THE UNIVERSITY OF BURDWAN

SYLLABUS OF TWO YEAR POSTGRADUATE PROGRAMME

IN

BIOTECHNOLOGY

Under

Curriculum and Credit Framework for Postgraduate Programme (CCFPP), as per N.E.P. 2020

w.e.f. 2026 – 2027

2- year PG Programme

Semesterwise and Coursewise Distribution of Credit & Marks under CCFPP as per NEP, 2020

SEMESTER	Course Type	Code & Level	Name of the Course	Credit	L – T - P	Marks	Marks Dist. Th. – Pr. - IA
I	Major/Core Course	**PG2 BIOT1011 (400-499)**	Microbiology & Industrial Application	6	5-0-1	75	40 – 20– 15
	Major/Core Course	**PG2 BIOT 1012 (400-499)**	Cytology & Developmental Biology	6	5-0-1	75	40 – 20– 15
	Major/Core Course	**PG2 BIOT 1013 (400-499)**	Biochemistry	6	5-0-1	75	40 – 20– 15
	Major/Core Course	**PG2 BIOT 1014 (400-499)**	Molecular Biology	6	5-0-1	75	40 – 20– 15
	Minor Course	**PG2 BIOT1021 (300-399)**	Biostatistics & Computer Application	4	3-0-1	75	40 – 20– 15
	Total			**28**		**375**	

II	Major/Core Course	**PG2 BIOT 2011 (400-499)**	Immunology & Immunotechniques	6	5-0-1	75	40 – 20– 15
	Major/Core Course	**PG2 BIOT 2012 (400-499)**	Genetic Engineering	4	3-0-1	75	40 – 20– 15
	Major/Core Course	**PG2 BIOT.2013 (400-499)**	Bioinformatics	4	3-0-1	75	40 – 20– 15
	Major/Core Course	**PG2 BIOT 2014 (400-499)**	Genetics	4	3-0-1	75	40 – 20– 15
	Minor Course	**PG2 BIOT 2021 (300-399)**	IPR, Biosafety & Bioentrepreneurship	4	3-0-1	75	40 – 20– 15
	Total			**22**		**375**	

OPTION- I: Course-work in the 3rd Semester & Research Thesis/Project in the 4th Semester

SEMESTER	Course Type	Code & Level	Name of the Course	Credit	L – T - P	Marks	Marks Dist. Th. – Pr. - IA
III	Major/Core Course	**PG2 BIOT 3011 (500-599)**	Biprocess Engineering	4	2-0-2	50	20-20-10
	Major/Core Course	**PG2 BIOT 3012 (500-599)**	Molecular Virology	4	4-0-0	50	40-0-10
	Major/Core Course	**PG2 BIOT 3013 (500-599)**	Indian Knowledge System (IKS): Drug Discovery and Development	4	2-0-2	50	20-20-10
	Major/Core Course	**PG2 BIOT 3014 (500-599)**	Bioanalytical Techniques	4	2-0-2	50	20-20-10
	Major/Core Course	**PG2 BIOT3015 (500-599)**	Generic Elective	4	2-0-2	50	20-20-10
	Total			**20**		**250**	
IV	Research Thesis/ Project	**PG2 BIOT 4031 (500-599)**	Research Thesis/ Project	20	0- 0- 20	250	0-250-0 Seminar Presentation, Preparation & Submission of Research Thesis/ Project /Document-150 + Viva-100
	Total			**20**		**250**	

GE: Generic elective **PG2 BIOT 3015-1 (500-599)**: Plant Biotechnology; **PG2 BIOT 3015-2 (500-599)**: Animal Biotechnology **PG2 BIOT 3015-3 (500-599)**: Microbial Biotechnology; **PG2 BIOT 3015-4 (500-599)**: Computer Skills for Biological Research

OR

OPTION- II: Only Course- work in 3rd & 4th Semesters

SEMESTER	Course Type	Code & Level	Name of the Course	Credit	L – T - P	Marks	Marks Dist. Th. – Pr. - IA
III	Major/Core Course	**PG2 BIOT 3011 (500-599)**	Biprocess Engineering	4	2-0-2	50	20-20-10
	Major/Core Course	**PG2 BIOT 3012 (500-599)**	Molecular Virology	4	4-0-0	50	40-0-10
	Major/Core Course	**PG2 BIOT3013 (500-599)**	Drug design and Drug Development	4	2-0-2	50	20-20-10
	Major/Core Course	**PG2 BIOT 3014 (500-599)**	Bioanalytical Techniques	4	2-0-2	50	20-20-10
	Major/Core Course	**PG2 BIOT3015 (500-599)**	Generic Elective (GE)	4	2-0-2	50	20-20-10
	Total			**20**		**250**	

IV	Major/Core Course	**PG2 BIOT.4011 (500-599)**	Molecular Genetics	4	4-0-0	50	40-0-10
	Major/Core Course	**PG2 BIOT 4012 (500-599)**	Protomics	4	4-0-0	50	40-0-10
	Major/Core Course	**PG2 BIOT 4013 (500-599)**	Research Methodology	4	4-0-0	50	40-0-10
	Major/Core Course	**PG2 BIOT 4014 (500-599)**	Ecology & Evolution	4	4-0-0	50	40-0-10
	Major/Core Course	**PG2 BIOT 4015 (500-599)**	Discipline Elective (DE)	4	2-0-2	50	20-20-10
	Total			**20**		**250**	

GE: Generic elective **PG2 BIOT 3015-1 (500-599)**: Plant Biotechnology; **PG2 BIOT 3015-2 (500-599)**: Animal Biotechnology **PG2 BIOT 3015-3 (500-599)**: Microbial Biotechnology; **PG2 BIOT 3015-4 (500-599)**: Computer Skills for Biological Research

DE: Generic elective **PG2 BIOT 4015-1 (500-599)**: Advanced Plant Biotechnology; **PG2 BIOT 4015-2 (500-599)**: Advanced Animal Biotechnology **PG2 BIOT 4015-3 (500-599)**: Advanced Microbial Biotechnology; **PG2 BIOT 3015-4 (500-599)**: Advanced Bioinformatics

OR

<u>OPTION-</u> III: Only Research Thesis/ Project in 3rd & 4th Semesters

SEMESTER	Course Type	Code & Level	Name of the Course	Credit	L – T - P	Marks	Marks Dist. Th. – Pr. - IA
III	Research Thesis/ Project	PG2 BIOT3031 **(500-599)**	Research Thesis/ Project	20	0-0-20	250	0-250-0 Seminar Presentation, Preparation & Submission of Research Thesis/ Project Document -150 + Viva-100
IV	Research Thesis/ Project	PG2 BIOT4031 **(500-599)**	Research Thesis/ Project	20	0-0-20	250	0-250-0 Seminar Presentation, Preparation & Submission of Research Thesis/ Project Document -150 + Viva-100
	Total			**40**		**500**	

