Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot (Autonomous)
Affiliated to Saurashtra University, Rajkot

Department of Biotechnology
M. Sc. BIOTECHNOLOGY

For Students Admitted from A.Y. 2016-2017 & Onwards

SEMESTER III

16PBTCC09	**Core 7: Genetic Engineering**	**4hrs/week**	**4 Credits**

Objectives:

1. Understand the concept of Classical Genetics
2. Understand the Fundamentals and applications of Population Genetics
3. Describe the genome organization , DNA replication and repair of damaged DNA
4. Understand the Transcription ,Translation and protein localization
5. Explain the regulation of Gene expression

Unit 1: Classical Genetics

- Fundamentals of Mendel's law of inheritance
- Extension and applications of Mendelian genetics
- Non Chromosomal Inheritance,
- Chromosomal Aberrations
- Genetic linkage , Sex Linked Inheritance, Inheritance patterns in Human and diseases (Sex-linked, Autosomal, Mitochondrial).

Unit 2: Population Genetics

- Types of genetic variation, Concept of Genetic Drift and gene flow
- Concept of gene frequency and genotypic frequency
- The Hardy-Weinberg principle and its exceptions.
- Concept of Natural selection
- Extension and applications of population genetics

Unit 3: Genome organization and DNA replication

- Organization of Bacterial genome and Eukaryotic chromosomes
- Genome complexity; Reassociation kinetics (Cot curve analysis),C- Value paradox
- Bacterial DNA polymerases, Mechanism of prokaryotic DNA replication
- Eukaryotic DNA polymerases and mechanism of replication. Telomere synthesis-telomerases. Replication of viral DNA, rolling circle model. Inhibitors of replication
- DNA Repair mechanisms

Unit 4: Transcription and Translation

- Bacterial RNA polymerases, Mechanism of transcription in prokaryotes
- Eukaryotic RNA polymerases, Transcription factors, Mechanism of transcription
- Post Transcriptional Modifications : 5'-Cap formation, 3'-end polyadenylation, Intron splicing, RNA editing. Processing of tRNA and rRNA . Inhibitors of transcription
- Mechanism of translation in prokaryotes and eukaryotes , Post-translational modifications
- Inhibitors of protein synthesis. Protein localization and Targeting

Unit 5: Regulation of Gene Expression

- Operon model-Inducible and repressible systems
- Lac, Trp, His and Arabinose operon
- Gene Silencing: Definition, types –transcriptional and post transcriptional gene silencing
- RNAi pathway (si RNA and mi RNA)
- Chromatin modification & gene expression. Histone acetylation & deacetylation

Reference books

1. Lewin, B. (2007). *Gene IX 9th Edition*. Jones and Barlett Publishers.
2. Watson, J. D., Baker, T. A., Bell, S. B., Gann, A., Levine, M., &Losick, R. (2008). Molecular biology of the gene. 6th ed. New York: Pearson Education
3. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J. D., &Grimstone, A.V. (1995). Molecular Biology of the Cell (3rd edn). Trends in Biochemical Sciences, 20(5), 210-210.
4. Karp, G. (2004). *Cell and Molecular Biology: Concepts and Experiments 4th Edition with Study*. John Wiley & Sons Geoffrey Cooper. *The- Cell Molecular Approach*. ASM Pub.
5. Griffiths, A. J. F., Gilbert W. M., Lewontin, R.C.& Miller, J. H. (2002). *Modern Genetic Analysis, Integrating Genes and Genomes*. 2nded, W.H.Freeman.
6. Primrose, S. B., & Twyman, R. (2013). *Principles of gene manipulation and genomics*. John Wiley & Sons.
7. Sambrook, J., Fritsch, E. F., & Maniatis, T. (1989). *Molecular cloning: A Laboratory Manual, Volume 1-3*. New York: Cold spring harbor laboratory press.
8. Brown, T. A. (2006). *Gene Cloning 3rd ed*. Garland science.

16PBTCC10	Core 8: Immunology	4hrs/week	4 Credits

Objectives:

After completion of this course, student will be able to:

1. Describe the cells and organs of immune system and distinguish different types of immune responses.
2. Understand the structure and function of antigens and antibodies, basis of their interaction and carry out diagnostic tests based on these interactions
3. Understand the molecular basis of transplantation reactions and predict the its success in different scenarios
4. Understand the basis of different autoimmune and immunodeficiency diseases.

