DAV UNIVERSITY JALANDHAR

SCHEME FOR

Master of Science (Hons.) Biotechnology
(Program ID-38)

1st TO 4th SEMESTER
Examinations 2015–2016 Session Onwards

Applicable For Admissions in 2015

DAV UNIVERSITY, JALANDHAR

Course Scheme
M.Sc. (Hons.) Biotechnology
Semester-I

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	BTY511	Molecular Biology	Core	4	0	0	4
2	BTY512	Molecular Biology- LAB	Core	0	0	3	2
3	BTY513	Cell Biology	Core	4	0	0	4
4	BTY514	Cell Biology- LAB	Core	0	0	3	2
5	BTY515	Genetics	Core	4	0	0	4
6	BTY516	Genetics- LAB	Core	0	0	3	2
7	BOT601	Scientific Writing and Research Methodology	Core	2	0	0	2
8	**Open Elective/Interdisciplinary Course-I**						4
Total							24

L: Lectures T: Tutorial P: Practical Cr: Credits

List of Open Elective							
1	CHE616	Medicinal Chemistry	Open Elective	4	0	0	4
2	ZOO257	Human Physiology	Open Elective	4	0	0	4
3	BOT533	Plant Physiology	Open Elective	4	0	0	4
4	MIC531	General Microbiology	Open Elective	4	0	0	4

Semester-II

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	BTY521	Recombinant DNA Technology	Core	4	0	0	4
2	BTY522	Recombinant DNA Technology Laboratory	Core	0	0	3	2
3	BTY523	Animal Biotechnology	Core	4	0	0	4
4	BTY524	Animal Biotechnology Laboratory	Core	0	0	3	2
5	BTY525	Fermentation and Bioprocess Engineering	Core	4	0	0	4
6	BTY526	Fermentation and Bioprocess Engineering Laboratory	Core	0	0	3	2
7	BTY527	Tools in Biotechnology	Core	2	0	0	2
8	BTY528	Tools in Biotechnology Laboratory	Core	0	0	2	1
9	BTY529	Seminar	Core	0	0	0	1
10	**Departmental Elective Course-1**						4
Total							26

List of Departmental Electives							
1	BTY541	Biostatistics	Departmental Elective	4	0	0	4
2	BTY542	Genetics	Departmental Elective	4	0	0	4

L: Lectures T: Tutorial P: Practical Cr: Credits

Semester-III

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	BTY631	Environmental Biotechnology	Core	3	0	0	3
2	BTY632	Environmental Biotechnology Laboratory	Core	0	0	2	1
3	BTY633	Plant Biotechnology	Core	4	0	0	4
4	BTY634	Plant Biotechnology- LAB	Core	0	0	3	2
5	BTY635	Computational Biology & Bioinformatics	Core	4	0	0	4
6	BCH524	Principles of Biochemistry	Core	4	0	0	4
7	BCH525	Principles of Biochemistry Laboratory	Core	0	0	3	2
8	BTY661	Project Part-I	Core	0	0	0	2
9	**Open Elective/Interdisciplinary Course-II**						4
Total							26

L: Lectures T: Tutorial P: Practical Cr: Credits

List of Open Elective							
1	CHE616	Medicinal Chemistry	Open Elective	4	0	0	4
2	ZOO257	Human Physiology	Open Elective	4	0	0	4
3	BOT533	Plant Physiology	Open Elective	4	0	0	4
4	BTY631	Nanotechnology in Healthcare	Open Elective	4	0	0	4
5	MIC603	Immunology	Open Elective	4	0	0	4

Semester-IV

S. No	Paper Code	Course Title	Course Type	L	T	P	Cr
1	BTY641	Intellectual Property Rights, Bio safety and Bioethics	Core	2	0	0	2
2	BTY642	Genomics, Proteomics & Metabolomics	Core	4	0	0	4
3	BTY643	Food Biotechnology	Core	2	0	0	2
4	BTY662	Project Part II	Core	0	0	0	8
5	**Departmental Elective Course-II**						4
Total							20

List of Departmental Electives							
1	BTY681	Virology	Departmental Elective	4	0	0	4
2	BTY682	Medical Biotechnology	Departmental Elective	4	0	0	4
3	BTY683	Plant Stress Biology	Departmental Elective	4	0	0	4

L: Lectures T: Tutorial P: Practical Cr: Credits

Course Title: Molecular Biology

Course Code: BTY511

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: A comprehensive knowledge of molecular aspects of biological function at the molecular level, particular emphasis on the structure and regulation of genes, as well as, the structure and synthesis of proteins and applications of these concepts in human medicine and health, agriculture, study evolution and other areas.

1. Introduction to molecular biology, basic techniques in molecular biology. DNA and its various forms, super coiling of DNA, DNA melting, repetitive sequences, cot and rot curves, C value paradox, DNA protein interaction, DNA super coiling. Prokaryotic & eukaryotic DNA replication, enzymes and accessory proteins involved in DNA replication, replication origin & replication fork, fidelity of replication, extra chromosomal replicons, DNA damage and repair mechanisms, gene amplification, mobile genetic elements, homologous and site specific recombination. **14 hours**
2. Prokaryotic and eukaryotic transcription, RNA polymerase, transcription factors, regulatory elements, transcriptional activator, repressor & mechanism of transcription regulation, post-transcriptional processing of mRNA, rRNA & tRNA. **14 hours**
3. Protein synthesis and processing: Ribosome structure, genetic code, prokaryotic & eukaryotic translation, the translation machinery, mechanism and regulation of translation & translation proof-reading, translational inhibitors, Post- translational modification of proteins and intracellular protein targeting, import into nucleus, mitochondria and peroxisome. **12 hours**
4. Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing). **10 hours**
5. Regulation of cell cycle, cancer and apoptosis. Signal transduction and its molecular basis, molecular mechanism of plant hormone action mitochondrial control of fertility, structure, organization and regulation of nuclear gene concerning storage proteins and starch synthesis. **10 hours**

Reference Books:

1. Molecular cell biology (2008). Harvey F. Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher (W.H.Freeman).
2. Genes IX (2008). Benjamin Lewin (Jones and Bartlett Publishers).

3. Molecular cloning: A laboratory manual (2000). J. Sambrook, E.F. Fritish and T. Maniatis (Cold Spring Harbor Laboratory Press,New York).

Course Title: Molecular Biology-LAB

Course Code: BTY512

L	T	P	Credits	Marks
0	0	3	2	50

- Isolation of genomic DNA from bacteria.
- Isolation of genomic DNA from plant.
- Isolation of total RNA from tissue.
- Demonstration of DNA protein interaction.
- Quantitation of nucleic acids and proteins.
- Gel electrophoresis:
    - Nucleic acid
    - Protein

Course Title: Cell Biology

Course Code: BTY513

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The object of the present course is to develop basic knowledge in cell biology to understand the structure and function of the cellular and sub cellular components of cells and tissues with the help of recent techniques. The course will help students to get an understanding of cell function at the molecular level including the fundamentals of biology. They will become aware of the complexity and harmony of the cell.

1. History of cell biology: Development of cell theory Diversity of cell size and shape: General organization and diversity of prokaryotic and eukaryotic cells. Origin of cells: Assembly of macromolecules (proteins and nucleic acid), mechanism of assembly, evolutionary steps in the origin of cells (Chemical evolution). **9 hours**
2. Microscopic techniques for study of cells: Bright field, Fluorescence, Phase contrast, DIC, dark field, Polarization, Confocal. Electron Microscopy: TEM, SEM, AFM, STEM, Preparation of samples for EM. Applications of Light Microscopy and EM in cell biology. **6 hours**
3. Sub cellular fractionation: Fractionation and marker enzymes and functional integrity, FACS, separation techniques for membrane proteins. Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility). **6 hours**
4. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. **5 hours**
5. Cell Trafficking: Targeting proteins to endoplasmic reticulum, signal recognition parcticle, signal recognition particle receptor; Protein sorting and export from Golgi Apparatus; SNARE hypothesis; Protein import into Mitochondria, mitochondrial genome; Import and sorting of chloroplast protein. Cellular energy transactions: Role of mitochondria and chloroplasts. **8 hours**
6. Cell division and Cell cycle & its regulation: Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle. Molecular events and model

systems; the role of the cyclins and cyclin-dependent kinases, cell cycle checkpoints, methods for synchronizing the cell cycle in cell populations. **3 hours**

7. Cellular responses to environmental signals in plants and animals: Mechanism of signal transduction. Cell signaling - Modes of cell signaling, steroid hormone receptors, plant hormones, G-protein coupled receptors; regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing, c- AMP pathway of signal transduction ; c GMP, phospholipids and calcium ions, Ras, Raf , MAP kinase pathway , JAK – STAT pathway. **4 hours**
8. Cell motility: Cilia, flagella of eukaryotes and prokaryotes, their molecular mechanism. **4 hours**

Reference Books:

1. Cell biology: A laboratory handbook Vol 1, 2, 3 (2006). Celis. J.E. (Academic Press, UK).
2. Stryer, L. (1995). Biochemistry, 4th edition, W.H. Freeman and Co., New York.
3. Nelson, D.L. and Cox, M.M. (2000). Lehninger Principles of Biochemistry, 3rd ed., Worth Publishers, New York.
4. Damal, J., Lodish, H. and Baltimore, D. (1990). Molecular Cell Biology, 2nd edition, Scientific American Books, New York.

Course Title: Genetics

Course Code: BTY542

L	T	P	Credits	Marks
4	0	0	4	100

Course objective: Genetic principles are unifying principles applicable across all the living forms. "Gene" is central to genetics, molecular biology and genetic engineering. Therefore the basic objectives of this course are to apprise the students with both classical and molecular genetics.