Semester-I

PG2 BIOT 1011 (400-499) MICROBIOLOGY & INDUSTRIAL APPLICATIONS (THEORY) 6 Credit (5-0-1: Marks 40-20-10) -40L

1. Outline of cell wall, cell membrane, capsule, slime, flagella, pili, flagellar movement, non-flagellar movement, Reserve materials and cytoplasmic inclusions of bacteria, principles of staining (Gram staining, Endospore staining, Acid fast staining, Negative staining)

2. Archaebacteria (Thermophiles, Halophiles and Acidophiles), Eubacteria, Cyanobacteria, Industrially important microorganisms (bacteria)

3. A brief outline of virology (History, Classification, Structure), Viruses (Bacterial, Plant, Animal viruses-basic ideas), Viriods and Prions.

4.Bacterial growth in liquid media and solid media, Diauxic growth, Growth requirements, growth factors, Kinetics of growth, Continuous culture, Synchronous culture, Enrichment culture with examples.

5. Transformation, Conjugation and Transduction (Outline), Quoram Sensing

6.Nitrogen cycle- Nitrification, Denitrification, Mechanism of biological N2 fixation 7.Industrial production of ethanol, citric acid, Antibiotic (penicillin), Amino acid (Tryptophan), Enzyme (Protease).

Practical: MICROBIOLOGY & INDUSTRIAL APPLICATIONS (PRACTICAL) 1 Credit (20 Marks)

1. Aseptic Methods Use of autoclave, hot air oven, laminar air flow, Sterilization of glass wares, Preparation and sterilization of culture media (Bacterial media, Fungal media), Preparation of slant and stab, Pure culture methods (streaking, pour plating and spread plate technique).

2. Staining methods: Simple staining by crystal violet stain, Gram staining, Endospore staining

3. Physiological and Biochemical tests Catalase, Protease, Amylase, Indole, V.P, Acid and Gas production

4. Assay of antibiotics Agar cup method and paper disk method.

5. Determination of Minimal Inhibitory Concentration of antibiotic.

6. Preparation of bacterial growth curve

PG2 BIOT 1012 (400-499); Cytology & Developmental Biology 6 Credit (5-0-1: Marks 40-20-10) -40L

1. Cell organelles:

1.1. Nucleus –Structure & function of Nuclear envelop, Nuclear lamina & nucleolus-r-RNA Biogenesis Macromolecular trafficking & across the nuclear envelop, Chromatin organization & packaging, Ultra structure of Lampbrush and Polytene chromosome.

1.2Mitochondria – Structure, organization of respiratory chain complexes, ATP synthase, Structure – function relationship, Mitochondrial DNA and inheritance.

1.3Chloroplast - Structure & function, Genome Organization & Biogenesis, Chloroplast DNA, Chloroplast biogenesis

1.4. Endomembrane system& Cell motility- Structure & function of microbodies, Golgi apparatus, lysosome, Endoplasmic reticulum. Organisation& role of microtubules & microfilaments.

2. Membrane system: Biological Membranes- Architecture & kinetics (transport, ion 5channels, diffusion, Na-K pump, Proton pump)

3. Cell cycle:

3.1. Phases, duration of different phases and the methods for their determination

3.2 Molecular regulations of different Check points, Molecular mechanism of Cell cycle regulation, Cell cycle regulation in Yeast

3.3. Cell Cycle inhibitor

Developmental Biology

1. Novel features of plant development

2. Shoot apical meristem (SAM) and Root apical meristem (RAM).Apical basal and Radial pattern formation in Arabidopsis thaliana

3. Genes in development of embryo from zygotic cell division in Arabidopsis thaliana, Hormonal regulation of polarity, endosperm development in plants

4. Phy gene- Types, mechanism of action, Genetic analysis of phytochrome function .

5. Floral meristem and Floral organ development: Organisation of floral organ, modification of floral organ, Role of Homeotic gene in determination of floral organ in Arabidopsis thaliana, ABC and ABCDE model, MADS- box.

6.Early embryonic development in Animals: Cleavage –Types and mechanism, Gastrulation- Movements involved; Cell specification with respect to amphibian and chick

7. Zygotic genes (gap gene, pair rule gene & segment polarity gene) in pattern formation; antero posterior embryogenesis in Drosophila; homeotic genes in Drosophila, Hox gene in mammals

Practical:

1. Study of method of preparation of Fixative, Pre-treating chemical and Stain

2. Study of different stages of mitosis, mitotic index & chromosome complement of Allium cepa/ Allium sativu, Lens culinaris

3. Study of different stages of meiosis in Allium cepa, Rhoeo discolor, Grasshopper

4. Study of Polytene Chromosome of Chironomus sp.

PG2 BIOT 1013 (400-499); Biochemistry 6 Credit (5-0-1: Marks 40-20-10) -40L

I

Scope and importance of Biochemistry; Structure of water; Acid base concept and buffers; pH; Hydrogen bonding; Hydrophobic, Electrostatic and Vander Waals forces; ATP as energy currency; Brief concept on free energy.

II

Amino acids: structure and nature (polar, non-polar, acidic, basic, hydrophobic and hydrophilic etc); specific rotation, D, L and R, S Configurations, Electrochemical properties, isoelectric properties, absorption properties. Proteins: classification of structures: primary, secondary, tertiary and quaternary; classification based on function and composition; Structure and stability of sugars, cellulose, glycogen and starch.

III

Enzymes and vitamins: water soluble vitamins and co-enzymes; lipid soluble vitamins and co-factors. Enzymes:

Classes of enzymes, active and binding sites; holo and apo enzymes; enzyme activity; enzymes inhibitors and activators; Enzyme kinetics- Michealis-Menten equation derivation; significance of kinetic parameters: kM and vMAX; enzymes inhibition kinetics: competitive, uncompetitive, mixed and noncompetitive.

IV

Intermediary metabolism: Glycolysis; TCA; Gluconeogenesis; Pentose phosphate pathway.

V

Nitrogen fixation and assimilation; Biosynthesis and regulation of essential amino acids, lipids and nucleic acids.

Practical: 1 Credit

1. General Methods for calculation, determination of solute concentration.
2. Titration of amino acids (neutral, acidic and basic) for determination of PI and pKa.
3. Qualitative tests for proteins and amino acids, Sugars and carbohydrates.
4. Quantitative test for DNA. RNA, Proteins and Sugars.
5. Preparation of different biological buffers.
6. Spectroscopy: Recording spectra of Protein and Nucleic acids and analysis of characteristic features of the spectra.