Unit 1: Basic aspects of Immune system (12 hrs)

- Overview and historical perspective of immune system.
- Innate and Adaptive Immune system.
- Cells of immune system: B lymphocyte, T-lymphocytes, macrophages, Dentritic cells, natural killer and lymphokine activated killer cells.
- Organs of the immune system- primary and secondary lymphoid organs; Lymphatic system; Mucosal and Cutaneous associated Lymphoid tissue (MALT&CALT).
- Molecules of innate and acquired immune response - complements, interferon, other molecules

Unit 2: Antigens and Antibodies (9 hrs)

- Antigens and Immunogenicity – Characteristics and factors influencing immunogenicity epitopes, heptanes, cross reactivity and adjuvants.
- Antibodies – structure, classification and functions.
- Organization and expression of antibody genes.
- Antigen and antibody interactions – Agglutination, precipitation, ELISA, RIA
- Antigen processing and presentation

Unit 3: Generation of B and T cell response (9 hrs)

- B cell maturation, activation and differentiation
- Generation of antibody diversity
- T-cell maturation, activation and differentiation and T-cell receptor
- Cell-mediated immune responses, ADCC
- Cytokines-properties, receptors and therapeutic uses, Hapten-carrier system

Unit 4: Transplantation Immunology (12 hrs)

- Basis of self - non-self-discrimination and graft rejection
- MHC- general organization of MHC molecules and genes
- MHC restriction; HLA Typing methods
- Immune Tolerance - central and peripheral
- Hypersensitivity reactions

Unit 5: Immune system in health and diseases (10 hrs)

- Vaccines & Vaccination – DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, passive & active immunization
- Recent advancement in vaccination

- Immuno deficiency diseases - Primary Immuno deficiency (AIDS) and Secondary Immuno deficiency (SCID)
- Autoimmunity and autoimmune diseases - Organ Specific (Graves disease, Insulin dependent diabetes mellitus)
- Systemic Autoimmune Diseases (Rheumatoid Arthritis, Multiple sclerosis)

Reference Books:

1. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2014). *Cellular and molecular immunology*. Elsevier Health Sciences.
2. Delves, P. J., Martin, S. J., Burton, D. R., &Roitt, I. M. (2011). *Roitt's essential immunology* (Vol. 20). John Wiley & Sons.
3. Kindt, T. J., Goldsby, R. A., Osborne, B. A., &Kuby, J. (2007). *Kuby immunology*. Macmillan.
4. Murphy, K., & Weaver, C. (2016). *Janeway'simmunobiology*. Garland Science.
5. Peakman, M., &Vergani, D. (2009). *Basic and clinical immunology*. Elsevier Health Sciences.
6. Coico, R., & Sunshine, G. (2015). *Immunology: a short course*. John Wiley & Sons.

16PBTCC11	Core 9: Analytical Techniques	4hrs/week	4 Credits

Objectives:

1. Understanding the principles of different biophysical techniques used in biological sciences.
2. Understanding the basis of physic-chemical and separation techniques used in study of biomolecules.
3. Understanding the role and application of electro-, magnato- physical techniques used in research and diagnosis.

Unit 1: Microscopy and Radio isotopic techniques (9 hrs)

- Light Microscopy: - Bright field, Dark field, Fluorescent Microscopy, Phase contrast Microscopy, Polarizing Microscopy, Atomic Force Microscopy
- Electron Microscopy:-Transmission, EM & Scanning EM
- Radioactivity: Radioactive &Stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity.
- Detection and Measurement of radioactivity; Interaction of Radiation with biological cells; Somatic and Genetic effects of radiations.
- Brief idea of radiation dosimetry; Cerenkov radiation; Measurement of stable isotopes; Falling drop method; Applications of isotopes in biological study

Unit 2: Spectroscopy (10 hrs)

- Electromagnetic Radiation: Basic Principles, Interaction of Electromagnetic Radiation with matter, Physical Phenomena of interaction
- UV-Visible spectroscopy, Atomic Absorption Spectroscopy &Atomic Emission Spectroscopy, Infrared (IR) Spectroscopy and Raman Spectroscopy,

- Mass spectrometry (MALDI-TOF)
- Magnetic Resonance (NMR), Electron Spin Resonance (ESR).
- X-ray Diffraction (XRD) and Crystallography, CD, ORD Spectroscopy

Unit 3: Centrifugation & Electrophoresis (9 hrs)