1. Molecular organization of chromosomes: Genome size and complexity, structure of eukaryotic and prokaryotic chromosome, polytene chromosomes, euchromatin and heterochromatin, satellite DNA, centromere and telomere structure, chromosomal staining, Organization of prokaryotic and eukaryotic genes and genomes including operon, unique and repetitive DNA, interrupted genes, gene families, exon, intron, enhancer promoter sequences and other regulatory elements. Structure of chromatin and chromosomes, heterochromatin, euchromatin, transposon. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. **12 hours**
2. Mendelian principles: Dominance, segregation, independent assortment. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. Linkage and chromosome mapping: linkage and crossing over; sex linkage, sex limited and sex influenced characters; genetic systems of Neurospora and yeast: tetrad analysis, centromere mapping, gene conversion and mating type, Extrachromosomal inheritance**:** Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. **12 hours**
3. Gene Concept: Molecular concept of gene, complementation test for functional allelism, fine structure of genes. Methods of gene isolation and identification, Split genes, overlapping genes and pseudo genes. **8 hours**
4. Mutagenesis: Spontaneous vs induced mutation, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis, site directed mutagenesis, molecular basis of mutagenesis, test for mutagenicity, mutation frequency., transformation, transduction, conjugation, transposable elements and transposition. **10 hours**

5. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. **8 hours**
6. Microbial genetics: Transformation, conjugation, transduction and sex-duction mapping genes by interrupted mating, RecA, plasmids, their replication, copy number and compatibility, drug resistance; transposable elements and transposition. Recombination in bacteria, fungi and viruses; Homologous and non-homologous recombination. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. **10 hours**

Reference Books:

1. Genetics (2010). Aggarwal, V.K. and Verma, V.S. 9th Edition. S. Chand, India. Print.
2. The Language of the Genes (2012). Jones, S. HarperCollins Publishers. Print.
3. Genetics: A Conceptual Approach (2010). Pierce, B.A. 4th Edition. W.H. Freeman & Company. Print.
4. Nature via Nurture: Genes, Experience, & What Makes Us Human (2004). Ridley, M. HarperCollins Publishers. Print.
5. Genetics (2008). Strickberger M.W. 3rd Edition. Prentice-Hall, India. Print.
6. Principles of Genetics (2011). Snustad, D.P. and Simmons, M.J. 6th Edition. John Wiley & Sons. Print.
7. Fundamentals of Genetics (2011).Singh, B.D. 4th Edition. Kalyani Publishers. Print.

Course Title: Recombinant DNA Technology

Course Code: BTY521

L	T	P	Credits	Marks
4	0	0	4	100

Course objective: The basic objective of the paper is to present the principles of gene manipulation and its associated technologies. How developments in gene manipulation have revolutionized medicine, agriculture and health.

1. Introduction and scope of Recombinant DNA Technology. **2 hour**
2. DNA modifying enzymes- Terminal deoxynucleotidyl transferase, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Methylases, Ligases- *E. coli* and T4 DNA ligases, Linker, Adaptor, Homopolymer tailing, Restriction Endonucleases. **8 hours**
3. Isolation and Purification of nucleic acid: Basic techniques and considerations criteria of purity, isolation and purification of phage DNA plasmid, chromosomal DNA, RNA and mRNA. **4 hours**
4. Cloning and expression vector: Characteristics of cloning and expression vectors; plasmid, phage and cosmid vectors, multipurpose cloning vectors, shuttle vectors; bacterial, yeast, plant and mammalian expression vectors. **10 hours**
5. Cloning and expression hosts: Characteristics of cloning and expression host, bacterial, yeast, plant and mammalian host systems for cloning and expression of genes. **4 hours**
6. DNA Cloning Strategies: Preparation of genomic and cDNA libraries, criteria for selection of cloning vectors - plasmid, bacteriophage and cosmid, transformation and transfection, electroporation, screening of gene library and selection of clone. **6 hours**
7. Nucleic acid Blotting and Hybridization: Southern and northern blotting and hybridization techniques, radioactive and non-radioactive labeling of probe, western blotting. **4 hours**
8. Expression of cloned genes :Expression of cloned genes in *E. coli*, *Bacillus subtilis*, s*treptomyces*, yeast and mammalian cells, detection and analysis of proteins expression from cloned genes. **8 hours**
9. Protein-Protein interactions-Phage display (*in vivo*, *in vitro* and *in planta*, Yeast two hybrid system, Yeast three hybrid system. Bicomplementation and Florescence Resonance Energy Transfer (FRET). **3 hours**
10. Polymerase chain reaction and site directed mutagenesis: Principle and application of polymerase chain reaction, Real Time PCR, random mutagenesis, site-directed mutagenesis and protein engineering. **4 hours**

11. Impact of rDNA on human genetics: Mapping & cloning of human disease genes, DNA based diagnosis, gene targetting, human genome project history and scope. **4 hours**
12. Applications of r-DNA technology in industry, agriculture and forensic science. **3 hours**

Reference Books:

1. Gene cloning and DNA analysis – An Introduction (2006). 5th edition, T.A. Brown, Blackwell publisher.

2. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes (1998). S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford.

3. Molecular Cloning : A Laboratory Manual (2000). J. sambrook, E.F. Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York.

4. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003). 3rd edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.

5. Principles of Genetic Engineering (2009). Mousumi Debnath, pointer publisher, Jaipur.

6. Principles of gene manipulation and Genomics (2006). 7th edition, S.B Primose and R.M Twyman, Blackwell publishing.

Course Title: Recombinant DNA Technology-LAB

Course Code: BTY522

L	T	P	Credits	Marks
0	0	3	2	50

- Preparation and purification of pUC plasmid.
- Preparation and purification of genomic DNA
- Restriction digestion of plasmid and genomic DNA and gel electrophoresis.
- Gene cloning
- Bacterial transformation
- Southern blotting and hybridization with non-radioactive probes.
- Amplification of DNA with PCR Temperature cycler.

Course Title: Animal Biotechnology

Course Code: BTY523

L	T	P	Credits	Marks
4	0	0	4	100

Course objective: This course provides a comprehensive understanding of the cell culture and techniques to be used in laboratory. The course also introduces students to techniques like hybridoma technology, transformation and cloning, etc.

1. Animal Biotechnology- Scope, global perspective and new horizons, Historical perspective. Culture Media and Reagents-Types of cell culture media, physiochemical properties, Balanced salt solution, Constituents of serum, Serum free media (SFM), Design of SFM, Advantages and disadvantages of serum supplemented and serum free media, Conditioned media. Primary culture methods, Culture of attached cells and cells in suspension, phases of cell growth and determination of cell growth data (calculation of *in vitro* age, multiplication rate, population doubling time, cell counting, phases of cell cycle) Commonly used animal cell lines, their origin and characteristics, Organ Culture, Cell synchronization methods and their applications. **9 hours**
2. Concept of stem cells, tissue engineering and its application. **6 hours**
3. Source of some important mammalian cell lines. Basic techniques of scale up of animal cell culture. : roller bottles modification of roller bottles, multiunit system and concept of bioreactors including hollow fibre system & their application. **8 hours**
4. Preservation and maintenance of animal cell lines, cryo-preservation and transport of animal germplasm (i.e. semen, ova and embryos). **6 hours**
5. Gene cloning techniques for mammalian cells, cloning in mammalian cells. **6 hours**
6. Transgenic animals, *in vitro* fertilization and embryo transfer. Molecular biological techniques for rapid diagnosis of genetic diseases and gene therapy. Transgenic mice: Methodology and applications; Transgenic cattle, Livestock transgenesis- production of drugs using animals. Sericulture and Pisciculture. **10 hours**

Reference Books:

1. Methods of Tissue Engineering (2001). Atala, A. and Lanza, R. 1st Edition. Academic Press. Print.
2. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (2010). Freshney, R. I. 6th Edition. Wiley-Blackwell. Print.
3. General Techniques of Cell Culture (1997). Harrison, M.A. and Rae, I.F. 1st Edition. Cambridge University Press. Print.

4. Animal Cell Culture: A Practical Approach (2000). Masters, J.R.W. 3rd Edition. Oxford University Press. Print.
5. Animal Cell Biotechnology (1994). Spier, R.E. and Griffiths, J.B. Vol. 1-6. Academic Press. Print.
6. Animal Biotechnology: Models in Discovery and Translation (2013). Verma, A. and Singh, A. 1st Edition. Academic Press. Print.
7. Animals as Biotechnology: Ethics, Sustainability and Critical Animal Studies (2010).Twine, R. 1st Edition. Routledge Publishers. Print.

Course Title: Animal Biotechnology - LAB

Course Code: BTY524

L	T	P	Credits	Marks
0	0	3	2	50

- Preparation of culture media and concept of sterilization in animal cell culture.
- Subculturing and maintenance of continuous cell lines such as myeloma, Hep-2 and HeLa cells.
- To determine doubling time of a given cell line.
- Cytotoxic assay of a given antibiotic for a cell line.
- Effect of nutrient (serum) on growth of given cell line.
- Cryopreservation of animal cells.

Course Title: Biostatistics

Course Code: BTY541

L	T	P	Credits	Marks
4	0	0	4	100

Course objective: The course aims to develop expertise in the application of statistical methods applied to biological data obtained in experimental findings.