PG2 BIOT 1014 (400-499); Molecular Biology 6 Credit (5-0-1: Marks 40-20-10) -40L

1.Central dogma of molecular biology
2.Structure and renaturation kinetics of DNA
3.Replication, DNA topology, DNA damage and repair in prokaryotes
4.Transcription in prokaryotes and eukaryotes, Operon concept
5.PCR types and its applications.
6.Post transcriptional modifications of RNA, gene silencing, anti-sense RNA, RNAi, SiRNA, Translation in prokaryotes and eukaryotes, protein targeting,
7.Biosignaling, basic ideas about signal transduction
8. Transposons and retroposons: prokaryotic and eukaryotic transposable Elements and their roles.

Practical: 1 Credit

1. Isolation of genomic DNA of plants and bacteria
2. Agarose gel electrophoresis
3. Phage titration by plaque assay
4. SDS-PAGE of proteins

PG2 BIOT1021 (300-399) Biostatistics Computer Application, Credit- 4 (3-0-1), Marks-75 (40-20-10) – 40L

1. General discussion about Statistics, Biostatistics and its application in Biological Science. Brief description and tabulation of data and its graphical representation for different data type (grouped and ungrouped).

2. Measurement of central tendency: Mean Median, Mode, Range, Standard Deviation, and Variance for different data type (grouped and ungrouped), Idea of two types of error and its level of significance, ChiSquare Test, Simple linear regression and correlation, Probability Distribution (Binomial, Poisson, Gaussian).

3. Basic commands of DOS and LINUX

4. Introduction of digital computer: Low and High level language, binary system. Difference between software and programme.

5. Programming in C: Introduction, Data Types, Condition checking and looping, Function, Array, String Handling.

Practical 1 Credit

1. Solving the problems of Biostatistics (Average, Median, Mode Mean Median, Mode, Range, Standard Deviation, and Variance for different data type (grouped and ungrouped), Chi square, Correlation coefficient, Normal/Poisson Distribution, t-test, z-test etc.) through MS- Excel.

2. Basic commands of DOS and LINUX.

3. Computer Application: Programming for Solving Statistical problems (Mean, Median (sorting), Mode, Standard Deviation, and Variance for different data type (grouped and ungrouped), Correlation Coefficient) through C programming

Semeter-II

PG2 BIOT 2011 (400-499), Immunology & Immunotechniques Credit-6 (5-0-1), Marks-75 (40-20-15) -40L

1. Immunology-fundamental concepts and anatomy of the immune system.

1.1. Components of innate and acquired immunology.

1.2. Antigens- immunogens, requirements for immunogenicity, haptens, antigen antibody interactions, affinity and avidity, adjuvant, cross reactivity; antigen presenting cells (APC).

1.3. Major Histocompatibility complex (MHC)- MHC genes, antigen processing and presentation.

2. Immune responses generated by lymphocytes.

2.1. Immunoglobulins- Basic structure, classes &subclasses,antigenic determinants, action of antibody, kinetics of immune response, B cell receptor,B-cell maturation and activation, monoclonal antibodies, clonal selection theory.

2.2. Multigene organization of immunoglobulin genes, generation of antibody diversity, class switching, allelic exclusion, affinity maturation.

2.3. Cytokines and its properties (pleiotropy, redundancy, synergy, antagonism).

2.4. T-cell and cell mediated immunity-structure of T-cell receptor molecules, function of T-cells.

3. Clinical immunology.

3.1. Hypersensitive reactions (Type I, II, III and IV).

3.2. Auto immunity, example of some auto immune diseases.

3.3. Tissue transplantation and graft rejection.

Immunotechniques

Antigen - Antibody interactions:

I. Precipitation reactions- precipitation reaction in fluids& in gel, radial immunodiffusion(Mancini method), double diffusion (Ouchterlony method).

II. II. Agglutination- Prozone effect, direct agglutination and passive agglutination.Advanced immunological techniques- RIA, ELISA, Immunofluorescence, Immunoelectrophoresis. Active and passive immunization; live, killed, sub unit, DNA and recombinant vector vaccine

Practical: 1 Credit

1. Microscopic observation of blood cells (RBC & WBC).
2. Blood grouping and allo-antigen classification.
3. Study of sex chromatin.
4. Dot blot
5. Isolation and characterization of Antibody
6. ELISA Assay
7. Study of Immuno-precipitation, Agglutination and Immunodiffusion
8. Study of Immunoflourescence 4.Western Blot
9. Immuno- electrophoresis
10. Study of Primary and Secondary antibody response (Demonstration)

PG2 BIOT 2012 (400-499), Genetic Engineering-4 (3-0-1), Marks-75 (40-20-15) -40L

1. Gene Manipulation—general concept, various tools scope and methodology

2. Cloning in E. coli: Vector plasmids, bacteriophages, cosmid, phasmid, Shuttle vectors, Cloning strategies; CDNA and genomic library construction.

3. Cloning in Yeast: Yeast vectors cloning and expression yeast artificial chromosome.

4. Cloning in plants: Agrobacterium mediated transformation, Ti and Ri plasmids, Binary vectors, plant specific promoters, incorporation of T-DNA into nuclear DNA of plant cells. Transgenic plants with insect resistance, herbicide resistance, RFLP/RAPD/AFLP mapping techniques.

5. Cloning in animals: Integration of DNA into mammalian cells, applications

Practical 1 Credit

1. Isolation of plasmid DNA from bacterial cells

2. Transformation of E.coli cells with plasmid.

3. Restriction digestion of lamda phage genomic DNA, and plasmid DNA and analysis by agarose gel electrophoresis

4. PCR amplification of specific DNA sequence and analysis on agarose gel electrophoresis.

PG2 BIOT 2013 (400-499), Bioinformatics-4 (3-0-1), Marks-75 (40-20-15) -40L

1. Bioinformatics and its application in Biotechnology.

2. Biological databases (DDBJ, EMBL, GEN – BANK, Swissprot, PIR etc.), Sequence formats, Brief idea of Scoring/Substitution matrices: PAM and BLOSUM series and its significance, Definition and significance of Pairwise and Multiple Sequence Alignment, Gap opening and extension penalty, Score calculation Methods and algorithms used in Pairwise alignment: Dot Matrix, Dynammic Programming Algorithm (SW and NW) and k-tuple. Methods for doing MSA: CLUSTALW, Scoring MSA.

