

Pharmacological screening models for therapeutic areas such as hypertension, cerebral ischaemia, pain, epilepsy, depression, parkinson's disease, alzheimer's disease, diabetic, leishmanial.

Course Outcomes (COs):

a. Evaluate different pharmaceutical parameters of current biotechnology products.
b. Determine parameters related to stability and formulation of biotechnology products
c. Discuss quality control procedures related to biotechnology products.
d. Discuss novel formulation methods for better delivery of biotechnology derived drugs.
e. Discuss the delivery of biotechnology products by the parenteral, oral, transdermal and nasal routes of administration.

**REFERENCES:**


1. Gennaro, A.R. and Remington, J.P. 1995. The science and practice of pharmacy. Vol I & II, Mack Publishing company, Pennsylvania, USA.
2. Gennaro, A.R. and Remington, J.P. 2005. The science and practice of pharmacy. Vol I & II, Mack Publishing company, Pennsylvania, USA.
3. Mount, D.W. 2005. Bioinformatics, sequence and genome analysis ($2^{nd}$ eds.). CBS Publishers.
4. Kokate, C.K., Jalalpure, S.S. and Hurakadle. 2011. A Textbook of Pharmaceutical Biotechnology. Elsevier, A division of Reed Elsevier India Private Limited, New Delhi.
5. Vyas, S.P. and Dixit, V. 2007. Pharmaceutical biotechnology, B.S. Publications and Distributors, New Delhi.

## DOWN STREAM PROCESSING

**BTD-702**

| Cr | L | T | P |
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Learning Objectives:

a. To understand separation techniques used in downstream process
b. To design and optimize downstream processes.
c. To understand the requirements for successful operation of downstream processes
d. To understand the principles of major unit operations used in downstream processing of biopharmaceuticals.

**UNIT – I DOWNSTREAM PROCESSING [8Hrs]**

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

**UNIT – II PHYSICAL METHODS OF SEPERATION [6Hrs]**

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

**UNIT – III ISOLATION OF PRODUCTS [8Hrs]**

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation –

ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

**UNIT – IV PRODUCT PURIFICATION [8Hrs]**

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

**UNIT – V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS [6Hrs]**

Crystallization, drying and lyophilization in final product formulation.

## Course Oucomes (COs):

a. Explain the significance of downstream processing in bioprocess industry.
b. Evaluate primary separation techniques for product recovery
c. Choose the techniques for product enrichment and purification.
d. Utilize membrane based operations for product purification.
e. Apply downstream processing concepts for commercial bio-products.

**REFERENCE BOOKS:**


1. Treybal E. Robert. 1993. Mass-Transfer operations (3rd eds). McGraw-Hill International Edition, Singapore.
2. Doran M. Paulines. 2003. Bioprocess engineering principles (8th eds). Academic Press, New York.
3. Warren, M.L., Julian, S.C. and Peter Harriott. 2001. Unit Operations of Chemical Engineering (6th eds). McGraw-Hill International Edition, New York.
4. Bailey, J. E. and Ollis, D.F. 1986. Biochemical Engineering Fundamentals (2nd eds.). McGraw-Hill Inc.


## IPR AND ENGINEERING ETHICS

| BMO -701 | Cr. | L | T | P |
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**UNIT - I TECHNOLOGY TRANSFER AND R&D [8Hrs]**

Role of Research & development University-industry technology transfer arrangements, how and why a biotech company can benefit, status of R&D in India, different GLPs, GMPs and other practices.

**UNIT - II INTELLECTUAL PROPERTIES AND APPLICATION [8Hrs]**

Intellectual properties in biotechnology, definitions. Trademarks, copyright and related rights, industrial design, traditional knowledge, patent laws, procedures, precautions, patent infringement. WIPO, international conventions.

**UNIT – III BIOETHICS AND RELATED LEGAL ISSUES [7Hrs]**

Bioethics and current legal issues. Ethics of new technology. Marketing and public perceptions in product development.

**UNIT – IV PATENTING [7Hrs]**

Patents, copyrights, Trademarks, Patent Act (1970), Patent (Amendment) Act (2002) Salient features, Different types of patents and patent specifications, Filling and processing of applications for patents.