1. Brief description and tabulation of data and its graphical representation. Measures of Central Tendency (Mean, Median, Mode), Measures of dispersion (Range, Mean Deviation, Standard Deviation, Quartile Deviation), combined mean and variance, covariance, Graphs (Bar Chart, Pie Chart, Box Plot, Histogram, Ogive, scatter plot) Probability: Experimental probability, probability when outcomes are equally likely, subjective probabilities. **12 hours**
2. Probability (Addition and Multiplication Theorem), Bayes theorem, Binomial, Poisson and Normal distribution. Correlation and linear regression **8 hours**
3. Random variables and distributions, Discrete and continuous random variables, Cumulative distribution function, Probability mass function and probability, Density function, Expectation of random variable– experimental Approach and theoretical approach. **10 hours**
4. Formulation of Hypothesis (One-tailed & Two-tailed), Type I and Type II errors, power of a test, Significance of a test, P-value testing, Hypothesis Testing (students T-test, Chi-square test). Analysis of variance (ANOVA) one and two way. Pearson correlation test. **8 hours**
5. Biological experimental designs- CRD, RBD, factorial designs, latin square designs. **6 hours**
6. Application of statistics biological experimental design: Data collection and explanation and conclusion case studies. **8 hours**
7. Sampling theory and different techniques,Applications of statistical methods using statistical software , SAS. **8 hours**

Reference Books:

1. Biostatistics (2012). Arora, P.N. and Malhan, P.K. Himalaya Publishing House. Print.
2. Introduction to Biostatistics (2013). Banerjee, P.K. 4th Edition. S. Chand & Co. Ltd. Print.

3. Biostatistics: A foundation for analysis in the Health Sciences (2013). Daniel, W.W. and Cross, C.L. 10th Edition. John Wiley and Sons. Print.
4. Introduction to Biostatistics (2006). Forthfer, R.H., Lee, E.S. and Hernandez, M. Academic Press. Print.
5. Statistical Methods (2013). Gupta, S.P. 43rd Edition. S.Chand & Co. Print.
6. Introduction to Biostatistics (2009). Sokal, R.R. and Rohlf, F.J. 2nd Edition. Dover Publications. Print.

Course Title: Tools in Biotechnology

Course Code: BTY527

L	T	P	Credits	Marks
2	0	0	2	50

Course Objective: A comprehensive knowledge of functioning and applications of the equipment used in molecular biology will be offered in the course.

1. Quantitative and real time PCR, DNA sequencer (Nucleotide sequencing of DNA); Protein DNA interaction assays. **7 hours**
2. Radioimmunoassay, ELISA, Flow cytometery. **3 hours**
3. Overview of Chemical and Physical cell disruption techniques for biomolecules. **2 hours**
4. Methods of separation of peptides and proteins by electrophoresis and chromatography; Methods of separation of oligonucleotides and DNA by electrophoresis and chromatography. **4 hours**
5. Advanced techniques of separation: 2D gel electrophoresis, HPLC and GC. **4 hours**
6. Detection of molecular mass by MALDI, ESI-MS. **4 hours**
7. Determination of structure of molecules by Nuclear Magnetic Resonance spectroscopy, ^{1}H NMR, ^{13}C NMR, Magnetic Resonance Imaging. **3 hours**
8. Spatial arrangement of atoms in a crystal by X-ray Crystallography and analysis of data to predict a protein structure. **3 hours**

Reference Books:

1. Radioisotopes in Biology-A Practical Approach. Slater, R.J. 2nd Edition. Oxford University Press, New York. 2002. Print.
2. Physical Biochemistry: Principles and Applications (2009). Sheehan, D. 2nd Edition. John Wiley & Sons Ltd. Print.
3. Biophysical Chemistry: Principles & Techniques (2002). Upadhayaye, A., Upadhyaye, K. and Nath, N. Himalaya Publication House, New Delhi. Print.
4. Principle and Practice of Bioanalysis (2008). Venn, R.E. 2nd Edition. CRC Press. Print.
5. Practical Biochemistry: Principles and Techniques (2005). Wilson, K. and Walker, J. 5th Edition. Cambridge University Press. Print.

Course Title: Tools in Biotechnology -LAB

Course Code: BTY528

L	T	P	Credits	Marks
0	0	2	1	25

- ELISA.
- Cell disruption
- Protein estimation
- Microscopy
- Thin layer chromatography.
- Native & Denaturing PAGE
- Quantitative PCR
- Demonstration
    - HPLC
    - NMR
    - 2D Gel Electrophoresis

Course Title: Seminar

Course Code: BTY529

L	T	P	Credits	Marks
0	0	0	1	25

Seminar Objective:

During the course students will come to know about the general understanding of the most common problems, recent advances in biotechnology research. Each student shall be allotted a topic by the instructor. Student will have to understand the topic, collect literature and prepare the presentation. Through this the students will develop habit of reading newer topics, will become inquisitive and develop confidence of presentation and discussion before audience.

The students shall submit a project report on the allotted topic, which shall be evaluated by the concerned internal faculty. He/She then would present a seminar on the concerned topic. The students will be encouraged to explore all available literature as well as the internet to prepare the seminar report and present the same using informative slides made using Power Point or projectors.

Seminar Contents:

Students will present their work on a selected topic with the following headings:

- Title
- Objectives
- Review of Literature
- Materials and Methods
- Results
- Conclusion/recommendations

Examination Scheme (Weightage in %):

Literature study/ Fabrication/ Presentation	50
Written Report	25
Question answer session	25

Course Title: Nanotechnology and Healthcare

Course Code: BTY631

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The objective of this course to utilise the biotechnology research into healthcare and deliver a drug substance at the biological target site. This course will give as insight to different drug delivery system including nanoparticles.

1. Molecular biology for drug discovery: Vaccines, Diagnostics and Forensics. **3 hours**
2. Gene therapy: Vectors and other delivery systems for gene therapy Viruses as vectors, Non-viral DNA delivery systems, synthetic particles as vectors. **4 hours**
3. The Science of Nano - What is Nanobiotechnology. **1 hours**
4. Nanoparticles in biological labeling and cellular imaging: Science of nanoparticles functionalization protein-based nanostructures: Nanomotors: Bacterial (*E. coli*) and Mammalian (Myosin family). **3 hours**
5. Applications of Nano-Materials in Biosystems: Proteins - Lipids - RNA and DNA Protein Targeting - Small molecule/nanomaterial - Protein interactions.
   Nanomaterial-Cell interactions-Manifestations of surface modification (Polyvalency). **4 hours**
6. Nanobiosensors: Science of Self-assembly - From Natural to Artificial Structures Nanotechnology Meets Microfluidics: Nano Printing of DNA, RNA, and Proteins Biochips Applications in Nano Scale Detection Lab-on-a-chip Devices (LOC). **4 hours**
7. Applications of Nanostructures in Drug: Discovery, delivery, and controlled release Nanotechnology for tissue engineering: Applications in regenerative therapy. **4 hours**
8. Nanomaterials and Diagnostics/Drug Delivery and Therapeutics Nanostructures in Cancer Research: Examples of nanostructures in research and therapy. Targeted delivery systems: Collodial drug carriers, nanoparticles and liposomes. Bioadhesives, prodrug and ligand appended carrier approach to site directed drug delivery. Protein and peptide drug delivery. Novel delivery systems. **8 hours**

Reference Books:

1. Burger's Medicinal Chemistry, Drug Discovery and Development (2010). Abraham, D.J. and Rotella, D.P. 8 Volume Set. 7th Edition. John Wiley & Sons Ltd. Print.
2. Wilson & Gisvold's textbook of organic medicinal and pharmaceutical Chemistry (2010). Beale, J.M. and Lock, J. 12th Edition. Lippincott Williams & Wilkins. Print.

3. Textbook of Drug Design and Discovery (2002). Liljefors, T., Krogsgaard-Larsen, P. and Madsen, U. 3rd Edition. CRC Press. Print.
4. Modern Concepts in Nanotechnology (2008). Prasad, S.K. Discovery Publishing House. Print.
5. Nanobiotechnology (2008). Trivedi, P.C. Pointer Publishers. Print.

Course Title: Plant Biotechnology

Course Code: BTY633

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The objective of this course to familiarize the students with integrated use of different biological sciences. Plant tissue culture has contributed greatly to understanding the factors responsible for growth, differentiation and other vital processes of plant cells, tissues & organs *in vitro*. The technique has contributed immensely towards plant improvement, plant protection and also for large-scale production of industrially important compounds by gene manipulation.