3. Algorithms used in Database similarity searching: BLAST. 4. Phylogenetic analysis: Concept and method: Distance based (UPGMA).

Practical: 1 Credit

1. Searching for a particular literature through PubMed.

2. Use of Public Domain Interfaces for downloading different DNA and Protein sequences from authenticated Databases (Using NCBI).

3. Performing BLAST and interpretation of the results.

4. Performing MSA by using CLUSTALW and presentation of the phylogenetic tree.

PG2 BIOT 2014 (400-499), Genetics-4 (3-0-1), Marks-75 (40-20-15) -40L

1. Mendelian genetics – Mendel's experiment, Extention of Mendelian's principals, Incomplete dominance, co-dominence, multiple alles lethal alleles, penetrance and expressivity, Epistasis, supplementary genes, pleiotropy, genomic imprinting.

2. Genetic linkage, Crossing over and Chromosome mapping: Recombination mapping with Three- point test cross, Tetrad analysis.

3. Numerical and Structural aberration of chromosome

4. Cancer genetics – Properties of malignant cells; benign and malignant tumor, properties of cancer cells, Genetic

basis of cancer, tumor suppressor gene (P53 & Rb gene),, gate keeper gene and care taker gene, apoptosis.

5. Population genetics: Calculating allelic frequencies, Hardy - Weinberg equilibrium, Quantitative inheritance; QTL.

Practical: 1 Credit

1. Chi-square test
2. Study of Cross over Frequency
3. Pedigree Analysis
4. Analysis of Gene frequencies following Hardy - Weinberg equilibrium.

PG2 BIOT 2021 (400-499), IPR, Biosafety & Bioentrepreneurship-4 (3-0-1), Marks-75 (40-20-15) -40L

1. Intellectual Property: Trademark, copyright & related rights, Industrial Design Traditional knowledge, geographical Indications, Protection of new GMOs. International framework for the protection of IP in R&D. Case studies in Biotechnological innovations. Introduction to the history of GATT,WHO, WIPO and TRIPS.

2. Basics of Patents: Prior Art, Patent databases-International and country wise patent searches. Indian Patent Act 1970, Recent amendments .Filing of a patent application-provisional and complete specifications.PCT and Implications Patent Infringement-meaning scope ,litigation case studies.

3. Bio-safety : Introduction, Biological safety cabinets. Primary containment for Biohazards, Biosafety levels. Bio safety guidelines-Definition of GMO's and LMO's. Role of International Biosafety committee. Environmental release of GMOs, Risk Analysis and Assessment. Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

4. Bioethics: Concerns of biological hazards, Genetic engineering issues.

Bioentrepreneurship

1. Starting the Enterprise: Understanding the Business of Biotechnology- Project Identification and selection-project formation-project appraisal-Institutional Finance and support to Bioentrepreneurship.

2. Managing the Enterprise: Basic issues relating to marketing like marketing planning, product management and new product decisions-Basic issues relating to Human Resource Management involving Acquisition, Development, Motivation, and maintenance of employees in technology-based firms-Fundamentals of accounting and Finance like Final accounts, Balance sheet, Financial analysis and Working Capital Management.

3. Sustaining the Enterprise: Emphasis on knowledge centers and R&D: Successful Biotech Business Strategies-Establishing network with Universities and research institutionsTechnology Acquisition, Development and Transfer: Issues and Challenges for Bioentrepreneurs.

Practical: 1 Credit

1. A case study on clinical trials of drugs in India with emphasis on ethical issues.
2. Case study on women health ethics.
3. Case study on medical errors and negligence.
4. Case study on handling and disposal of radioactive waste

Semester-III

PG2 BIOT 3011 (500-599) Bioprocess Engineering Credit-4 (2-0-2) Marks-50 (20-20-10) -40L

1. Basic Principle of Biochemical engineering: What is biochemical engineering? Gene products and their processing, modification and application: utilization of gene products in basic and applied metabolism.

2. Application of Enzymes in food, leather & paper industry: Isolation and purification of enzymes, immobilization of enzymes: enzyme engineering; synzymes, Uses of enzymes in food & beverage, textile, paper, leather industries.

3. Applications of Microbes in food process operation and production: Edible vaccines, production of single cell protein (SCP), commercial production of biofuels, Biopesticides, biofertiliser, biomineralization & phytomining.

4. Concepts of basic mode of fermentation processes: Bioreactor design,Types of fermentation & fermenters, solid state fermentation, aerobic and anaerobic fermenter.

Practical: 1 Credit

1. Isolation of industrially important microorganisms for microbial processes
2. Determination of growth curve of a supplied microorganism
3 Monitoring of dissolved oxygen during aerobic fermentation.
4. Cell disruption for endoenzymes by sonication.
5. Bioreactors(Demonstration)

PG2 BIOT 3012 (500-599) Molecular Virology Credit-4 (4-0-2) Marks-50 (40-0-10) – 40L

Diagnostics for Sexually transmitted diseases (STD)

I. Detailed Diagnostic Virology for
HIV (I & II),
HPV (High and low risk),
Hepatitis –HAV, HBV, HCV, HDV, HEV with special focus on HBV HSV-HSV1, HSV2, VZV, EBV, CMV

II. DiagnosticBacteriology –Neisseriagonorie, Chlamydia trachomatis

1. Oncogenesis Mechanism of oncogenesis: Acute Transforming virus and Oncogenesis, HTLV1, HTLV2 Carcinogens or mutagens detection by Ames' Salmonella assay

2. Drugs:

I. Drugs discovery and development ,

II. Understanding of target based design of drugs with suitable example.

II. ADME parameters, drugs action, metabolism and secretion.

PG2 BIOT 3013 (500-599) Drug Desiging and Drug Development Credit-4 (2-0-2) Marks-50 (20-20-10)-40L

Unit I

Introduction to Drugs Historical background: Sources of Drugs, Classification of drugs- important terminologies used in medicinal Chemistry. Drug Action: role of intermolecular forces - drug targets: lipids, carbohydrates, proteins (enzymes, receptor) and nucleic acids as drug targets.

UNIT II: 8 Pharmacokinetics and pharmacodynamics: Routs of drug administration, dosage forms. Fate of drugs in the body- absorption, distribution, metabolism, and elimination of drugs (ADME). Bioavailability of drugs, drug addiction and drug toxicity.