- Centrifugation: Basic principles; Settling time and velocity, Types of rotor, Sedimentation coefficient, RCF; Types of centrifuges
- Preparative centrifugation & Analytical centrifugation
- Electrophoresis: Basic Principles of electrophoresis; Support Media; Modes of electrophoresis
- Electrophoretic methods for Nucleic Acid Analysis: Agarose gel electrophoresis, Pulsed field gel electrophoresis, Polyacrylamide gel electrophoresis (PAGE), Denaturing PAGE
- Electrophoretic methods for Protein Analysis: SDS-PAGE, Gradient gel, Isoelectric focusing (2D Electrophoresis),High/Low voltage electrophoresis, Capillary electrophoresis; Disc gel electrophoresis

Unit 4: Chromatography techniques (10 hrs)

- Chromatography: Theory and principles.
- Definition of key terms: Retention time, Peak shape, Band broadenings, Column efficiency, Theoretical plate model(HETP), Rate Theory, Resolution, Selectivity.
- Partition theory: Retention &differential migration mechanism, Equilibrium between two phases, Properties of solvents (MP), Stationary phase and Supporting phase.
- Planar &Column Chromatography: TLC, HPTLC, Paper chromatography, Normal and Reverse-phase, Gel permeation, Ion exchange, Adsorption, Partition and Affinity chromatography.
- Analytical Chromatography: Quantitative Biochemical Measurements, GC/ GLC, HPLC, UHPLC and FPLC, GC-MS, LC-MS Criteria of protein purity.

Unit 5: Advanced Biophysics (10 hrs)

- Biosensors: Introduction, Principle, Characteristics of Ideal Biosensor, Application of Biosensors, Types of Biosensors.
- Electrophysical techniques in diagnostics: Single neuron recording, patch-clamp recording, electrocardiogram, Brain activity recording, lesion and stimulation of brain, PET, MRI, fMRI, CAT, Density.
- CT Scanners and Their Applications, Overview of Digital Subtraction Radiography and Mammography
- Role and applications of biophysics in nuclear medicines, Principle of localization & usages of radiopharmaceuticals
- Flow cytometry

Reference Books:

1. Sambrook, J., Fritsch, E. F., &Maniatis, T. (1989). *Molecular cloning* (Vol. 2, pp. 14-9). New York: Cold spring harbor laboratory press.

2. Blau, K., & King, G. S. (Eds.). (1993). *Handbook of derivatives for chromatography* (Vol. 2). New York: Wiley.
3. Kindt, T. J., Goldsby, R. A., Osborne, B. A., &Kuby, J. (2007). *Kuby immunology*. Macmillan.
4. Hayat, M. A. (1974). *Principles and techniques of scanning electron microscopy. Biological applications. Volume 1*. Van Nostrand Reinhold Company.

16PBTDC09/ 16PMBDC09	DSE III: Advanced Molecular Techniques	4hrs/week	4 Credits

Objectives:

After the completion of the course the student will be able to:

1. Describe different techniques used for detecting specific DNA segment and for gene expression analysis
2. List out techniques used in biotechnology that are based on DNA-Protein and Protein-Protein interactions and will be able to design experiments based on them
3. Understand the principals of protein folding and realize its significance in biotechnology and neurodegenerative diseases
4. Understand the basis of protein engineering and drug designing and different approaches used in these

Unit 1: Techniques used in gene detection and gene expression studies (9 hrs)

- Blotting and hybridization studies:Southern hybridization, Northern hybridization, Westernhybridization, Fluorescent in situ hybridization
- Subtractive hybridization, Differential display
- RT PCR, Real time PCR, RNA arbitrarily primer (RAP)-PCR
- SAGE, DNA microarray

Unit 2: DNA-protein interaction techniques (10 hrs)

- DNA-protein cross-linking assay, Gel mobility shift assay, Dnase I foot printing and Sl nuclease mapping, Chromatin immunoprecipitation (ChIP)
- Protein- protein interactions: Chemical cross-linking, Co-immunoprecipitation (CIP), Tandam affinity tags (TAT), Phage display, Fluorescent resonance energy transfer (FRET), Yeast-2-hybid, Yeast-3-hybid and their various version

Unit 3: Reporter and marker genes (10 hrs)

- Introduction to reporter and marker genes
- Application of reporter and markers in biotechnology
- Green Fluorescent Protein (GFP), Chloramphenicol acetyl transferase (cat), Neomycin phosphoryltransferase II (nptII), Luciferase, β- galactosidase, β – lactamase gene and β-glucuronidase

Unit 4: Protein folding (10 hrs)

- Introduction to protein folding
- Principals governing protein folding

- *In vitro* vs *In vivo* protein folding
- Assisted protein folding and molecularchaperones
- Relevance of protein folding tobiotechnology
- Diseases due to defective protein folding

