Unit IV:

Hypersensitivity: immediate (type I, type II, type III and type V) and delayed hypersensitivity (type IV); Immunodeficiency diseases – SCID and AIDS; Autoimmunity - organ specific (Hashimoto's thyroiditis) and systemic (Rheumatoid arthritis) diseases; Tissue transplantation – types, graft rejection and graft acceptance, immunosuppressive agents.

Suggested Reading:

1. Delves PJ, Martin, SJ, Burton DR and Ivan M. Roitt (2013). "Essential immunology" 13th Edition, Wiley Blackwell

2. John W.Kinball (1986). "Introduction to Immunology". Revised Edition, Macmillan, USA

3. D.M. Weir and Stewart (1997). "Immunology". 8th Edition, Churchill Livingstone Publisher

4. Punt J, Stanford S, Jones P and Owen JA (2018). "Kuby Immunology". 8th Edition, WH Freeman, UK

SEMESTER – II
COURSE-IV
BIOINFORMATICS & BIOSTATISTICS

Teaching hours for week	Credits	Internal marks	SEM end/ External marks	Max. marks
4	4	25	75	100

Course outcome: The course aims to help students understand:

- The basic bioinformatics tools and explains the importance and introduces them to the applications of computational methods in Biology.

- How to retrieve information from different biological databases by bioinformatic approaches.

- The biostatistical concepts, statistical tools to work with biological data and understand about the data by using tests of significance Chi-square test and ANOVA.

- And get trained in bioinformatics and biostatistics which paves a platform for research studies on field data.

   Students find jobs as Bio-statisticians, Data scientists in Bioinformatics industry, ICMR institttues as Project Scientists and may also get an opportunity in computational drug designing fields and pharmaceutical industries

Unit-I

Scope of computers in current biological research. Basic operations, architecture of computer. Introduction of digital computers. Organization, low level and high level languages, binary number system. The soft side of the computer – Different operating systems – Windows, Linux. Introduction of programming in C. Introduction to Internet and its applications.

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Unit-II

Introduction to Bioinformatics, Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases; An overview of types of biological databases – NCBI, EMBL, Gen bank, Swiss prot, and PDB. Database searching using BLAST and FASTA. Human Genome Project.

Unit-III

Sequence alignment-Introduction and significance of sequence alignments. Pair wise and Multiple sequence alignment. Gene and Genome annotation – Tools used. Physical map of genomes. Protein secondary structure prediction. Protein 3D structure prediction. Protein docking. Introduction to homology modeling, Computer Aided Drug Design (CADD) in Drug discovery. Molecular phylogeny - Concept methods of tree construction.

Unit-IV

Brief description and tabulation of data and its graphical representation. Measures of central tendency - mean, median, mode. Measures of dispersion- range, variance, standard deviation. Simple linear regression and correlation. Types of errors and level of significance. Tests of significance – t- test, Chi-square test, ANOVA.

Suggested Reading:

1. Stephen Misener & S.A. Krawez. (2000). "Bioinformatics Methods and Protocols", 1st Edition, Humana Press,
2. R. Durbin, S. Eddy, A. Krogh & G. Mitchson. (2002) Biological sequence analysis. 7th Edition, University Press, Cambridge
3. C.P. Freidman & J.C. Wyatt, (1997) Computers and machine: Evaluation methods in Medical information. Springer Verlag, New York.
4. M.J. Bishop & Rawling, (1997) DNA and Protein structure analysis: A Practical approach. Oxford University Press.
5. Mount DW (2004). "Bioinformatics – "Sequence and Genome Analysis" 2nd Edition, Cold Spring Harbor Laboratory Press, U.S
6. Arthur M.Lesk (2013). "Introduction to Bioinformatics". 4th Fourth Edition, Oxford University Press, Oxford.
7. Mahajan and Srimathi (2018). "Methods in biostatistics". 9th Edition. Jaypee brothers Medical Publishers,
8. PSS Sundar Rao & J Richard. (2012). "An introduction to biostatistics and Research methods" 5th Edition, PHI Learning, New Delhi