UNITIII

Drugs and Their Mechanism of Action Antibacterial agents-mechanism of action-antibacterial agents that act against cell metabolism (sulfonamides), inhibit cell wall synthesis (penicillins, cephalosporins), interact with plasma membrane (valinomycin and gramicidin A), drugs impair protein synthesis (tetracyclines, chloramphenicol) and drugs act on nucleic acids (quinolones and fluoroquinolones, rifamycins). Antiviral agents-general principles-nucleic acid synthesis inhibitors (HIV, HBV), host cell penetration inhibitors, inhibitors of viral protein synthesis. Antifungal agents-azoles, allyamines and phenols. Anti-protozoal drugs (antiamoebic, Giardia, Trichomoniasis, Leishmaniasis, Anthelimintics)

UNIT IV:

Anticancer drugs and their mechanism of action- role of antimetabolites, antisense drugs, alkylating agents and interchelating agents in cancer chemotherapy. Cardiovascular drugs: antiarrhythemic and antihypertension drugs. Gastro intestinal drugs; Peptic ulcer, gastroesophagal reflux disorders, laxatives,antidiarrhoeal.

UNITIII

Drug discovery, Design and Development Identification of diseases and corresponding targets, bioassays and leads. Stereochemistry and solubility issues in drug design. Structure activity relationships (SARs): changing size and shape-introduction of new substituents. Quantitative structure activity relationships (QSARs): lipophilicity-electronic and steric effects- Hansch Analysis-Topliss decision tree. Chemical and process development of drugs. Preclinical trials: pharmacology, toxicology, metabolism and stability studies-formulation. Clinical trials: phase IIV studies ethical issues. Patent protection and regulation.

Practical, 1 Credit

1. Protein structure prediction and validation
2. Different drug Bank
3. Virtual Screeening
4. Molecular docking
5. Molecualr Dynamics and simulation
6. ADME analysis

PG2 BIOT 3014 (500-599) Bioanalytical Techniques Credit-4 (2-0-2) Marks-50 (20-20-10)- 40L

1 .Microscopy: Light, Phase contrast microscope, Fluorescence microscope, SEM & TEM, Confocal Microscope

2. Chromatography: Gel filtration, ion- exchange, affinity, TLC, GC, HPLC, FPLC, Electrophoresis,

Electrofocussing, Centrifugation

3. Sequencing of DNA and proteins

4. Blotting and hybridization techniques: Southern, Northern and Western Blotting

5. DNA fingerprinting and foot printing, chromosome walking, DNA microarrays

6. Analytical and preparative Ultracentrifugation and its application

7.Principle and application of spectroscopy.

8.Circular dichroism and its application.

9.Real time PCR and its application

Practical Credit-1

1. Separation techniques- Centrifugation, chromatography (paper, TLC, Silica Gel Chromatography) and Electrophoresis.

2. General Concept of Spectrophotometry, Electrophoresis

3. Demonstration of PCR (including Real time PCR), HPLC, GCMS, SEM and FM

PG2 BIOT 3015 (500-599) Generic Elective Credit-4 (2-0-2) Marks-50 (20-20-10)- 40L

PG2 BIOT 3015-1 Plant Biotechnology

1. Plant cell, tissue and organ culture: A brief history of plant tissue culture, totipotency, callus and cell s technology and its application.

2. Protoplast culture: isolation, purification, culture methods and regeneration of plants, Fusion of protoplasts, selection of somatic hybrid cells and regeneration of somatic hybrid plants, cybrids and cybridization technique.

3. Pollen Biotechnology: Anther & pollen culture- Technique and application, role in crop improvement, an outline of pollen based gene transfer technology

4. Micropropagation: Technique & application ; Micropropagation of horticultural, agricultural & forest tree plants.

5. In vitro conservation of plant cell and tissue culture & establishment of gene banks: Introduction ,technology of cryopreservation of germplasm

Practical: 1 Credit

1. General process of sterilization and preparation of different culture media

2. Initiation and maintenance of callus

3. Study of organogenesis

4. Shoot tip and node culture and strategies of microproparation

PG2 BIOT 3015-2 Animal Biotechnology

1. Primary culture and cell lines: Tissue disagrregation (Mechanical versus enzymatic), Established versus continuous cell lines, Hayflick limit.

2. Culture environment and media optimization: Serum containing versus serum free media, chemically define media, sodium bicarbonate/ CO_2 buffering system

3. Cell growth kinetics assesment: Cell viability assay, Cell counting

4. Physiscal and chemical transfection technique: transient versus stable expression

Practical – 1 Credit

1.Handling of laboratory animals and methods of breeding.

2. Use of special equipments in Animal Biotechnology Experiments.

3. Preparation of Animal tissue culture method and sterilization.

4. Isolation and detection of DNA,RNA and Protein from animal cells.

5. Demonstration of Monoclonal antibody production.

PG2 BIOT 3015-3 Microbial Biotechnology

a: Application of microbes for SCP production, Prebiotics and Probiotics.

b: Biopesticides, food processing and food preservation.

c: Glutamic acid (Amino acid), Streptomycin and Tetracyclin (Antibiotic), Lactic acid (Anaerobic fermentation), Vitamin A (Vitamin), Cheese and Yogurt (Milk products)

d: Microbial leaching

e: Immobilization Technique

f: Basic ideas of algal biotechnology, Application of algae as food supplement, Fungi of Veterinary & medical interest, role of fungi in food processing

Practical 1 Credit

a: Isolation of industrially important microorganism from different sources.

b: Isolation of nitrogen fixing bacteria (from soil),

c: Isolation of Phosphate solubilizing bacteria.

d: Determination of quality of a milk sample by methylene blue reduction test.

PG2 BIOT 3015-4 Computer skills for Biological research

1. Basics of computer and internet. Different operating systems. DOS and LINUX commands.

2. Introduction of digital computer: Low and High level language, binary system.

3. Introduction to DBMS and MySQL. Syntax for creation and manipulation of table and databases through MySQL.

4. PERL and SHELL programming language.

5. Introduction to R.

6. Functions and their Graphical Representation with Application in Biology: Linear-Power-PeriodicLogarithmic-Exponential functions.

7. Matrix Algebra: Determinants with examples from biology, matrix as operation of reflection rotation inversion-magnification-translation-symmetry, applications in biology.

Practical 1 Credit

1. DOS and LINUX commands.

2. MySQL

3. PERL

4. R

5. Shell programming

6. Excel for advanced statistical analysis.

Semester-IV

PG2 BIOT 4031 (500-599) Research Thesis/ Project Credit-20 Marks-250

Seminar Presentation, Preparation & Submission of Research Thesis/ Project / Document-150 + Viva-100

OR

Option II

Semester-III

PG2 BIOT 3011 (500-599) Bioprocess Engineering Credit-4 (2-0-2) Marks-50 (20-20-10) -40L

1. Basic Principle of Biochemical engineering: What is biochemical engineering? Gene products and their processing, modification and application: utilization of gene products in basic and applied metabolism.