Unit 5: Protein engineering and drugs design (9 hrs)

- Rational of protein engineering
- Methods and approaches: Directed evolution and gene shuffling, random mutagenesis and selection of engineered proteins, gene modification at specific sites, synthesis of complete gene. Engineering by gene fusion.
- Drug design and various approaches: by blocking enzyme activity, Inhibitor for Dihydroxyfolatereducase (DHFR), Renin. HIV reverse transcriptase etc Drug design by blocking hormone receptors, propanolol for norepinephrine and epinephrine and drug design by inhibiting nucleic acid synthesis using antisense RNA technology.

Reference Books:

1. Strauch, M. A. Protein–DNA Interactions: Techniques Used. *eLS,* John Wiley & Sons.
2. Brown, T. A., & Brown, T. (2016). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.
3. Dale, J. W., Von Schantz, M., & Plant, N. (2012). *From genes to genomes: concepts and applications of DNA technology*. John Wiley & Sons.
4. Research and review papers

16PBTDC11/ 16PMBDC11	**DSE III: Nanobiotechnology**	**4hrs/week**	**4 Credits**

Objectives:

At the end of the course, the students will be able to:

1. Students can utilize the imparted knowledge for synthesis of desired nanomaterials and employ them for their specific application.
2. Students can fabricate biosensors and diagnostic assays.
3. It will impart knowledge about applications of nanomaterials in healthcare, Industry, bioremediation, and biotechnology.
4. It will spread awareness about health/environmental hazards associated with nanomaterials.

Unit 1: Introduction to nanomaterials (9hrs)

- Introduction to Nanomaterials
- Historical Background
- Basic definitions of nanomaterials
- Classification of nanomaterials (viz. nanoparticles, nanotubes, quantum-dots, wires & wells, fullerene)
- Top-down and bottom-up approaches

Unit 2: Synthesis of Nanomaterials (10 hrs)

- Synthesis of nanomaterials (Physical, Chemical and Biological methods)
- Zero dimensional, one dimensional and two dimensional nanostructures
- Synthesis of metal, metal oxides and semiconductor nanostructures by few approaches.
- Nanocomposites
- Nanofabrication-lithography

Unit 3: Properties of Nanomaterials (10 hrs)

- Size/quantum confinement and density of states of low dimensional structures (e.g. Quantum dots, Quantum wells, Quantum wires)
- Surface to volume ratio
- Surface states and effects in nanomaterials
- Electrical and magnetic properties of nanomaterials
- Functionalization and Stabilization of nanomaterials.

Unit 4: Characterization and Properties of Nanomaterials (9hrs)

- Structural Characterization: X-ray diffraction (XRD)
- Imaging Techniques: Scanning electron microscope, Transmission electron microscope, Atomic Force Microscopy
- Chemical Characterization: Optical spectroscopy (UV-vis and FTIR), Electron spectroscopy
- Physical Characterization: Optical (SPR), Magnetic (SQUID) properties, surface area analysis-BET
- Particle size analysis: Dynamic light scattering and Zeta potential

Unit 5: Application of Nanomaterials (10 hrs)

- Medicine and Healthcare: drug delivery, imaging and biosensors
- Industry: ceramic, textiles etc.
- Energy storage devices
- Health hazard and toxicology
- Recent trends in nanobiotechnology

Reference Books:

1. Cao, G (2004). *Nanostructures & Nanomaterials- Synthesis, Properties and Application.* Imperial College Press.
2. Bhushan, B (Ed.) (2010). *Springer Handbook of Nanotechnology*.Springer-Verlag.
3. Wang, Z.L., Liu, Yi, Zhang, Ze (Eds.) (2002). *Handbook of Nanophase and Nanostructured Materials*. Springer-Verlag.
4. Jain, K. K. (2006), *Nanobiotechnology in Molecular Diagnostics: Current Techniques and Applications*. Horizon Bioscience.