1. Introduction & basic techniques in tissue culture. Conventional breeding vs tissue culture. Tissue culture media (composition & preparation), sterilization techniques, tissue culture as a technique to produce novel plants & hybrids, Green house and Green home technology. Concept of cellular totipotency. Basic techniques in cell culture and somatic cell genetics. Regulation of cell cycle and cell division. Initiation and maintenance of callus and suspension cultures, single cell clones, nurse culture technique, differentiation, organogenesis & somatic embryogenesis, Production and application of artificial seeds. **10 hours**
2. Clonal propagation & production of virus-free plants, stages of micropropagation, propagation by direct and indirect organogenesis. Transfer and establishment of whole plants in soil, *in situ* and *ex situ* rooting & difference. Changes during hardening of micropropagated plants. Importance of variability, somaclonal and gametoclonal variations, practical application of somaclonal variations. **10 hours**
3. Protoplast culture, fusion & culture, somatic hybridization and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids and role of protoplast culture and somatic hybridization in crop improvement. **7 hours**
4. Haploid production and its significance, anther, pollen culture, monoploid production. Hybrid embryo culture/embryo rescue and ovary culture. Endosperm culture, production of triploids. Role of haploids, monoploids and triploids in agriculture. **8 hours**

5. Germplasm conservation: Cryopreservation in germplasm storage, factors affecting revival of frozen cells, slow growth & DNA banking for germplasm conservation. Plant secondary metabolites a general account, (synthesis & extraction) central mechanism and manipulation of phenylpropanoid pathway, shikimate pathway, Biotransformation and elicitation. Plant tissue culture repository. **10 hours**
6. Molecular marker-aided breeding: RFLP maps, linkage analysis, RAPD markers, STS, microsatellites, SCAR (Sequence Characterized Amplified Regions), SSCP (Single Stand Conformational Polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection in plant breeding. **10 hours**
7. Transgenic Plants Technology: Genetic Transformation, Methods for gene transfer in plants, Molecular mechanism of *Agrobacterium* mediated transformation. Selectable markers, Reporter gene and Promoters used in plant transformation vectors. Selection of transgenic (verification of transgene and agronomic traits). Marker free transgenics. **5 hours**

Reference Books:

1. Plant tissue culture – Theory and Practice (2005). Bhojwani, S.S. and Razdan, M.K. Elsevier Publication. Print.
2. Biotechnology in Crop Improvement (1998). Chawla, H.S. International Book distributing company. Print.
3. Introduction to Plant Biotechnology (2009). Chawla, H.S. 3rd Edition. CRC Press. Print.
4. Plant Biotechnology (2000). Hammond, J., McGarvey, P. and Yusibov, V. Springer verlag, Germany. Print.
5. Recent Advances in Plant Biotechnology (2009). Kirakosyan, A. and Kaufman, P.B. Springer. Print.
6. Plant Biotechnology: The Genetic Manipulation of Plants (2008). Slater, A., Scott, N.W. and Fowler, M.R. 2nd Edition. Oxford University Press. Print.

Course Title: Plant Biotechnology -LAB

Course Code: BTY634

L	T	P	Credits	Marks
0	0	3	2	50

- Methods of sterilization
- Preparation of different media
- Callus induction & sub culturing, organogenesis, Suspension cultures and their maintenance.
- Micro propagation.
- Protoplast isolation and culture.
- Agro bacterium culture, selection of transformants.
- Isolation of Plant genomic DNA from the leaves tissue.
- Restriction digestion of plant genomic DNA.
- Developing RFLP and RAPD maps.

Course Title: Computational Biology & Bioinformatics

Course Code: BTY635

L	T	P	Credits	Marks
4	0	0	4	100

1. Introduction to Computational Biology: Nature and scope of Computational Biology and Bioinformatics, Basic Algorithms in Computational Biology, Introduction to sequence alignment. Analysis of the whole genome sequencing data: Processing and assembly of whole genome sequence data, Base-calling (PHRED), Vector and E-coli masking. Assembly using PHRAP, CAP3, Assessment of final data quality (Coverage, PHRAP score International guidelines for data quality) Types of Misassembles and their solution. **10 hours**
2. Analysis and submission of EST and GSS data: Processing and quality trimming of nascent sequences; Preparation of submission files; Clustering of ESTs (overview of clustering procedure, pros and cons of clustering). **6 hours**
3. Whole Genome annotation strategies: Basic overview of whole genome annotation strategies, strategies for Human and Arabidopsis genomes. Introduction to DNA and Protein sequencing, Human Genome Project. **6 hours**
4. Bioinformatics databases, Type of databases, Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, GeneBank, DDBJ; Secondary nucleotide sequence databases. **5 hours**
5. Protein structure prediction: Protein Secondary Structure Prediction: Secondary Structure Prediction for Globular Proteins, Transmembrane Proteins, Coiled Coil Prediction. **3 hours**
6. Protein Tertiary Structure Prediction: Methods, Homology Modeling, Threading and Fold Recognition, Ab Initio Protein Structural Prediction, CASP. **3 hours**
7. Sequence motif databases -Pfam, PROSITE, Protein structure databases, Protein Data Bank-SCOP, CATH, KEGG, Chembank, Sequence, structure and function relationship. **5 hours**
8. Applications of bioinformatics: Bioinformatics in pharmaceutical industries, Bioinformatics in immunology, Bioinformatics in agriculture, Bioinformatics in forestry, Geoinformatics, Legal, ethical and commercial ramifications of bioinformatics, Biosensing. **7 hours**

Reference Books:

1. Bioinformatics: Sequence and genome analysis (2004). D.W. Mount, Cold Spring Harbor Laboratory Press.
2. Bioinformatics: A practical guide to the analysis of genes and proteins (2004). A.D. Baxevanis and BFF Ouellette, Wiley Interscience.
3. Computational Molecular Biology: An Algorithmic Approach (2001). P. A. Pevzner, MIT Press.
4. Computer Methods for Macromolecular Sequence Analysis (1998). R.F. Doolittle, J.N, Abelson, M.I. Simon, Academic press
5. Essentials of Genomics and Bioinformatics (2007). C.W. Sensen, John Wiley and Sons Inc.

Course Title: Virology

Course Code: BTY681

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: This course deal with the classical as well as modern concept of virology plant as well as animal virology, as biological concept arising from the virology. Role of plant and animal viruses in agriculture and human health.

1. History and development of virology, taxonomy of viruses (earlier classification systems) and viroids, significance of virology and latest ICTV classification of viruses. Origin and evolution of viruses. **8 hours**
2. Principles of biosafety, containment facilities, maintenance and handling of laboratory animals and plants. **4 hours**
3. Propagation, purification, characterization, identification and genomics of viruses. Methods of virus diagnosis, detection, assays and comparison of their sensitivities. Structure of viruses and methods employed in structural and functional genomics of the viruses. **8 hours**
4. Symptoms of plant virus diseases, transmission of plant viruses, viral and viroid diseases and their control: General discussion on symptoms caused by viruses and viroids in diseased economically important trees and agricultural crops, and their control. **5 hours**
5. Microbial viruses: Diversity, classification, characteristics and applications of bacteriophages, and general account on algal, fungal and protozoan viruses. Virus-like agents: Prions, satellite DNAs and RNAs, satellite viruses; defective interfering particles and virophages. **6 hours**
6. Virus replication Strategies: Principal events involved in replication: Adsorption, penetration, uncoating nucleic acid and protein synthesis, intracellular trafficking, assembly, maturation and release, viral-host interaction, Host response to viral infection. **8 hours**
7. Anti-viral strategies: prevention and control of viral diseases. Introduction to recent trends in management and control of viral diseases. Introduction to applications of plant and animals viruses. **6 hours**

Reference Books:

1. Principles of Virology: Molecular Biology, Pathogenesis and Control of Animal Viruses (2003). Flint, S.J., Enquist, L.W., Racaniello, V.R. and Skalka, A.M. 2nd Edition, ASM Press, Washington, DC. Print.
2. Introduction to Modern Virology (2007). Dimmock, N., Easton, A. and Leppard, K. 6th Edition. Wiley-Blackwell. Print.
3. Basic Virology (2007). Wanger, E.K., Hewiett, M., Bloom, D. and Camerini, D. 3rd edition, Wiley-Blackwell. Print.
4. Principles of Molecular Virology (2011). Cann, A.J. 5th Edition. Elsevier Academic Press. Print.
5. Plant Virology (2013). Hull, R. 5th Edition. Academic Press. Print.
6. Principles of Molecular Virology (2001). Alan J. Cann, 3rd edition, Elsevier Academic Press.
7. Plant Virology (2002). Roger Hull, 4th edition, Academic press.

Course Title: Project Part-I

Course Code: BTY661

L	T	P	Credits	Marks
0	0	0	2	50

Seminar Objective:

During the course students will come to know about the general understanding of the most common problems, recent advances in biotechnology research. Each student shall be allotted a topic by the instructor. Student will have to understand the topic, collect literature and prepare the presentation. Through this the students will develop habit of reading newer topics, will become inquisitive and develop confidence of presentation and discussion before audience.

The students shall submit a project report on the allotted topic, which shall be evaluated by the concerned internal faculty. He/She then would present a seminar on the concerned topic. The students will be encouraged to explore all available literature as well as the internet to prepare the seminar report and present the same using informative slides made using Power Point or projectors.

Contents:

Students will present their proposed work on a selected topic with the following headings:

- Title
- Objectives
- Review of Literature
- Materials and Methods
- Results
- Conclusion/recommendations

Examination Scheme (Weightage in %):

Literature study/ Fabrication/ Presentation	50
Written Report	25
Question answer session	25

Course Title: Intellectual Property Rights, Bio Safety and Bioethics

L	T	P	Credits	Marks
2	0	0	2	50

Course Code: BTY641

Course Objective: This course has been designed to cover various aspects of IPR, Biosafety and bioethics. Lot of advances have been made in application of biotechnology for the benefit of human being in field of agriculture, medical application, animal husbandry, industrial production and environmental management. Intellectual property ie legal rights resulting from intellectual activity in the Industrial and scientific fields is very important. In this course, safety concerns and ethical issues on application of biotechnology will be discussed under the current issues associated with the benefits and risk concerns on biotechnology.