2. Application of Enzymes in food, leather & paper industry: Isolation and purification of enzymes, immobilization of enzymes: enzyme engineering; synzymes, Uses of enzymes in food & beverage, textile, paper, leather industries.

3. Applications of Microbes in food process operation and production: Edible vaccines, production of single cell protein (SCP), commercial production of biofuels, Biopesticides, biofertiliser, biomineralization & phytomining.

4. Concepts of basic mode of fermentation processes: Bioreactor design,Types of fermentation & fermenters, solid state fermentation, aerobic and anaerobic fermenter.

Practical: 1 Credit

1. Isolation of industrially important microorganisms for microbial processes

2. Determination of growth curve of a supplied microorganism

3 Monitoring of dissolved oxygen during aerobic fermentation.

4. Cell disruption for endoenzymes by sonication.

5. Bioreactors(Demonstration)

PG2 BIOT 3012 (500-599) Molecular Virology Credit-4 (4-0-2) Marks-50 (40-0-10) – 40L

Diagnostics for Sexually transmitted diseases (STD)

III. Detailed Diagnostic Virology for
HIV (I & II),
HPV (High and low risk),
Hepatitis –HAV, HBV, HCV, HDV, HEV with special focus on HBV HSV-HSV1, HSV2, VZV,

EBV, CMV

II. DiagnosticBacteriology –Neisseriagonorie, Chlamydia trachomatis

1. Oncogenesis Mechanism of oncogenesis: Acute Transforming virus and Oncogenesis, HTLV1, HTLV2 Carcinogens or mutagens detection by Ames' Salmonella assay

2. Drugs:

I. Drugs discovery and development ,

II. Understanding of target based design of drugs with suitable example.

IV. ADME parameters, drugs action, metabolism and secretion.

PG2 BIOT 3013 (500-599) Indian Knowledge System (IKS): Drug Discovery and Development Credit-4 (2-0-2) Marks-50 (20-20-10)- 40L

Unit I

Introduction to Drugs Historical background: Ancient Indian system, Sources of Drugs, Classification of drugs-important terminologies used in medicinal Chemistry. Drug Action: role of intermolecular forces - drug targets: lipids, carbohydrates, proteins (enzymes, receptor) and nucleic acids as drug targets.

UNIT II: 8 Pharmacokinetics and pharmacodynamics: Routs of drug administration, dosage forms. Fate of drugs in the body- absorption, distribution, metabolism, and elimination of drugs (ADME). Bioavailability of drugs, drug addiction and drug toxicity.

UNITIII

Drugs and Their Mechanism of Action Antibacterial agents-mechanism of action-antibacterial agents that act against cell metabolism (sulfonamides), inhibit cell wall synthesis (penicillins, cephalosporins), interact with plasma membrane (valinomycin and gramicidin A), drugs impair protein synthesis (tetracyclines, chloramphenicol) and drugs act on nucleic acids (quinolones and fluoroquinolones, rifamycins). Antiviral agents-general principles-nucleic acid synthesis inhibitors (HIV, HBV), host cell penetration inhibitors, inhibitors of viral protein synthesis. Antifungal agents-azoles, allyamines and phenols. Anti-protozoal drugs (antiamoebic, Giardia, Trichomoniasis, Leishmaniasis, Anthelimintics)

UNIT IV:

Anticancer drugs and their mechanism of action- role of antimetabolites, antisense drugs, alkylating agents and interchelating agents in cancer chemotherapy. Cardiovascular drugs: antiarrhythemic and antihypertension drugs. Gastro intestinal drugs; Peptic ulcer, gastroesophagal reflux disorders, laxatives,antidiarrhoeal.

UNITIII

Drug discovery, Design and Development Identification of diseases and corresponding targets, bioassays and leads. Stereochemistry and solubility issues in drug design. Structure activity relationships (SARs): changing size and shape-introduction of new substituents. Quantitative structure activity relationships (QSARs): lipophilicity-electronic and steric effects- Hansch Analysis-Topliss decision tree. Chemical and process development of drugs. Preclinical trials: pharmacology, toxicology, metabolism and stability studies-formulation. Clinical trials: phase IIV studies ethical issues. Patent protection and regulation.

Practical, 1 Credit

1. Protein structure prediction and validation
2. Different drug Bank
3. Virtual Screeening
4. Molecular docking
5. Molecualr Dynamics and simulation
6. ADME analysis

PG2 BIOT 3014 (500-599) Bioanalytical Techniques Credit-4 (2-0-2) Marks-50 (20-20-10)- 40L

1 .Microscopy: Light, Phase contrast microscope, Fluorescence microscope, SEM & TEM, Confocal Microscope

2. Chromatography: Gel filtration, ion- exchange, affinity, TLC, GC, HPLC, FPLC, Electrophoresis, Electrofocussing, Centrifugation

3. Sequencing of DNA and proteins

4. Blotting and hybridization techniques: Southern, Northern and Western Blotting

5. DNA fingerprinting and foot printing, chromosome walking, DNA microarrays

6. Analytical and preparative Ultracentrifugation and its application

7.Principle and application of spectroscopy.

8.Circular dichroism and its application.

9.Real time PCR and its application

Practical Credit-1

1. Separation techniques- Centrifugation, chromatography (paper, TLC, Silica Gel Chromatography) and Electrophoresis.

2. General Concept of Spectrophotometry, Electrophoresis

3. Demonstration of PCR (including Real time PCR), HPLC, GCMS, SEM and FM

PG2 BIOT 3015 (500-599) Generic Elective Credit-4 (2-0-2) Marks-50 (20-20-10)- 40L

PG2 BIOT 3015-1 Plant Biotechnology

1. Plant cell, tissue and organ culture: A brief history of plant tissue culture, totipotency, callus and cell s technology and its application.

2. Protoplast culture: isolation, purification, culture methods and regeneration of plants, Fusion of protoplasts, selection of somatic hybrid cells and regeneration of somatic hybrid plants, cybrids and cybridization technique.

3. Pollen Biotechnology: Anther & pollen culture- Technique and application, role in crop improvement, an outline of pollen based gene transfer technology

4. Micropropagation: Technique & application ; Micropropagation of horticultural, agricultural & forest tree plants.

5. In vitro conservation of plant cell and tissue culture & establishment of gene banks: Introduction ,technology of cryopreservation of germplasm

Practical: 1 Credit

1. General process of sterilization and preparation of different culture media
2. Initiation and maintenance of callus
3. Study of organogenesis
4. Shoot tip and node culture and strategies of microproparation

PG2 BIOT 3015-2 Animal Biotechnology

1. Primary culture and cell lines: Tissue disagrregation (Mechanical versus enzymatic), Established versus continuous cell lines, Hayflick limit.