16PBTCC13	**Combined Practical Core – VI Genetic Engineering, Immunological & Analytical Techniques.**	**6hrs/week**	**3 Credits**

1. Problems on (a) law of segregation (b) Independent assortment (c) Sex linked inheritance (d) population genetics
2. Isolation of Genomic DNA from bacterial cell / plant cell
3. Isolation of RNA from Yeast cells
4. Isolation of Temperature sensitive conditional Mutant
5. Isolation of auxotrophic mutant by 5 BrU mutagenesis
6. Bacterial Conjunction
7. Physical mapping with interrupted conjugation techniques (By Problem solving approach)
8. Bacterial Transformation
9. Restriction Digestion of λ DNA using three Restriction Endonuclease enzymes: a) EcoR V b) Hind III c) BamH I
10. Determination of Tm values of DNA
11. Plasmid Curing by Acridine Orange
12. Isolation & Characterization of plasmid DNA
13. Cloning in Plasmid or Phage vectors
14. Total & Differential Count of blood cells
15. Exercise based on Ag/Ab interaction (Agglutination & Precipitation)
    Blood Grouping
    WidalTest (Slide /Tube)
    Oucterlouny Double diffusion (ODD)
    HIV detection rapid test
    SRID (Single Radial Immunodiffusion)Test
    Latex Agglutination
    Coomb's test.
16. Dot ELISA/ ELISA Test
17. Gel Techniques; SDS PAGE
18. Determination of mass of small molecules and fragmentation patterns by Mass Spectrometry (GC-MS).
19. Analysis of compound by IR (FTIR) spectroscopic technique
20. To study the working of Atomic Absorption Spectrometer and AAS spectrum analysis.
21. To learn the working of High Performance Liquid Chromatography instrument and Chromatogram analysis.

16PBTDC12/16PMBDC12	**DSE – III Practical (Advanced Molecular Techniques)**	**2hrs/week**	**1 Credits**

1. Southern blotting
2. Western blotting
3. Real time PCR
4. Protein structure retrieval and visualization
5. Ligand retrieval and visualization
6. Molecular docking studies
7. Visualization and analysis of docking results

16PBTDC14/ 16PMBDC14	**DSC – III Practical (Nanobiotechnology)**	**2hrs/week**	**1 Credits**

1. Synthesis of metal/metal oxide nanoparticles
2. Functionalization of nanoparticles
3. Characterization of synthesized nanoparticles using UV vis spectroscopy.
4. Characterization of synthesized nanoparticles using FT-IR.
5. Characterization of synthesized nanoparticles using Microscopic technique.
6. Effect of nanoparticles on bacterial growth.
7. Evaluating the antibacterial potential of nanoparticles
8. Screening of blood compatibility of nanoparticles.

16PBTCE07/ 16PMBCE07	**Technical Skill- III: Career Competency Skill Development –II**	**2 hrs/ week**	**Credits: 2**

Objective:

1. Understand the central ecological process and able to describe interaction among and between biotic and abiotic component of ecosystem.
2. Understand the concept behind evolution, changes during era and periods and able to explain about role of light in plant development and stress physiology.
3. Understand the logical and technical concept based on mathematical formula.

Course Content:

1.	**Habitat and niche concepts:** Concept of habitat and niche, niche width and overlap, Fundamental and realized niche, resource partitioning, character displacement.	1 hr
2.	**Population ecology:** Characteristics of a population,population growth curves, population regulation, life history strategies (rand Kselection), concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.	1 hr
3.	**Species interactions**: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.	1 hr
4.	**Community ecology & successions**: Nature of communities, community structure and attributes, levels of species diversity and itsmeasurement, edges and ecotones, Succession:Types,	1 hrs

	mechanisms,changes involved in succession,concept of climax	
5.	**Ecosystem & Biomes:**Structure and function, energy flow and mineral cycling (CNP), primary production and decomposition, structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine, Type of Biomes	2 hr
6.	**Biodiversity**: level, scope and loss of Biodiversity, Diversity index,effort for Biodiversity conservation, IUCN category of species of animal and plant	2 hrs
7.	**Sensory photobiology:** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.	2 hrs
8.	**Stress physiology:** Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses, mechanisms of resistance to biotic stress and tolerance to abiotic stress	1 hrs
9.	**Evolution:** periods & era, Concepts of neutral evolution, molecular divergence and molecular clocks, molecular tools in phylogeny, classification and identification, protein and nucleotide sequence analysis,origin of new genes and proteins; gene duplication and divergence.	2 hrs
10.	**Secondary metabolites:** Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.	1 hrs
11.	**Mensuration:**Area,Volume,perimeter,sphere,circle,rectangle,square	2 hrs
12.	**Number system**	2 hrs
13.	**Geometry**	2 hrs
14.	**Problem based on number sequence**	1 hr

Reference book:

1. Agarwal,R.S.(2013). *Quantitative Aptitude for Competitive Examinations,* 20th edition, S Chand Publications.
2. Odum, E.P. (2004). *Fundamentals of Ecology*. 5th edn, Brooks Cole
3. Salisbury, F. B., & Ross, C. W. (1992). *Plant Physiology*. 4th. *edn.* Belmont, CA. Wadsworth.