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SEMESTER- II PRACTICALS

Molecular Biology Lab

1. Isolationof DNAfrombacterial,plantandanimalcells.
2. IsolationofRNA fromyeastcells.
3. Estimationof DNA and RNA by UV absorption method and determination of purity of nucleicacids.
4. Agarosegel forRNA,DNA,blotthegel
5. Determination of sugar and phosphate ratios in DNA and RNA samples.
6. Determination of melting Temperature(Tm)of DNA.

Enzymology Lab

1. Assay of Amylase from saliva
2. Assay of Acid phosphatase from potato
3. Effect of substrate concentration on enzyme activity
4. Time course effect on enzyme activity
5. Effect of pH on enzyme activity
6. Effect of temperature on enzyme activity
7. Isoenzymes of LDH – electrophoretic separation and specific staining technique-demonstration

Immunology Lab

1. Determination of A, B, O and Rh blood groups in human beings
2. Diagnostic test for typhoid fever
3. VDRL Test
4. Bleeding time and clotting time
5. Total WBC count
6. Radial Immunodiffusion
7. Rocket immunoelectrophoresis- demonstration
8. Enzyme Linked Immuno Sorbent Assay (ELISA)- demonstration

Bioinformatics and Biostatistics Lab

1. Searching Data from NCBI Database.
2. Working on EMBL.
3. Searching structural data from PDB.
4. Genome Map viewer from NCBI.
5. Database search using BLAST.
6. Sequence alignments.
7. Measures of dispersion- Standard deviation
8. Correlation coefficient calculation
9. Tests of significance - one way ANOVA.

SEMESTER – III
COURSE-IV
MEDICAL AND ENVIRONMENTAL BIOTECHNOLOGY

Teaching hours for week	Credits	Internal marks	SEM end/ External marks	Max. marks
4	4	25	75	100

Course outcome: By the end of the course, the students will gain:

- Skills and knowledge on the health care products like insulin, growth hormone by using recombinant DNA Technology and vaccines for various viral infectionsB

- Knowledge in disease diagnosis, genetic diseases, gene therapy and approaches for development of vaccines to deadly diseases

- The knowledge in Environmental Pollution, Bioremediation, and energy production from waste

- Substantial knowledge to students to pursue their career in the field of medicine as research personnel including scientists

Students after completion of this course can work as biotechnologists in food, agriculture, bioremediation and human health sector

Unit-I

Health care products. Products from recombinant DNA Technology - insulin, growth hormone, factor VIII, tissue plasminogen activator, interferons, lymphokines and Hepatitis- B vaccines.

Unit-II

Disease diagnosis: DNA probes, Enzyme probes - glucose oxidase, lactate oxidase, onoamine oxidase. PCR amplification and diagnosis - Applications in forensic medicine. Genetic diseases and gene therapy. Current strategies for development of vaccines against HIV, Malaria, Tuberculosis.

Unit–III

Environmental pollution – types, sources and control. Reduction of environmental impact of industrial effluents, chemical herbicides and fertilizers. Removal of oil spills. Environmental monitoring and biomonitoring. Bioremediation - solid and liquid waste treatment. Biomass and energy production from waste. Bioleaching – Microbial recovery of metals and acid mine drainage. Water pollution and its control. Microbiological approach of waste water treatment.

Unit-IV

Environment and energy: Renewable sources of energy – Biogas, waste materials, energy crops, cellulose. Production of energy and fuel using microorganism – Biofuels and Biodiesel. Global environmental problems: Ozone depletion, UV-B, Green house effect. Biodiversity - benefits to mankind - Conservation; Ecology and sustainable development.