2. Culture environment and media optimization: Serum containing versus serum free media, chemically define media, sodium bicarbonate/ CO_2 buffering system

3. Cell growth kinetics assesment: Cell viability assay, Cell counting

4. Physiscal and chemical transfection technique: transient versus stable expression

Practical – 1 Credit

1.Handling of laboratory animals and methods of breeding.

2. Use of special equipments in Animal Biotechnology Experiments.

3. Preparation of Animal tissue culture method and sterilization.

4. Isolation and detection of DNA,RNA and Protein from animal cells.

5. Demonstration of Monoclonal antibody production.

PG2 BIOT 3015-3 Microbial Biotechnology

a: Application of microbes for SCP production, Prebiotics and Probiotics.

b: Biopesticides, food processing and food preservation.

c: Glutamic acid (Amino acid), Streptomycin and Tetracyclin (Antibiotic), Lactic acid (Anaerobic fermentation), Vitamin A (Vitamin), Cheese and Yogurt (Milk products)

d: Microbial leaching

e: Immobilization Technique

f: Basic ideas of algal biotechnology, Application of algae as food supplement, Fungi of Veterinary & medical interest, role of fungi in food processing

Practical 1 Credit

a: Isolation of industrially important microorganism from different sources.

b: Isolation of nitrogen fixing bacteria (from soil),

c: Isolation of Phosphate solubilizing bacteria.

d: Determination of quality of a milk sample by methylene blue reduction test.

PG2 BIOT 3015-4 Computer skills for Biological research

1. Basics of computer and internet. Different operating systems. DOS and LINUX commands.

2. Introduction of digital computer: Low and High level language, binary system.

3. Introduction to DBMS and MySQL. Syntax for creation and manipulation of table and databases through MySQL.

4. PERL and SHELL programming language.

5. Introduction to R.

6. Functions and their Graphical Representation with Application in Biology: Linear-Power-PeriodicLogarithmic-Exponential functions.

7. Matrix Algebra: Determinants with examples from biology, matrix as operation of reflection rotation inversion-magnification-translation-symmetry, applications in biology.

Practical 1 Credit

1. DOS and LINUX commands.

2. MySQL

3. PERL

4. R

5. Shell programming

6. Excel for advanced statistical analysis.

Semester –IV

PG2 BIOT4011 (500-599) Molecular Genetics Credit 4 (4-0-0) Marks 50 (40-0-10) 40L

1. Salient Features of prokaryotic and Eukaryotic genome.

2. C-value paradox, Unique and Repetitive DNA, tandem and interspersed, Reassociation Kinetics, Determination of TM and Cot value.

3. Genome genomics : Concept and types.

4. Mapping genomes: * Genetic mapping:- Linkage analysis is the basis of genetic mapping, Drawbacks. * Cytogenetic mapping:- Concept, Fluorescence In situ hybridization, Radiation hybrid method, chromosome walking. * DNA markers for genetic mapping. * Physical mapping: Concept, Restriction mapping, RFLP mapping technique and application STS mapping technique in plant and human diseases. And application. Random amplified polymorphic DNA technique and application.

5. An outline of Human genome project and DNA finger printing

PG2 BIOT4012 (500-599) Proteomics Credit 4 (4-0-0) Marks 50 (40-0-10) 40L

1. General idea : Definition, Classification, Scope and present advances. The emergence of proteome concept: structural and functional proteomes, Protein structures related to functional kinetics e.g. Prions.

2. Methods: 2D-PAGE, Mass Spectrometry with special emphasis on MALDI-TOF, peptide and protein Micro array technology. Application of these methods in proteomics.

3. Analytical Procedure and their Application: Analytical methods, Bacterial and Yeast two hybrid System. Basic idea of Protein database

4. Transcriptomes: Basic ideas

5. Proteomics in relation to animal and plant health and welfare.

PG2 BIOT4013 (500-599) Research Methodology Credit 4 (4-0-0) Marks 50 (40-0-10) 40L

Research

Objectives of Research, Types of Research, Research approach, Research Methods, Research Process, Research Design, Scientific writing, Thesis Writing, Paper Writing, Publication in Research journals, Research Institute, Research Schemes (minor & major), Preparation of project proposal, format, different funding agencies.

Basic Biostatistics

Measures of Central tendency & disruption, Probability distribution, Sampling Errors, Levels of Significance, Regression & Correlation, Analysis of Variance, t-test, z-test, $\chi 2$ test, Least Significant **Difference test.**

Computer application

Practical Knowledge of MS word; Construction of Spreadsheet from experimental data, MS EXCEL design & application of formula for calculations & their application to the experimental data, Preparation of Power point Presentation based on the topic of research. Internet & its application, Application exploring various websites & Search Engine for collecting quality literature & Secondary data related to research work,

Molecular Dynamics Simulation, Homology method.

Concept & application of Bioinformatics

Biological Databases- Primary & Secondary; Sequence databases (EMBL, Genbank, SWISSPROT), Protein Family Databases (PROSITE), Structure Database (PDB) Tools: BLAST, FASTA.

Research and Publication Ethics (RPE)

PHILOSOPHY OF ETHICS

1. Introduction of philosophy: Definition, Nature and scope, concept, branches
2. Ethics: Definition, moral philosophy, nature f moral judgements and reactions

SCIENTIFIC CONDUCT

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification an, Fabrication, and Plagiarism (FFP)
4. Redundant publications: Duplicate and overlapping publications, SalamiSlicing
5. Selective reporting and mispresentation of data

PUBLICATION ETHICS

1. Publication ethics: Definition, introduction and importance
2. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: Definition, concept, problems that lead to unethical behavior and vice-versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals 7. Predatory publishers and journals

PG2 BIOT4014 (500-599) Ecology & Evolution Credit 4 (4-0-0) Marks 50 (40-0-10) 40L

Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and

aquatic (fresh water, marine, eustarine).

A. Emergence of evolutionary thoughts

Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

B. Origin of cells and unicellular evolution:

Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

C. Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

D. Molecular Evolution:

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.

PG2 BIOT4015 (500-599) Discipline/ Elective Creditit 4 (2-0-2) Marks 50 (20-0-20) 40L

PG2 BIOT4015-1 Advanced Plant Biotechnology

1. Plant transformation: The basis of tumor formation, features of Ti-plasmid, mechanisn of DNA transfer, role of virulence gene, binary vectors, Electroporation, Particle bombardment method , Chloroplast transformation, detection of transgene ,identification of intregation site, determination of copy number, inheritance of transgene.