SEMESTER IV

16PBTCC14	Core 11: Bioinformatics	4hrs/week	4 Credits

Objectives:

Upon completion of this course students will be able to

1. Browse, search, and retrieve biological data from public repositories & describe the contents and properties
2. Upload new sequences onto GenBank
3. perform text- and sequence-based searches, and analyze the results
4. explain the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming
5. Edit raw Sanger sequence data for phylogenetic analysis (edit chromatograms, identify
6. Contamination, align sequences, remove ambiguously aligned sites)
7. Obtain basal knowledge of phylogentic theory as well as various analytic tools which will enable them to analyze different kind of data and interpret the result.
8. Produce publication ready trees
9. Explain the major features of methods for modelling protein structures and use programs for visualizing and analysing such structures.

Unit 1: Introduction and Bioinformatics Resources (10 hrs)

- Introduction to Bioinformatics: Definition, role, scope in different areas and current perspective.
- Database concepts, Biological Databases
- Nucleic acid sequence database: GenBank, ENA, DDBJ.
- Protein Resources: UniProtKB, SWISS-PROT, TrEMBL,
- Secondary sequence databases: PROSITE, Pfam, PRODOM.

Unit: 2 Databases & sequence alignments (10 hrs)

- Structure database: PDB, NDB
- Small Molecule database: DrugBank,PubChem, ZINC
- Basic concepts of sequence alignment,
- Needleman &Wunsch, Smith & Waterman algorithms for pair wise alignments,
- Multiple sequence alignment: Concept, Algorithm, tools and importance

Unit 3: Sequence analyses & primer designing (9 hrs)

- Biological sequences file formats: genbank, fasta, gcg, msf, nbrf-pir etc.
- Sequence similarity: similarity, identity and homology
- Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series.
- Sequence-based Database Searches: BLAST and FASTA
- Primer designing

Unit 4: Phylogenetic Analysis (9 hrs)

- Phylogenetic analysis: Description and types of trees

- Computational Models in Phylogenetics: Various computational models of phylogenetic and molecular evolutionary analysis.
- Tree construction methods: distance based,
- Maximum Parsimony and Maximum Likelihood
- Tree Evaluation: Bootstrap and its computational aspects

Unit 5: Structural Bioinformatics and Drug designing (10 hrs)

- Structural Bioinformatics: Introduction, coordinate systems, Visualization & presentation of structure.
- Secondary structure: algorithms of Chou Fasman, GOR methods.
- Tertiary Structure: Homology modeling, threading method.
- Protein structure Alignment & structure assessment methods
- Introduction to drug discovery: History, analogue and structural drug discovery, ligand designing and optimization, Molecular docking – concept and methods.

Reference Books:

1. Lesk, A. (2013). *Introduction to bioinformatics*. Oxford University Press.
2. Mount, D. W., & Mount, D. W. (2001). *Bioinformatics: sequence and genome analysis* (Vol. 2). New York: Cold spring harbor laboratory press.
3. Rastogi, S. C., Mendriratta, N., & Rastogi, P. (2006). *Bioinformatics: Concepts, Skills & Applications.* CBS Publishers & Distributors Pvt. Limited.
4. Baxevanis Andreas, D., Davison Daniel, B., Page Roderic, D. M., Petsko Gregory, A., Stein Lincoln, D., & Stormo Gary, D. (2003). *Current protocols in bioinformatics*. John Wiley & Sons.
5. Higgens, D. G., Taylor, W. R., & Webster, D. M. (2000). *Protein Structure Prediction: Methods and Protocols.* Springer Science & Business Media.
6. Rastogi, S. C., Rastogi, P., & Mendiratta, N. (2008). *Bioinformatics Methods and Applications: Genomics Proteomics and Drug Discovery 3rd ed*. PHI Learning Pvt. Ltd.
7. Xiong, J. (2006). *Essential bioinformatics.* Cambridge University Press.
8. Baxevanis, A. D., & Ouellette, B. F. (2004). *Bioinformatics: a practical guide to the analysis of genes and proteins* (Vol. 43). John Wiley &Sons.
9. Eidhammer, I., Jonassen, I. T., William, R., & Inge Jonassen, W. R. T. (2004). *Protein Bioinformatics: An algorithmic approach to sequence and structure analysis* (Vol. 1). John Wiley& Sons.