Suggested Reading:

1. BD.Singh (2014). "Biotechnology". 4th Edition, Kalyani publishers, New Delhi
2. PD Sharma, (2011). "Ecology and Environment", 3rd Edition, Rastogi publications
3. Odum, EP (2004). "Fundamentals of Ecology", 5th Edition, (Mc Graw Hill)
4. U. Satyanarayana (2020). "Biotechnology" (Books & Allied (P) Ltd).

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SEMESTER-III PRACTICALS

Cell Culture Technology and Tissue Engineering Lab

1. Preparation of media for plant tissue culture (MS and B5).
2. Establishment of callus cultures from carrot cambial tissue.
3. Establishment of cell cultures and plating.
4. Embryo culture of maize/ Crotalaria.
5. Organogenesis and regeneration of plants from tobacco explants.
6. Anther culture and production of haploids.
7. Micropropagation using suitable system: Potato / Solanum

Plant Biotechnology Lab

1. Isolation of genomic DNA from dicot and monocot plants.
2. Qualitative and quantitative analysis of plant genomic DNA
3. Amplification and cloning of a plant gene
4. Mapping of a plant gene. Analysis of a plant gene sequence using Clone Map Software
5. Western analyses of expressed plant protein.
6. *Agrobacterium* mediated plant transformation/Preparation of compotent cells
7. *Agrobacterium* Co-cultivation method
8. Strip test/dipstick test for GMO detection

Animal and Aquaculture Biotechnology Lab

1. Preparation of animal cell culture media and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. MTT assay for cell viability and growth.
4. Demonstration of sections of human ovary, testis and aborted human embryos.
5. Identification of some commercially important aquatic species.
6. Estimation of water quality parameters: Dissolved Oxygen, Alkalinity, Hardness
7. Identification and partial characterization of fish and shrimp pathogens.
8. Fish Pituitary hypophysation- Demonstration
9. PCR diagnosis of WSSV-Demonstration

Medical and Environmental Biotechnology Lab

1. Estimation of dissolved oxygen
2. Estimation of salinity in water samples.
3. Estimation of Chemical Oxygen Demand (COD).
4. Estimation of Biochemical Oxygen Demand (BOD).
5. Determination of suspended solids in industrial effluents.
6. Removal of colour of the industrial effluents by biological methods.
7. Reduction of pollution load in effluents by biological methods (laboratory models).
8. PCR - demonstration.

Unit-IV
Functional Genomics - ESTs, SAGE, Shotgun libraries. Conventional sequencing (Sanger and Maxam & Gilbert methods), automated sequencing. Analysis of Single nucleotide polymorphism (SNP) using DNA chips.

Suggested Reading:

1. T. Palzkill (2002). "Proteomics", Kluwer Academic Publishers
2. Jenny Gu, P.E. Bourne (2009). "Structural bioinformatics". 2nd Edition, Wiley Blackwell publishers
3. C. Kannicht (2002). "Methods in Molecular Biology Vol 194": Posttranlational modifications of proteins: Tools for functional proteomics" Himana Press, New Jersey
4. DW Mount (2004). "Bioinformatics: Sequence and Genome analysis", 2nd Edition, Cold Spring Harbor press
5. AD Baxevanis and BFF Ouellette "Bioinformatics: A practical guide to the analysis of genes and proteins", John Wiley and Sons Inc.
6. Stephen P. Hunt and Risk Livesey, eds., (2000). "Functional Genomics: A practical approach" 1st Edition, Oxford University Press.
7. Arthur Lesk. "Introduction to Genomics". 3rd Edition, Oxford University Press,
8. A. Malcolm Campbell. (2003). "Discovering Genomics, Proteomics and Bioinformatics" Benjamin Cummings

SEMESTER – IV
PAPER-IV
BIOETHICS, IPR AND RESEARCH METHODOLOGY

Teaching hours for week	Credits	Internal marks	SEM end/ External marks	Max. marks
4	4	25	75	100

Course outcome: After completing the course the students will get introduced to:

- Professional conducting, good laboratory practices and gain better understanding about Bioethics, good manufacturing practices and laboratory accreditation.