**UNIT – V BIO-SAFETY [8Hrs]**

Bio-safety regulation and national and international guidelines, r-DNA guidelines. Experimental protocol approvals, levels of containment, Environmental aspects of biotech applications, Use of genetically modified organisms and their release in environment, Special procedures for r-DNA based product production (GMP).

**REFERENCE BOOKS:**


1. N. R. Subbaram, *Handbook of Indian Patent Law and Practice*, S. Viswanathan (Printers and Publishers) Pvt. Ltd., India, 1998.
2. Teece, David J., Managing Intellectual Capital: Organizational, Strategic and Policy Dimensions, Oxford University Press, 2000.

## Course Oucomes (COs):

a) Upon completion of the course the students will learn about basics of entrepreneurship
b) Upon completion of the course the students will learn about protection of rights
c) Upon completion of the course the students will learn about different types of patents
d) Upon completion of the course the students will learn about patent filing
e) Upon completion of the course the students will learn about biosafety levels

### DRUG DESIGN

**BIO-702** **Cr L T P**
**3 3 0 0**

Learning Objectives:

a. To understand the concept of structure-function relationship of lead molecules in drug discovery.
b. To understand the target identification in drug discovery.
c. To apply the proteomics and genomics techniques in drug design.
d. To understand the methods of drug delivery.
e. To design new drugs using computational methods.

**UNIT – I INTRODUCTION [8Hrs]**

Introduction to the drug discovery and development, structural effects on drug action, physicochemical properties that are related to drug action, role and types of chemical bonding involved in drug-target interactions.

**UNIT – II APPROACHES AND PRINCIPLES TO DRUG DESIGN [8Hrs]**

Enzyme Inhibition, molecular recognition, receptor based molecular modelling, molecular docking, QSAR, agonist and antagonist. Computer-aided drug Design: lead optimization and computer-aided drug design, overview of ligand-based and structure-based design, viewing tools and graphics tools.

**UNIT – III PRECLINICAL DEVELOPMENT [5Hrs]**

Clinical trials, patenting and clearance for application.

**UNIT – IV DESIGNED DRUG IN APPLICATION [6Hrs]**

Antihypertensive, antiviral, anticancer and antibiotic, combinatorial library and highthrouput Screening

**UNIT – V DRUG DELIVERY APPROACHES [7Hrs]**

Pharamacokinetics and its role in drug discovery, vehicles used for drug delivery, drug development and process development, drug absorption, distribution and excretion.

**UNIT – VI DRUG METABOLISM [7Hrs]**

Different routes of drug administration, drug absorption, drug transport in biological systems, drug permeation through biological barriers, drug distribution, transcapillary exchange of drugs, perfusion limited and permeability limited distribution of drugs, drug excretion.

**Course Outcomes:**

a. Review pharmaceutical methodology for the design of new drugs and propose synthetic pathways for their preparation.

b. Devise appropriate methodology for the design of new drugs.

c. Apply drug design methodology, including computer-aided and related techniques to the design of a new drug.

d. Review and present data to peers and demonstrators with responsibility and accountability.

**REFERENCE BOOKS:**


1. Graham, L. Patricks. An Introduction to Medicinal Chemistry, Oxford University Press.
2. A.R.Leach, Molecular Modelling Principles and Application, Longman, 2001.
3. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.
4. SatyaPrakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.


## MINOR PROJECT

**BTC-361**

**COURSE OUTCOMES:**

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs
e) The student may develop a tool to for the betterment of the society

## TECHNICAL REPORT WRITING

**MCC-708**

**COURSE OUTCOMES:**

a) The students would have gained knowledge to disseminate the area of interest
b) The students would have gained knowledge about literature survey
c) The students would have gained knowledge to select the methodologies for the research work
d) The students would have gained knowledge about the principles behind the process
**e)** The students would have gained knowledge about the expected outcome of the work

## EIGHT SEMESTER

| | | | |
|---|---|---|---|
| **1** | **Seminar ,Project Work and Internship** | **BTC-861** | **15** |

## COURSE OUTCOMES

a) Upon completion of the project work the students would have achieved the expected outcome of the research
b) Upon completion of the project work the student would have gained knowledge to develop a product which will benefit the society
c) Upon completion of the project work the student would have predicted the commercial probability of their product
d) Upon completion of the project work the student would gain knowledge about the success rate of the product
e) Upon completion of the project work the student would have assessed the impact of the research work