1. Fundamentals of IPR: Intellectual Property Rights, general introduction patent claims, ownership of tangible and intellectual property. Patents, copyrights, trademarks, trade secrets, geographical indications, industrial designs, protection of IC layout designs, WIPO, TRIPS agreement. **5 hours**
2. Basic requirements of patentability, Patentable subject matter novelty and the public domain, non obviousness. **2 hours**
3. Special issues in biotechnology patents: Disclosure requirements, collaborative research, competitive research, foreign patents, patenting of microorganisms and cells, patenting animals and plants, PPA, PVPA, PVPC, utility patents. **4 hours**
4. Patent litigation: Substantive aspects of patent litigation, procedural aspects of patent litigation, recent development in patent system and patentability of biotechnology inventions, IPR issues of the Indian content, current patent laws, International Depository Authority (IDA), International agreements relevant to biological inventions: PCT, UPOV, Budapest Treaty, EPC, Pan- S Union Convention. **6 hours**
5. Public acceptance issues for biotechnology: Case studies/ experiences from developing and developed countries, biotechnology and hunger, challenges for the Indian biotechnological research and industries. **3 hours**
6. Bioethics: Social and ethical implications of biotechnology and biological weapons. **2 hours**
7. Good safety practices, GLP standards, lab contaminants, GMPs, The Cartagena protocol on biosafety. **3 hours**

8. Biosafety management: Key to the environmentally responsible use of biotechnology, Regulatory bodies- EPA, USDA, FDA, APHIS. **5 hours**

Reference Books:

- New developments in biotechnology: Patenting life-special report (1990) Office of Technology Assessment (OTA), US Congress (Washington D.C. Dekker).
- Evolution of patent laws: "developing countries' perspective" (2006) by D.N. Choudhary, (Capital Law House).
- Draft manual of patent practice and procedure (2008) Patent Office, India.

Course Title: Genomics, Proteomics and Metabolomics

Course Code: BTY642

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The aim of the course is to provide students practical and bioinformatical skills in genomics, transcriptomics, proteomics and metabolomics, knowledge and the notion about how the methods are applied in real-life scientific research.

1. Introduction to –omes and –omics. Gene, Genome and Genomics. **2 hour**
2. Whole genome analysis: Preparation of genomic library in vectors, ordered cosmid libraries, BAC libraries, shotgun libraries. Genome analysis for global patterns of gene expression using fluorescent-labelled cDNA or end-labelled RNA probes. **6 hours**
3. FISH, Sequencing: Conventional sequencing (Sanger, Maxam and Gilbert methods), automated sequencing, analysis of sequence information FISH. Analysis of single nucleotide polymorphism using DNA chips. **4 hours**
4. Transcriptomics. Microarray, EST, SAGE. Bioinformatical methods in transcriptomics.

   Application of transcriptomics. Genome sequencing projects (technology of sequencing and assembly, bioinformatics of genome annotation, current status of genome sequencing projects) Genomic browsers and databases Orthology prediction (comparative genomics), Search for transcription factor binding sites (TFBS), Computational prediction of miRNA target genes *De novo* prediction of regulatory motifs in genome, Single nucleotide polymorphisms (SNP) in medical genetics and basic research. **10 hours**
5. Next generation sequencing using new technologies. Alignment of pairs of sequences of DNA and proteins. Multiple sequence alignment. Searching databases for similar sequences. Phylogeny: Different approaches to tree construction. Analyze sequences and its role in understanding the evolution of organisms and genes. **6 hours**
6. **Proteomics.** Aims, strategies and methods. Bioinformatics tools in proteomics. Application of proteomics. Protein microarrays. Proteomics technologies: 2D-electrophoresis, MALDI-TOF mass spectrometry, yeast 2-hybrid system. Protein-protein interactions: experimental and computational methods, databases. **8 hours**
7. Types of data and databases, quality of annotation. Protein structure prediction. The proteome. High throughput proteomics and its use to the biologists. **4 hours**

8. Novel approaches to protein expression analysis: Scope of functional proteomics. Proteome analysis: 2DE based strategy. Alternatives to 2DE for protein expression analysis. **5 hours**
9. Application of proteome analysis to drug development and toxicology: Basic principle and making use of the data. **4 hours**
10. Protien-DNA interactions. Cancer profiling using DNA microarrays. Proteomics as tool for plant genetics and breeding. **5 hours**
11. Introduction to metabolomics. Technologies in metabolomics. Nutrigenomics. Nuclear Magnetic Resonance Spectroscopy and Mass Spectrometry in metabolomics. Metabolic pathways resources: KEGG, Biocarta. Nutrigenomics and metabolic health. Solved problems and future challenges. **6 hours**

Reference Books:

1. A primer of genome science (2009). Gibson G. and Muse S. V., (Sinauer Associates, Inc. Sunderland, MA).
2. Knowledge discovery in proteomics (2006). Igor Jurisica, Dennis Wigle (Chapman & Hall / CRC).
3. Proteomics: From protein sequence to function (2002). Pennington SR, Dunn M. J. (Viva Books Pvt. Ltd).
4. Informatics in proteomics (2005). Srivastava Sudhir (Taylor & Francis Group / CRC).
5. Genomics and proteomics engineering in medicine and biology (2007). Akay M. (Wiley-Interscience John Wiley & Sons, Inc. Publication, USA).
6. Essentials of genomics and bioinformatics (2002). Christoph W. Sensen (Wiley-VCH, Weinheim).
7. Current protocols in bioinformatics (2004). Baxevanis A.D., Davison, D.B., Page, R.D.M. & Petsko, G.A (John Wiley & Sons, Inc. Publications, New York).

Project Part II

Course Code: BTY662

L	T	P	Credits	Marks
0	0	0	8	200

Guidelines for Project:

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-art instrumentation. Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be criticized by the faculty guide and corrected by the student at each stage.

The file is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include:

- A short account of the activities that were undertaken as part of the project
- A statement about the extent to which the project has achieved its stated goals.
- Assessment about the outcomes of the experimentation processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

- **Title or Cover Page**

  The title page should contain the following information: Project Title; Student' name; Course; Year; Supervisor' name

- **Acknowledgements** (optional)

  Acknowledgement to any advisory or financial assistance received in the course of work may be given

- **Abstract**

A good abstract should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project.

- **Table of Contents**

  Title and subtitles are to correspond exactly with those in the text

- **Introduction**

  Here brief introduction to the problem that is the central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

- **Materials and Methods**

  This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modification if any.

- **Results and Discussion**

  Present results, discuss and compare these with those from other workers etc. In writing these section, emphasis should be given on what has been performed and was achieved in the course of the work, rather than discuss in detail what is readily available in the text books. Avoid abrupt changes in the contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph ins every chapter should be included in a smooth flow.

  Note that in writing the various sections, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in “point” form.

- **Conclusion**

  A conclusion should be the final section in which the outcome of the work is mentioned briefly.

  Future Prospects

- **Appendices**

  The appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

- **References**

This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the authors surname. The titles of the journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognized system.

Examples

For research article

Voravuthikunchai, SP, Lortheeranuwat, A, Ninrprom, T. Popaya, W, Pongpaichit Sanjay, Supawita T.(2002) Antibacterial activity of Thai medicinal plant against enterohaemorrhagic *E.coli* 157:H7.Clin Microbiol Infect, 8(SUPPL 1):116-117

For Book

Kowalski, M.(1976) Transduction of effectiveness in Rhizobium Meliloti. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), 7:63-67

ASSESSMENT OF THE PROJECT FILE

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution.

Technical merit attempts to assess the quality and depth of the intellectual efforts put into project.

The file should fulfil the following assessment objectives:

Range of Research Methods used to Obtain Information

Execution of Research

Data Analysis

Analyse Quantitative/Qualitative information

Control quality

Draw Conclusions

Assessment Scheme:

Continuous Evaluation: 40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/mid-course corrections etc. as reflected in the Project File)

Final Evaluation: 60% (Based on the documentation in the file, Final report layout, analysis and results, achievements of objectives, presentations/viva)

Course Title: Environmental Biotechnology

L	T	P	Credits	Marks
3	0	0	3	75

Paper Code: BTY631

Course Objective: The basic object of the course is to familiarize the students with the gene manipulation processes and microorganisms used for a cleaner environment with respect to various microbial treatments, biofuels, biofertilizers, biopesticides, biomineralization, biodegradation etc.

1. Renewable and Non-renewable energy resources, Biofuels: Bioethanol, Biodiesel, Biogas and Algal fuels Bioremediation and Biodegradation of major environmental pollutants- heavy metals, pesticides and hydrocarbons. Biomineralization- Use of microbes for mining of metals from ores Biofertilizers- Concept of N_2-fixation, nodule formation, azolla, cyanobacteria, rhizobium and VAM. **7 hours**
2. Microbiology of waste water treatment, aerobic processes, activated sludge, oxidation ponds, trickling filters, and rotating biological contactors. Treatment strategies for wastewaters of dairy, distillery, tannery, sugar, antibiotic industry. **5 hours**
3. Anaerobic processes: Anaerobic digesters, upward flow anaerobic sludge blanket reactors. **2 hours**
4. Bioremediation- Biotechnology for clean environment. Biodegradation of xenobiotics in the environment-Ecological considerations, decay behaviour, derivative plasmids, Degradation of hydrocarbons, substituted hydrocarbons, surfactants and pesticides. Bioremediation of contaminated soil. Biopesticides and Integrated Pest Management. **6 hours**
5. Solid waste management: Sources, types, composition, characteristics and composition of municipal solid waste, recycling and transformation. **2 hours**
6. Environmental impact assessment, eco-planning and sustainable development: Indian standards IS2490, IS3360, IS3307, IS2296, ISO14000 series, Minas for industries and Ecomarks, public liability insurance act, ElA guidelines and assessment methods, environmental priorities in India and agenda, conservation biotechnology, remote sensing and GIS (Principal and applications in ecological mapping and environmental hazard predictions), ecological modeling. **6 hours**
7. Bioindicators and biosensors for detection of pollution. **2 hours**

Reference Books:

1. Principles of gene manipulation (2006). Sandy Primrose, Richard Twyman, Bob Old, Giuseppe Bertola (Black Well Publication).