- IPR, copyrights, acquisition of rights and patent application process, obtaining patents and development of patent law. They will also be much aware of Patent specifications – International Institutions

- Protocols in research methodology and need based research, Research project planning, design of the experiments, evaluation of results, statistical approach, validation of findings and research communications.

- How to pursue good quality research in public and private sector organizations.

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Students after completion of this course can work as Patent officers in State, Central Organizations and also haveIntellectual property lead jobs in companies like Vakilsearch etc. They can also find jobs like content writers in academic industry

Unit–I

Introduction – causes of unethical acts, ignorance of laws, policies and procedures, recognition, friendship, personal gains. Professional ethics – professional conduct Ethical decision making, ethical dilemmas Teaching ethical values to scientists, good laboratory practices, good manufacturing practices, laboratory accreditation.

Unit–II

Socio-economic and legal impacts of biotechnology, national and international guidelines, experimental protocols approval, levels of containment Use of genetically modified organisms, their release in the environment, moral and ethical issues in biotechnology, cloning, safety issues with GMO.

Unit–III

Fundamentals of IPR, Basic Principles, Copyright, Trademark, Design, Geographical indication, Acquisition of rights and remedies for infringement of these IPRs- Patent Law History, development of patent law, basic principles, criteria, novelty. Utility and non obviousness, subject matter in US, UK, drafting patent specifications – International Institutions and International instruments (WTO, WIPO, TRIPS, CBT, Paris Convention, Budapest treaty)

Unit–IV

Introduction – Basic research, applied research, need based research, Identification of the problem, defining the problem, Research project planning, Literature search – Information sources, library resources – online literature search. Design of the experimental programme – variables in the experiments, materials and methods, evolution of methods, application of methods, Progress of research – evaluation of results, statistical approach, comparison with existing methodologies, validation of findings, research communications, impact factor of journals

Suggested Reading:

1. PK Gupta (2010). "Elements of Biotechnology. 2nd Edition, Rastogi & Co, New Delhi
2. P.K. Gupta. (2000). "Environmental Biology" 1st Edition, Rastogi Publ., Meerut, India.
3. V. Sree Krishna (2007). "Bioethics and Biosafety in Biotechnology" 1st Edition, New Age International Publishers.

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IV SEMESTER PRACTICALS

Industrial Biotechnology Lab

1. Production of protease/amylase by batch fermentation.
2. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
3. Screening of soil samples for isolation of bacteria, fungi and actinomycetes.
4. Microbial growth curve.
5. Production of alcohol by *S.cerevisiae* and its estimation.
6. Production of citric acid by *A. niger*.
7. Production of red wine from grapes.

Genetic Engineering and Gene Transfer Techniques

1. Isolation of DNA from blood
2. Isolation of RNA from yeast
3. Blotting Techniques
4. Gene transfer techniques
5. PCR applications

Proteomics & Genomics Lab:

1. Demonstrate familiarity with databases of information pertaining to genes, markers, maps
2. Diseases such as Online Mendelian Inheritance in Man (OMIM) and Medline;
3. Understanding the principles of designing oligonucleotide primers for PCR and utilization of relevant software;
4. PCR applications in assigning genotypes to RFLP / VNTR sequences;
5. Screening samples for identified mutations.
6. Immobilisation of an enzyme (amylase or invertase) and its assay.
7. Expression of an enzyme activity using a western Blotting technique.
8. Equation for substrate consumption in an immobilized cell reactor.
9. Affinity purification of Histidine Tagged proteins.
10. Expression of Eukaryotic protein in a prokaryotic system.

Bioethics, IPR And Research Methodology Lab:

1. Intellectual property and India: e filing of patents , Trademarks.
2. On line patent search.
3. Online patent register and application status.
4. Online public search for Patents, trademarks and design.
5. e filing services for designs, GI, status of patents, designs, trademarks,
6. IP Case studies.
7. WIPO online database search.

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