16PBTDC15/ 16PMBDC15	DSE IV: Bio entrepreneurship	5hrs/week	5 Credits

Objectives:

1. Student will be able to integrate and make autonomous use of their knowledge.
2. Understand the concept and need of entrepreneurship development and develop qualities of entrepreneur.
3. Identify various avenues of entrepreneurship and able to describe role of various central and state government agencies

4. Explain the role of entrepreneurship in economic development.
5. Explain the importance of innovation for entrepreneurship.
6. Understand the role of entrepreneur in modern economy.
7. Describe social responsibility and relate with economic performance.

Unit 1: Basics of Entrepreneurship (8 hrs)

- Entrepreneurship definition, Characteristics of Entrepreneurship, factors necessary for entrepreneurship, Functions of Entrepreneurship, Types of Entrepreneurship,
- Entrepreneurship and Intrapreneurship, Entrepreneurship Strategy
- The Business Plan: Creating and Starting the Venture: The Marketing Plan, The Financial Plan, Sources of Capita, Market Survey Concept, Risk Management
- Legal Issues for the Entrepreneur:Licensing,Product Safety and Liability Registration, Process,Insurance,Contracts,Advertising,Supply Chain Management, Retail& FDI
- Industry Size & Current schemes: Micro, Small, Medium- Industry

Unit 2: Importance of innovation for entrepreneurship (9 hrs)

- Entrepreneurship and Innovation:The Innovation Concept,Source of Innovation for Opportunities
- The Innovation Process,Product life cycle, new product development process, mortality curve
- Creativity and innovation in product modification/ development
- Entrepreneurship and Economic Development: Role of Entrepreneurship in Modern ,Economy Managers Vs Entrepreneurship
- Characteristic of Managers & Characteristic of Entrepreneurs, Similarities and differences between Managers and Entrepreneurs

Unit 3: Concept of Management and Organization (10 hrs)

- Introduction of Industry, Commerce and Business
- Types of ownership in the organization :Definition, Characteristics, Merits & Demerits
- Single ownership, Partnership, Cooperative Organizations,Joint Stock Companies,Government owned Management and Administration
- Differences between Management and Administration
- Management as a science and as an art Leadership Models, Different Leadership Models

Unit 4: Functions of Management and social responsibility (9 hrs)

- Function of Management: Planning,What is planning? Definition and
- Meaning,Types of Planning - Strategic Plan, Tactical Plan and Operation Plan
- The Basic Steps in the Planning ,Process
- Function of Management:Definition,type,basic steps,emerging issues, merit and demerit of planning, organizing,staffing, directing
- Social Responsibility:What is Social Responsibility, Social Responsibility and Economic Performance, Social Obligation, Social Responsibility Managerial Ethics in Modern Times

Unit 5: Entrepreneur in Biotechnology (10 hrs)

- Innovation,Strategy and Strategic Thinking in Biotechnology Entrepreneurship.
- Funding of biotech business, support mechanisms for entrepreneurship, Bio-entrepreneurship efforts in India, difficulties in India experienced.
- Biotech growth, Biotechnology Industry and Firm Structure, The Biotechnology Value Chain areas of scope, biotech policy initiatives
- The biomedical drug, diagnostic, and devices industries and their markets, The Biotechnology Value Chain
- Role of knowledge centers and R&D:knowledge centers like universities and research institutions, role of technology and upgradation.

Reference Books:

1. Roy,R.(2011). *Entrepreneurship*, Oxford University Press India
2. Shimasaki, C. (Ed.). (2014). *Biotechnology entrepreneurship: starting, managing, and leading biotech companies*. Academic Press.
3. Gordon, E.,& Natarajan, K. (2008), *Entrepreneurship Development.* Himalaya Publishing House.
4. Khanka S. S.(2001). *Entrepreneurial Development.* S. Chand & Company Ltd.
5. Lal, A. K. (2012).*Entrepreneurship Development and Management*.Vayu Education of India.
6. Basu, S.K., Sahu, K.C. & Rajiv, B. (2012). *Industrial Organization and Management*. PHI Learning Private Ltd.
7. Mohanty, S.K. (2005).*Fundamentals of Entrepreneurship*. PHI Learning Private Ltd.