2. Molecular markers: SNP, SSR ,CAPS, Application of markers in breeding, genome editing and mutagenesis

3.Genome editing: Zinc finger nuclease,CRISPER technology,selection and application

4.Strategies for introducing Biotic & Abiotic stress Resistance/Tolerance: Herbicide, insect, virus, drought and salinity.

5. Plants as Biofactories: Concept of Biofactories, Cell culture for secondary metabolite production of pharmaceutically important compounds, elicitors, Hairy root culture

6. Genetic Engineering for Plant Architechture and Metabolism: Molecular farming, its benefits & risks, long shelf life of fruits-Use of ACC synthase, ACC oxidase, Polygalacturonase, Male sterile line- barnase/barstar system. Golden rice, Seed-storage proteins ,bioplastic, Terminator seed technology, Safety and social concern of GM crop; Metabolomics

7. Eco-Biotechnology: Biosensors : Types ,Applications.

8. Patenting for biological materials, Plant breeders rights(PBRS) & Farmer's rights

Practical: 2 Credit

1. Suspension Culture

2. Preparation of Synthetic Seed

3. Haploid Culture

4. Protoplast culture

PG2 BIOT4015-2 Advanced Animal Biotechnology

I

Assisted reproductive biotechnology (human and animal) - endocrine basis of reproduction, endocrine therapeutics. Reproductive ultrasonography and its application in OPU and ETT. Synchronization, Superovulation and embryo transfer technology, in vitro embryo production and micromanipulation of embryos, sperm and embryo sexing

II

Transgenesis and its application - transgenic animal production, different methods of gene transfer (microinjection, calcium phosphate co-precipitation, lipofection, electroporation, nucleofection and viral vectors), transfection of DNA; embryo micromanipulation, Intracytoplasmic sperm injection; production of transgenic livestock, regulatory issue. Genetic engineering of farm animals - cloning vectors, viral vectors, reproductive cloning, somatic cell nuclear transfer. Cloning of domestic animals, conservation of endangered species; Gene therapy - methods of gene therapy; Ethical issues in animal biotechnology.

III

Animal genomics - Genome organization in eukaryotes, ,Eukaryotic DNA markers. Importance of gene mapping in livestock, methods and techniques used for gene mapping (physical mapping, linkage analysis, cytogenetic techniques, FISH technique), somatic cell hybridization, in-situ hybridization.

IV

Trends in vaccinology - Molecular approaches to development of vaccines: recombinant peptide vaccines, vectored vaccines, DNA vaccines, genetically manipulated live vaccines, cell culture based vaccines. Idiotype and synthetic peptide based vaccines, reverse genetic approach and computational vaccinology.

Practical: 2 Credit

1. Animal cell viability test.

2. Antigen- Antibody reaction (Precipitation and Agglutination).

3.Antibody titration (Ouchterlony and Double diffusion)

5. Purification of isolated Antibody.

6. Competitive and Noncompetitive immuno assay.

7.Western blot Analysis.

PG2 BIOT4015-3 Advanced Microbial Biotechnology

a. Fermenter/ Bioreactor, Design of pilot plant fermenter, Different parts of fermenter and their uses, Scale up process, Outline of downstream processings.

b. Biofertiliser & plant productivity: Bacterial- Nitrogen fixers symbiotic(Rhizobium),non-symbiotic(Azotobacter); Phosphate mobiliser (VAM), Vermicompost

c. Strain improvement.

d.Bioplastics

e. Xenobiotics and recalcitrant compounds

f: Bioremediation with respect to Arsenic, Chromium, Lead and Mercury

g. Microbial degradation of insecticides.

Practical: Credit 2

a: Isolation of toxic compound degrading bacteria.

b: Amylase, Cellulase production test.

c: Bioremediation Technology (demonstration).

d: 16S rRNA gene based molecular phylogenetic approach for identification of bacteria (theoretical demonstration or experimental knowledge if possible).

PG2 BIOT4015-4 Advanced Bioinformatics

1. Biological databases - Primary; Secondary/derived; structure (SCOP, CATH, PDB); metabolic pathway based (KEGG), Resources – NCBI; EBI; ExPASY.

2. Sliding window method in DOT matrix.

3. Substitution matrix – PAM and BLOSUM; generation and utility of different series.

4. Algorithm behind searching tools: BLAST; PSI-BLAST; PHI-BLAST; FASTA. Importance and creation of PSSM.

5. Dynamic programming algorithm and its use in sequence alignment. Multiple and Pairwise sequence alignment algorithms (Needleman and Wuncsh; Smith and Waterman). Iterative refinement of MSA.Basic idea of MSA editors (CLUSTALW/X; CINEMA). Pattern searching algorithm: HASH-CODING.

6. Phylogeny: Terminologies; Molecular clock hypothesis; Conversion from unrooted to rooted; Tree generation methods – UPGMA; FM; NJ; Maximum Parsimony/Likelihood; Bootstrapping and use of PHYLIP.

7. Protein Secondary structure prediction.

8. Some parameters for genetic study like: RSCU, CAI etc.

Practical: 2 Credit

1. Retrieval of data from different databases like: NCBI, KEGG.

2. Retrieval of protein structure from PDB and Visualization through different software like: Rasmol, Chimera, PyMOL.

3. Use of different ExPASY tools for sequence analysis.

4. Retrieval of homologous sequences through different BLAST.

5. Multiple/pairwise sequence alignment through clustalX/CINEMA and bootstrapped phylogenetic tree

generation using MEGA/PHYLIP and visualization through treeview/iTOL

6. Protein secondary and tertiary structure prediction through online server like SWISS MODEL.

7. Molecular Docking analysis

OR

OPTION- III: Only Research Thesis/ Project in 3rd & 4th Semesters

SEMESTER	Course Type	Code & Level	Name of the Course	Credit	L – T - P	Marks	Marks Dist. Th. – Pr. - IA
III	Research Thesis/ Project	PG2 BIOT3031 **(500-599)**	Research Thesis/ Project	20	0-0-20	250	0-250-0 Seminar Presentation, Preparation & Submission of Research Thesis/ Project Document -150 + Viva-100
IV	Research Thesis/ Project	PG2 BIOT4031 **(500-599)**	Research Thesis/ Project	20	0-0-20	250	0-250-0 Seminar Presentation, Preparation & Submission of Research Thesis/ Project Document -150 + Viva-100
	Total			**40**		**500**	