2. Biodegradation and Bioremediation: Soil Biology (2004).Singh A. and Ward O.P. Springer.
3. Environmental Science and Technology (1997). Stankey E.M., Lewis Publishers, New York.
4. Bioremediation Protocols (1997). David S., Humana Press, New Jersey.
5. Environmental Chemistry. A.K. De, Wiley Eastern Ltd., New Delhi.
6. Introduction to Biodeterioration. D. Allsopp and K.J. Seal, ELBS/Edward Arnold.
7. Environmental Biotechnology (1998). Agarwal S. K., APH Publishing Corporation, New Delhi.
8. Waste Water Engineering, Metcalf and Eddy
9. Environmental Biotechnology- Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
10. Environmental Biotechnology, Pradipta Kumar Mohapatra

Course Title: Immunology

L	T	P	Credit	Marks
4	0	0	4	100

Course Code: MIC631

Unit A:
History of immunology.
Three fundamental concepts in immunology: Specificity, discrimination of self from non-self and memory
Structure, Functions and origin of Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell and Immune Organs like Bone marrow, Thymus, Lymph Node, Spleen.
Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes, Adjuvants, Structure, Types and Functions of antibodies.
Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA.

Unit B:
Immune cell receptors: Detailed structure and development of B cell (Ig) and T cell (TcR) receptors.
Structure of CD4, CD8, MHC-I, MHC-II molecules, cellular adhesion molecules (ICAM, VCAM, MadCAM, selectins, integrins); Pattern Recognition Receptors (PRRs) and Toll-like receptors (TLR).
Markers of suppressor / regulatory T cells - CD4+ CD25+

Unit C:
Genetic organization: Organization of the genes for B and T cell receptors.
Genetic organization of MHC-I and MHC-II complex, Peptide loading and expression of MHC-I and MHC-II molecules.
Molecular mechanisms responsible for generating diversity of antibodies and T cell receptors.
Hybridoma technology and monoclonal antibodies.
Complement system. Classical, lectin and alternative pathway for complement activation.

Unit D:
Major cytokines and their role in immune system: TNF, IFN, IL-1, IL-2, IL-4, 1L-6, IL-10, IL-12, IL-17, TGFβ.
Tolerance and autoimmunity and their mechanism; Mechanisms of autoimmunity; Autoimmune components of diabetes mellitus (DM), multiple sclerosis (MS), experimental autoimmune encephalitis (EAE); Infections leading to autoimmune diseases.
Hypersensitivity and allergy. Comparative study of Type I-V hypersensitivities with examples.

Course Title: Immunology Laboratory

L	T	P	Credit	Marks
0	0	3	2	50

Course Code: MIC632

1. Identification of human blood groups.
2. To separate serum from the blood sample (demonstration).
3. To perform Total Leukocyte Count of the given blood sample.
4. To perform Differential Leukocyte Count of the given blood sample.
5. To perform immunodiffusion by Ouchterlony method.
6. Agglutination of bacteria
7. Separation of IgG by ammonium sulfate precipitation of blood serum.
8. Reduction of IgG with mercaptoethanol to four chain.
9. SDS-PAGE electrophoresis of immunologic effector proteins.
10. Papain digestion of IgG
11. Pepsin digestion of IgG
12. Immunoelectrophoresis
13. Western Blotting
14. ELISA

Course Title: Medical Biotechnology

Course Code: BTY682

L	T	P	Credits	Marks
4	0	0	4	100

1. **Introduction :** Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; theory of clonal selection. **8 Hours**
2. **Cellular responses :** Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions; monoclonal antibodies: principles and applications; antigen presenting cells; major histocompatibility complex; antigen processing and presentation; regulation of T-cell and B-cell responses. **15 Hours**
3. **Infection and immunity :** Injury and inflammation; immune responses to infections: immunity to microbs; allergy and hypersensitivity; Vaccine development; recombinant vaccines and clinical applications. AIDS and Immunodeficiencies; resistance and immunisation. **18 Hours**
4. **Autoimmunity :** Autoimmunity, Autoimmune disorders and diagnosis. **18 Hours**
5. **Stem cells & tissue engineering and their clinical applications:** Cellular therapy; Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells; Concept of tissue engineering, Recombinant therapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone. **18 Hours**

Reference Books:

1. Basic Immunology: Functions and Disorders of the Immune System (2006-2007). Abbas, A.K., Litchman, A.H., 2nd Ed. (updated edition), Philadelphia, Pennsylvania: W.B. Saunders Company Publishers.
2. Immunology: A Short Course (2009). Benjamini, E., Coico, R. and Sunshine, G., 6th Ed., New York, Wiley-Blackwell.
3. Essential Immunology (2006). Roit, I.M., Delves, P. Seamus M. and Burton D., 11th Ed., Willey- Blackwell.
4. Animal Cell Biotechnology (1994). Spier, R.R. and Griffttths, J.B., 6th Ed., Academic Press, London.

5. Textbook of Drug Design and Discovery (2002). Krogsgaard-larsen P. , Liljefors T., Madsen U. and Larsen K, Liljefors T. Madsen U., Taylor and Francis Publications, Washington D.C.
6. Tissue Engineering (2009). Palson, O.B. and Bhatia, N.S. Dorling Kindersley (India) Pvt. Ltd.

Course Title: Environmental Biotechnology-LAB

Course Code: BTY632

L	T	P	Credits	Marks
0	0	2	1	25

- To determine BOD and COD of the given industrial effluent.
- To check the faecal contamination
- To check the chlorine content of water
- Isolation of nitrogen fixing and phosphate solubilizing bacteria
- Isolation of pesticide degrading organisms from soil.

Course Title: Fermentation and Bioprocess Engineering

Course Code: BTY525

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: This course deal with utilization of various biological processes especially gene expression, gene manipulation, protein engineering at large scale in field of medicine, agriculture and environmental management in terms of new products and services. During the course the students are introduced to the fundamentals of processes such as enzymatic conversion, fermentation, bioconversion, cell cultivation and sterile techniques and are trained using examples from industry.

1. Introduction to bioprocess engineering. Microbial growth parameters and its kinetics, microbial growth yield and concepts of the yield coefficient, maintenance energy and its significance, stoichiometry of production. **2 hours**
2. Design of a bioreactor, animal, plant and microbial type bioreactors, body, agitator (impeller), baffles, spargers, valves, different types of bioreactors. **2 hours**
3. Instrumentation, measurement and control of the bioprocess parameter, methods of measuring process variables, temperature, flow measurement, pressure, agitation, foam, microbial biomass, dissolved oxygen and Kla, redox and PH, control systems: manual control, automatic control PID (Proportional plus Integral plus Derivative) control. **4 hours**
4. Design of the batch sterilization processes, calculation of del factor, Richards rapid methods for designing the sterilization cycles, scale up of the sterilization, design of the continuous sterilization, filter sterilization, theory of the depth filter, design of the depth filters. **2 hours**
5. Types of fermentation processes, analysis of batch, plug flow, fed batch and continuous bioreactors, stability of microbial bioreactors, steady state condition and feedback bioreactors, fluid rheology and factors affecting bioreactor processes. **3 hours**
6. Introduction to fermentation processes, microbial enzymes, metabolites, recombinant products, biotransformation products. **2 hours**
7. Isolation, preservation and maintenance of industrial microorganisms, screening methods, improvement of industrial microorganism and use of different strategies, quality control of preserved industrial strains. **5 hours**

8. Downstream processing, removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid extraction, aquous two phage separation, membrane process, drying and crystallization, effluent treatment, BOD & COD treatment and disposal of effluents. **5 hours**
9. Media designing for industrial fermentation, medium formulation, energy sources, carbon sources, nitrogen sources, nutrient recycle & medium optimization for the industrial processes. Scale up of fermentation processes. **3 hours**
10. Industrial processes and production of alcohol (ethanol), citric acid, glycerol, acetone-butanol, penicillin antibiotics, glutamic acid and lysine, single cell protein. Food products, bread, cheese, idli. Industrial enzymes and biodegradable plastics. **3 hours**

Reference Books:

1. Biochemical Reactors (1990). Atkinson, B., 3rd ed., Pion Ltd., London.
2. Bioprocess Engineering: Basic concepts (1996). Shuler, M.L. and Kargi, F., 2nd ed., Prentice Hall, Engelwood Cliffs.
3. Process Engineering in Biotechnology (1997). Jackson, A.T., 2nd ed., Prentice Hall, Engelwood Cliffs.
4. Biochemical Engineering Fundamentals (2000). Bailey, J.E. and Ollis, D.F., 2nd ed., McGraw-Hill Book Co., New York.
5. Principles of Fermentation Technology (2001). Stanbury, P.F. Whitaker, A. and Hall, S.J., 2nd ed., Aditya Books (P) Ltd., New Delhi.
6. Biotechnology (2004). Crueger, W., A text book of Industrial Microbiology.
7. Principle of Fermentation Technology (2001). Stanbury, P.F., Whitaker, A and Hall, S.J., 2nd ed., Aditya Books (P) Ltd., New Delhi.
8. Comprehensive Biotechnology (2004). Moo-Young,M. ed., Vol.I-IV Pergamon Press, Oxford.
9. Bioseparation Engineering (2004). Lodish, M.R., Principle, Practice and Economics.
10. Food Microbiology (2004). Doyle, M.P., Fundamental and Frontiers.
11. Environmental Microbiology (2004). Maier, R.M.
12. Biotechnology, A text book of Industrial Microbiology (2004). Crueger, W.
13. Microbiology (2005). Prescott, I.S.