16PBTDC16/ 16PMBDC16	DSE IV: Bioethics and IPR	5hrs/week	5 Credits

Objectives:

1. Able to recognize and distinguish the Bioethical issue from other issue and also able to explain the principles of bioethics and how to balance these principles in practice.
2. Understand the principles, function and basic legal rules of IP Law.
3. Recognize the relevant criteria for generating and protecting intellectual works.
4. Understand the different forms of infringement of intellectual property rights.
5. Demonstrate and develop basic skills of legal issue related with IPR.

Unit 1: Bioethical issues (10 hrs)

- Introduction to bioethics, incidences and types of unethical practices.
- Ignorance of laws, codes, policies and procedures.
- Professional ethics-professional conduct. Ethical decision making.
- Ethical Issues: Human cloning, Designer baby, Cord banking, GMO, Abortion, Sex determination, Usage of lab animals, human clinical trials.

- Ethical practices of scientists, scientific/ research organization, business houses, medical practice, regulatory bodies.

Unit 2: General Regime of Intellectual Property Rights & patenting (10 hrs)

- History and general concept of Intellectual Property Rights, type, Major International treaty and their role.
- Need for Protecting Intellectual Property, Policy Consideration: National Perspectives and
- International demands.
- Introduction to Patent, Indian Patent Law **,**The Patents Act, 1970 **,**Amendments to the Patents Act
- Patentable Subject Matter, Patentability Criteria, Procedure for Filing Patent Applications, Patent Granting Procedure.
- Patent Infringement and Remedies, patent information system, patent search

Unit 3: Patenting in Biotechnology (8 hrs)

- Concept of Novelty in Biotechnological Inventions, current issues in patenting of live form with special reference to biotechnological product.
- Patenting of microorganism, higher plants and animals: Transgenic organisms and isolated genes.
- Patenting of genes and DNA sequences, plant breeder's rights and farmer's right.
- Plant Varieties Protection, the Protection of Plant Varieties and Farmer's Rights Act, 2001. Justification for Protection, Plant Protection Varieties in India.
- Biotechnology and International Treaties.

Unit 4: Copyright and Industrial Designs (8 hrs)

- Introduction of copyright, Protection of Copyright and Related rights, Indian Copyright Law ,The Copyright Act, 1957 with its amendments
- Copyright works, Ownership, transfer and duration of Copyright ,Renewal and Termination of Copyright ,Neighbouring Rights, Infringement of copyrights and remedies
- Industrial Designs: Need for Protection of Industrial Designs, Subject Matter of Protection and Requirements, The Designs Act, 2000.
- Procedure for obtaining Design Protection, Revocation, Infringement and Remedies

Unit 5: Trademarks & Trade secret (8 hrs)

- Introduction to Trademarks & service mark, Need for Protection of Trademarks.
- Kinds of Trademarks, Indian Trademarks Law, the Trade and Merchandise Marks Act, 1958
- Trademarks Act, 1999, Procedural Requirements of Protection of Trademarks.
- Content of the Rights, Exhaustion of Rights, Domain Names and Effects of New Technology (Internet).
- Introduction of trade secret, conditions of protection, Subject matter

Reference Books:

1. Narayana, P. (2006) *Patent Law*. Eastern Law House Private Ltd.
2. Ganguli, P. (2001). *Intellectual property rights: unleashing the knowledge economy*. Tata McGraw-Hill Publishing Company.
3. Merges, R. P., & Duffy, J. F. (2013). *Patent law and policy: Cases and materials*. LexisNexis.
4. Reid, B. C. (1999). *A practical guide to patent law*. Sweet & Maxwell.
5. Khader, F. A. (2007).*The Law of Patents – with a special Focus on Pharmaceuticals in India*. LexisNexis.
6. Gopalakrishnan, N. S. &Agitha,T.G. (2009). *Principles of Intellectual Property.* Eastern Book Company.

16PBTCC15	**Practical (Core) –V (BioinformaticsPractical)**	**3hrs/week**	**2 Credits**

1. Retrieval of biological sequences from major databases
2. Editing of chromatogram, Elimination of contamination and submission of sequence to Genbank
3. Sequence Alignments – Pair wise & multiple sequence alignments
4. Sequence similarity search for a given sequence in biological databases using BLAST and FASTA.
5. Primer Designing
6. Calculate Properties of a protein based on its primary structure using tools at EXPASY molecular Biology Server
7. Find out secondary structure of a protein whose structure is already available at Protein Data Bank(PDB)
8. Protein databank retrieval & Protein Visualization (RASMOL, SPDB VIEWER, PROTEIN EXPLORER)
9. Predict Secondary structure of a protein using Chou &Fasman Method
10. Take a PDB file from PDB bank. Plot the Ramachandran map for the same