Course Title: Fermentation and Bioprocess Engineering

Course Code: BTY526

L	T	P	Credits	Marks
0	0	3	2	50

- Isolation of industrially important microorganisms for microbial processes.
- Determination of thermal death point and thermal death time of microorganism for design of a sterilizer.
- Determination of growth curve of a supplied microorganism and also determines substrate degradation profile. Compute specific growth (m), growth yield (Yx/s) from the above.
- Production and estimation of alkaline protease.
- Production and estimation of alcohol.
- Demonstration of fermenters and its functioning.

Course Title: Food Biotechnology

Course Code: BTY643

L	T	P	Credits	Marks
2	0	0	2	50

1. Bioreactors in Food Fermentations: Cultivation of microorganisms, Instrumentation regulation and process control, Laboratory scale submerged and solid state fermentation, Pilot scale submerged and solid state fermentation.
2. Development of Novel Food and food Ingredients Single cell protein, Polysaccharides, Low calorie sweeteners, Naturally produced flavor modifiers, Amino acids, Vitamins, Food supplements, Food coloring, Neutraceuticals, Water binding agents
3. Food Fermentation Technology : Origin, scope, and development of fermented products, Primary feed stock, raw materials and conversions, Fermented food and microbial starters, Commercial potential, Food fermentation industries, their magnitude, R & D innovations
4. Food Spoilage and Preservation: General principle of spoilage, Microbial toxins (endotoxins and exotoxins), Contamination and preservation, Factors affecting spoilage, Methods of food preservation (Thermal processing, Cold preservation, Chemical preservatives, food dehydration, Food irradiation, Biological control), Monitoring of food quality
5. Packaging of Food: Need for packaging, Requirements for packaging, Containers for packaging (Glass, Metal, Plastics, Moulded pulp and Aluminium foil), Dispensing devices.

Reference Books:

1. Biotechnology: Food Fermentation Vol I and II, Eds. V. K. Joshi and A. Pandey

2. Food Processing: Biotechnological Applications- Eds. S. S. Marwaha and J. K. Arora

Course Title: General Microbiology

L	T	P	Credits	Marks
4	0	0	4	100

Course Code: MIC531

Unit A:

History of microbiology. Spontaneous generation *vs*. biogenesis. Germ theory of disease. Discovery of anaerobic life form. Discovery of first antibiotic penicillin. Development of key techniques for isolation and pure culture of microorganisms. History of soil microbiology and enrichment culture techniques. History of medical microbiology and immunology.

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification system. Difference between three kingdoms.

General characteristics of acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit B:

Bacterial Cellular organization: Cell size, shape and arrangement, outer membrane, lipopolysaccharide, cell wall, inner membrane, capsule, flagella, endoflagella, fimbriae and pili, cytoplasm, ribosomes, mesosomes. Endospores. Effect of antibiotics and enzymes on the cell wall. Sphaeroplasts and protoplasts.

Basics of microscopy and observation of microbes. Light microscopy: bright field microscopy, dark field microscopy, phase contrast microscopy, fluorescence microscopy, transmission electron microscopy, scanning electron microscopy.

Unit C:

Nutritional requirements in bacteria and nutritional categories. Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media.

Physical methods involving heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation to control microbes. Chemical methods involving antiseptics, disinfectants, sanitizers, sterilizers and antibiotics to control microbes.

Unit D:

Asexual methods of reproduction, logarithmic growth of bacterial populations, phases of growth, calculation of generation time and specific growth rate. Diauxic growth. Maintenance of population in exponential phase, synchronous growth, continuous culture, fed batch culture and measurement of growth. Catabolism vs. anabolism. Energy currency and reducing power of a living cell. Fermentation vs. aerobic and anaerobic respiration. Bacterial cell division and genes involved in the process.

Course Title: General Microbiology Laboratory

L	T	P	Credit	Marks
0	0	3	2	50

Course Code: MIC532

1. Microbiology Good Laboratory Practices and Biosafety.
2. Study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, light microscope, pH meter, spectrophotometer) used in the microbiology laboratory
3. Preparation of general purpose culture media for bacterial cultivation
4. Sterilization of medium using Autoclave and assessment for sterility
5. Sterilization of glassware using Hot Air Oven and assessment for sterility
6. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
7. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air
8. Use of compound light microscope
9. Motility by hanging drop method
10. Simple staining
11. Negative staining
12. Study of different shapes of microorganisms under microscope.
13. Isolation of pure cultures of bacteria by streaking method
14. Preservation of bacterial cultures by various techniques
15. Gram's staining
16. Acid fast staining
17. Endospore staining
18. Spread plate technique
19. Pour plate technique
20. Estimation of CFU count by spread plate method/pour plate method.

Course Title: Principles of Biochemistry

Paper Code: BCH524

L	T	P	Credit	Marks
4	0	0	4	100

Course Objective: The course is intended for master's course students. This course is a broad survey of all the major concepts of biochemistry with emphasis on all the important categories of biomolecules and their biochemistry.

Unit A (15 hours)

Introduction to Biochemistry

Water as a biological solvent. Weak acids and bases. pH and buffers. Henderson-Hasselbalch equation. Physiological buffers. Fitness of the aqueous environment for living organisms.

Carbohydrates

Structure of monosaccharides. Stereoisomerism and optical isomerism of sugars. Reactions of aldehyde and ketone groups. Ring structure and anomeric forms, mutarotation. Reactions of sugars due to hydroxyl groups. Important derivatives of monosaccharides, disaccharides and trisaccharides (structure, function and occurrence of important ones). Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides - cellulose, chitin, agar, algenic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, glycogen and starch. Bacterial cell wall polysaccharides. Glycoproteins.

Proteins

Introduction to proteins. Classification based on solubility, shape, composition and functions. Amino acids: common structural features, stereoisomerism and RS system of designating optical isomers. Classification and structures of standard amino acids as zwitterion in aqueous solutions. Physical and chemical properties of amino acids. Titration of amino acids. Separation of amino acids. Essential amino acids.

Structure of peptide bond. Solid-phase synthesis of peptides. Peptide sequencing. Chemical and enzymatic cleavage of polypeptide chains and separation of peptides. Levels of structure in protein architecture. denaturation and renaturation of proteins. Behaviour of proteins in solutions. Salting in and salting out of proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (haemoglobin, myoglobin), lipoproteins, metalloproteins, glycoproteins and nucleoproteins.

Unit B (15 hours)

Nucleic Acids

Nature of genetic material. Evidence that DNA is the genetic material. Composition of DNA and RNA. Generalized structural plan and Nomenclature of nucleic acids. DNA double helix.

Structure and roles of different types of RNA. Size of DNA in prokaryotes and eukaryotes. Central dogma of molecular biology. Concepts of gene, genome and chromosome.

Porphyrins

Porphyrin nucleus and classification of porphyrins. Important metalloporphyrins occurring in nature. Detection of porphyrins. Bile pigments – chemical nature and physiological significance.

Lipids

Definition and classification of lipids. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, prostaglandins. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats – hydrolysis, saponification value, rancidity of fats, Reichert-Meissel Number and reaction of glycerol. Biological significance of fats. Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidylserine, phosphatidylinositol, plasmalogens), sphingomyelins, glycolipids – cerebrosides, gangliosides. Properties and functions of phospholipids, isoprenoids and sterols.

Unit C (15 hours)

Introduction to Metabolism

General features of metabolism, experimental approaches to study metabolism – intact organisms, bacterial mutants, tissue slices, radioisotopes.

Carbohydrate Metabolism

Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Reactions and energetics of TCA cycle. Gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of pentose phosphate pathway. Regulation of glycolysis and TCA cycle. Photosynthesis – a brief review.

Electron Transport Chain and Oxidative Phosphorylation

Structure of mitochondria. Sequence of electron carriers. Sites of ATP production. Inhibitors of electron transport chain. Chemiosmotic hypothesis. Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing potentials into mitochondria.

Unit D (15 hours)

Lipid Metabolism

Introduction. Hydrolysis of triacylglycerols. Transport of fatty acids into mitochondria. β-oxidation of saturated fatty acids. ATP yield from fatty acid oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of ketone bodies. Oxidation of unsaturated

and odd chain fatty acids. Biosynthesis of triglycerides and important phospholipids, glycolipids, sphingolipids and cholesterol. Regulation of cholesterol metabolism.

Amino Acid Metabolism

General reactions of amino acid metabolism – transamination, oxidative deamination and decarboxylation. Urea cycle. Degradation and biosynthesis of amino acids. Glycogenic and ketogenic amino acids.

Nucleotide Metabolism

Sources of atoms in the purine and pyrimidine nucleotides. Biosynthesis and degradation of purines and pyrimidines. Regulation of purine and pyrimidine biosynthesis.

Porphyrin Metabolism

Biosynthesis and degradation of porphyrins. Production of bile pigments.

Reference Books:

1. Lehninger Principles of Biochemistry (2008). Nelson DL & Cox M.M., , 5th Edition, WH Freeman & Company, New York.

2. Outlines of Biochemistry (1987). Conn EE, Stumpf PK, Bruening G and Doi RH.. 5th edition, John Wiley & Sons Inc.

3. Biochemistry (2004). Voet D & Voet JG, , 3rd Edition, John Wiley & Sons Inc., Singapore.

4. Harper's Illustrated Biochemistry (2006). Murray, R.K., Granner, D.K. and Rodwell, V.W., 27th Edition, McGraw Hill Company Inc. Singapore.

Course Title: Principles of Biochemistry Laboratory

L	T	P	Credits	Marks
0	0	3	2	50

Paper Code: BCH525

Experiments:

1. Quantitative estimation of blood glucose by Folin-Wu/Anthrone/DNS/o-Toluidine/Enzymatic method
2. Estimation of proteins by Biuret method
3. Quantitative estimation of cholesterol in the blood
4. Estimation of alkaline and acid phosphatases
5. Estimation of blood glucose.
6. Estimation of cholesterol
7. Sugar Fermentation in Microorganisms.
8. Estimation of Glucose 6-P.
9. Estimation of Urea.
10. Estimation of Uric acid.
11. Estimation of Creatinine.

Paper: Scientific Writing and Research Methodology

Code: BOT601

L	T	P	Credits	Marks
2	0	0	2	50

Objective:

To make the students learn how to design an experiment and what are the various research strategies?

Teaching Methodology:

Class room Lectures, practicals, models, charts, power point presentations.

Learning outcomes

This course will impart the comprehensive knowledge of designing a research experiment, how to write a research paper, the relevant ethics, copy right, impact factor etc.

UNIT-I

Basic principles and significance of research design

Experimental set-up

Randomized Block Designs (RBD), completely randomized designs. **(5 Lectures)**

UNIT-II

Research articles research papers, popular research articles and reviews;

How to write a research paper, reference styles. **(4 Lectures)**

UNIT-III

Process of reviewing

Process of submission of a paper

Important journals in plant sciences. **(3 Lectures)**

UNIT-IV

An introduction to Science citation index; Impact factor of a journal;

Copyright act; Academic frauds; plagiarism. **(5 Lectures)**

Suggested Readings

1. Research Methodology – Methods and Techniques (2007). Kothari C.R.. 2nd revised ed. New Age International (P) Ltd. Publishers, New Delhi.
2. Statistics Explained. An Introductory Guide for Life Scientists (2006). McKillup S. Cambridge University Press, Cambridge, UK.
3. Biostatistics – How it Works (2007). Selvin S. First Impression. Pearson Education Inc., New Delhi.

Paper: Plant Physiology

L	T	P	Credits	Marks
4	0	0	4	100

Code: BOT533

Objective:

To acquaint the students about various physiological processes at cellular and organ level in plants.

Teaching Methodology:

Class room Lectures, practical's, models, charts, and power point presentations.

Learning outcomes

The students will come to know the how a plant cell responds to various biotic and abiotic stresses, defence mechanism in plants, events of seed and fruit development, and the various physiological roles of plant hormones.

UNIT-I

Water and Plant Cells: Water in plant life; Water transport processes; Concept of water potential; Absorption of water by roots and transport through the xylem; Transpiration and factors affecting transpiration; The Soil-Plant-Atmosphere Continuum. (6 Lectures)

Mineral Nutrition: Concept of essentiality of mineral elements; Essential nutrients and their deficiency in plants; Absorption of minerals by roots; Transport proteins; Membrane transport process; Role of microbes in nutrient acquisition by plants; Assimilation of mineral nutrients. (6 Lectures)

UNIT-II

Photosynthesis: Energy pathways in photosynthesis; Composition and characterization of photosystem-I and -II; molecular basis of electron flow through cyclic, non-cyclic and pseudo-cyclic photophosphorylations, Biochemical events and regulation of CO_2 fixation (C3, C4 and CAM); Mechanism and regulation of photorespiration; RUBISCO as an example of model enzyme for semi-autonomy at the molecular level. (7 Lectures)

Plant Respiration: Detailed mechanism; Glycolysis and TCA cycle Mitochondria as biological oxidators; Chemiosmatic regeneration of ATP; CN- resistant respiration and metabolic inhibitors regulating the respiration. (5 Lectures)

UNIT-III

Physiology of seed development, maturation, dormancy and germination: Hormonal regulation of seed development, events associated with seed maturation, factors

regulating seed dormancy, mechanisms of mobilization of food reserves during seed germination. (4 Lectures)

Fruit development and ripening: Stages of fruit development and their regulation, biochemical and related events during fruit ripening in climacteric and non-climacteric fruits, physiology and biochemistry of fruit abscission, post-harvest changes, production of transgenic fruits. (4 Lectures)

Sensory physiology: Phytochromes and cryptochromes; Localization of phytochrome; Physiological responses of phytochrome with special reference to shade avoidance and circadian rythms; Blue-light mediated responses; Photoperiodism. (4 Lectures)

UNIT-IV

Flowering in plants: Control of flowering; Floral organ development; Phase changes during floral development; Role of Photoperiodism and Vernalization in flowering. (2 Lectures)

Plant Hormones: Physiological effects and molecular mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid, jasmonic acid, brassinosteroids, polyamines, salicylic acid. (8 Lectures)

Stress physiology: Plant responses to abiotic stresses, mechanisms of abiotic stress tolerance, water deficit and drought tolerance, salinity stress, metal toxicity, freezing and heat stress. (3 Lectures)

Reference Books

1. Bonner, B., and Varner, J.E. Plant Biochemistry. Academic Press: London, 1976.

2. Srivastava, L.M. Plant Growth and Development. Associated Press: NewYork, 2002.

3. Stryer, L. Biochemistry. 5th edition. W.H. Freeman and Co.: New York, 1995.

4. Taiz, L., and Zeiger, E. Plant Physiology. The Benjamin/Cumming Publishing Company: California, 1998.

5. Voet, D., and Voet, J.G. Biochemistry. John Wiley and Sons Inc.: New York, 1995.

6. Wilkins, M.B. Advanced Plant Physiology. Pitman: New York, 1984.

7. Buchanan, B.B., Gruissem, W. and Jones, R.L. Biochemistry and Molecular Biology of Plants. I K Internationals: India, 2005.

Course Name: Human Physiology

Course Code: ZOO257

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the functioning of all systems of the human body.

UNIT-A

- **Nutrition:** Types of nutrition and nutrients; sources and functions of nutrients and the diseases associated with their excess or lesser intake. — 2 hours
- **Digestive System:** Alimentary canal; Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and Hormonal control of Digestion — 10 hours

UNIT-B

- **Respiratory System:** Ventilation; External and Internal Respiration; Transport of oxygen and carbon dioxide in blood; Factors affecting transport of gases. — 6 hours
- **Circulatory System:** Composition of blood; Lymph; Blood groups; Blood coagulation**;** Structure of heart; co-ordination of heart beat, Cardiac cycle; ECG — 10 hours
- **Excretory System:** Functional anatomy of kidney; Mechanism and regulation of urine formation. — 8 hours

UNIT-C

- **Endocrine System:** Structure of pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, testes; and the diseases associated with them — 7 hours
- **Reproductive System:** Spermatogenesis; Oogenesis; Physiology of male and female reproductive systems; hormonal and neuronal control — 7 hours

UNIT-D

- **Nervous System:** Structure of Neuron; Propagation of nerve impulses (myelinated and non-myelinated nerve fibres); neuromuscular junctions — 5 hours
- **Muscular system:** Structure of skeletal muscle, Mechanism of muscle contraction (sliding filament theory) — 5 hours

Reference books

1. Guyton, A.C., Hall, J.E. Text Book of Medical Physiology, XIIth edition, Harcourt Asia Pvt. Ltd./W.B. Saunders Company, 2011
2. Best, J.P., Best and Taylor's physiological basis of medical practice, 11th ed., William and Wilkins, 1985.
3. Hoar, W.S., General and comparative physiology, Adaptation and Environment, 3rd ed., Cambridge University Press, 1983.
4. Rhoades, R.A., Tanner, G.A., Medical Physiology, 2nd ed., Lippincott Williams and

Wilkins, 2003.
5. Tortora, G.J., Derrickson, B.H. Principles of Anatomy and Physiology, XII Edition, John Wiley and Sons, Inc., 2009.

Course Name: Medicinal Chemistry

Course Code: CHE616

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives:

This course is intended to learn the basic concepts of Medicinal Chemistry. The present syllabus has been framed as per the latest UGC guidelines and recent research trends in the subject. The various topics of the syllabus are grouped under different units in order to bring forth the importance of academic interest.

Expected Prospective: This course will equip students with the necessary medicinal chemistry knowledge concerning the fundamentals in the basic areas of pharmaceutical sciences The students will be able to pursue their career objectives in advance education, in scientific research and in teaching careers.

PART A

Enzymes (8 Hrs)

Basic considerations. Proximity effects and molecular adaptation. Introduction and historical prospective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-menten and lineweaver-Burk plots, reversible and irreversible inhibition.

Mechanism of Enzyme Action (5Hrs)

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribonucleases, lysozyme and carboxypeptidase A.

PART B

Kinds of Reaction Catalysed by Enzymes (8Hrs)

Nucleophilic displacement on a phosphorus atom, multiple displacement reaction and the coupling of ATP cleavage to endergonic processes. Transfer of sulphates, addition and elimination reactions, enolic intermediates in isomerization reactions, β-cleavage and condensation, some isomerisation and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

PART C

Co-Enzyme Chemistry (6Hrs)

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, LIPOIC ACID, vitamin B12. Mechanisms of reactions catalysed by the above cofactors.

PART D

Drug Design (18Hrs)

Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure-activity relationship (SAP), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptors interactions. Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Shelton and surface activity parameters and redox potentials. LD-50, ED-50 (Mathematical equations excluded)

Suggested Books:

1. Lehninger, *Principles of Biochemistry*, WH-Freeman, 5th edition.

2. Silverman, R. B. *The organic chemistry of drug design and drug action,* Academic press 2nd edition, 2004.

3. Pandeya S. S. and Dimmock, J.R. *An introduction to drug design,* New Age International.