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 their importance, 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 the data by using tests of significance Chi-square test and ANOVA.

- Bioinformatics and biostatistics which paves a platform for research studies on field data.

Students find jobs as Bio-statisticians, Data scientists in Bioinformatics industry, 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

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Medical Publishers.

8. PSS Sundar Rao & J Richard. (2012). "An introduction to biostatistics and Research methods" 5th Edition. PHI Learning, New Delhi

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

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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.

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5.L.E.Casida JR (2016). "Industrial Microbiology" 2ndEdition , New Age International Publishers.

6.R. G. McKinnell, R. E. Parchment, A. O. Perantoni, G.Barry Pierce, I. Damjanov (2006). "The Biological Basis of Cancer", 2ndEdition, Cambridge University Press, UK.

7.R. A. Weinberg (2006). "The Biology of Cancer", Garland Science, New York.

SEMESTER – IV
COURSE -IV
OMICS, BIOETHICS 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 be able to:

- Acquire knowledge on advanced computational biology on proteins and genes.
- Study proteomics and genomics and understand online protein structure prediction tools and gene identification and sequencing tools.
- Study insilico analysis for novel genes and proteins.
- Understand the concepts of bioethics, intellectual property rights (IPR) and research methodology.
- Develop research articles and research proposals writing skills which is an entry step for research field.

After completion of this course the student can be placed as Data Scientists/ Computational Biologists in Bioinformatic companies and Research institutes as content writers in the academics.

Unit I:

Proteomics - Introduction, principle and techniques – 2D gel electrophoresis, 2D-DIGE, MALDI-TOF, Quadrupole Time-of-Flight (Q-TOF); Significance and applications of proteomics in modern biology; Molecular Modeling – Structure of protein at Primary, secondary, tertiary and quaternary level; Understanding Molegro Molecular viewer for protein 3D visualization – RASMOL.

Unit II:

Genomics- Whole genome sequencing and/or analysis; Preparation of cosmid libraries, bacterial artificial chromosomal libraries, shotgun libraries;Sequencing - conventional sequencing (Sanger, Maxam and Gilbert Methods), automated sequencing, Sequence analysis – BLAST, Sequence assembly, Gene prediction; Comparative genomics - Orthologs, paralogs, andhomologs.

Unit III:

Introduction to Bioethics, Genetic Testing- Merits and Demerits; Human Genome Project Ethical, Legal, Social Issues (ELSI); Biosafety- Guidelines for Research in Transgenic organisms; Introduction of Genetically Modified Organisms into environment; Regulations to Biotech companies, Good laboratory practices (GLP), Good Manufacturing Practices (GMP), laboratory accreditation; Patenting and Intellectual Property Rights (IPR).

Unit IV:

Research Methodology – Basics, Origin and identification of problem, Literature survey, Formulation of hypothesis, Experimental design, Execution, Sampling, Analysis of data, Testing of hypothesis, Interpretation of research findings; Methodology for writing science report and program of writing, useof vocabulary, art of illustration and manuscript writing for publication in peer reviewed scientific journals; Preparation of project proposal- Project description, goals, work plan, progress reporting.

Suggested Reading:

1. Primrose S.B. (1998). "Principles of Genome Analysis: a guide to mapping and sequencing DNA from different organisms" , 2nd Edition, Blackwell Science, Oxford.

2. Paul H Dear (1997). "Genome Mapping: A practical approach", Oxford University Press, Oxford.

3. Alfonso Valencia and Blaschke(2001). "Developing Bioinformatics Skills" O'Reilly Media Inc. Publication.

4. Des Higgins and WillieTaylor (2000). "Bioinformatics: sequence, structure and data banks", Oxford University Press.

5. Zhumur Ghosh and Bibekanand Mallick (2008). "Bioinformatics: Principles and Applications", Oxford University Press.

6. V. Sree Krishna (2007). "Bioethics and Biosafety in Biotechnology" 1st Edition, NewAgeInternationalPublishers.

7. M.K.Sateesh I.K. (2009). "Bioethics and Biosafety", International Publishing House Pvt.Ltd.

IV SEMESTER PRACTICALS

Plant and Environmental Biochemistry Lab

1.Estimation of total chlorophyll, chlorophyll a and chlorophyll b pigments fromthe leaves.

2.Estimation of starch content by Anthronereagent.

3.Spectrophotometric estimation of Indole acetic acid in planttissues.

4.Determination of Gibberllic acid by half seedmethod.

5.Determination of protein under abioticstress.

6.Isolation of chloroplastDNA

Clinical Biochemistry and Human Nutrition Lab

1.Estimation of bloodglucose.

2.Estimation of bloodurea.

3.Estimation of creatinine inserum.

4.Estimation of uric acid inserum.

5.Estimation of serum totalprotein.

6.Estimation of Serumalbumin.

7.Estimation of Serumcholesterol.

8.Estimation of serumcalcium.

9.Estimation of serumphosphate.

1.Estimation of serumbilirubin.

Applied Biochemistryand Cancer Biology Lab

1.Isolation of genomic DNA from animal cellculture

2.Quantitative and quantitative analysis of genomic DNA isolated from animal cellculture

3.TLC of Plant tissue culturecompounds

4.Estimation of plant tissue cultureproteins

5.SDS PAGE of cell cultureproteins.

6.Immobilization of enzymes(demonstration)

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7.Primer designing foroncogenes

8.Gene expression analysis of oncogenes by polymerase chainreaction.

Omics, Bioethics and Research Methodology Lab

1.OMIM database and human geneticdisorders

2.Retrieve DNA sequence from database(NCBI)

3.Retrieve protein sequence from database(NCBI)

4.Retrieve protein structure fromdatabase(PDB)

5.KEGG database forpathways

6.Local alignment of DNA,protein

7.Global alignment of DNA,protein

8.Multiple sequencealignments

9.In silicorestrictionmapping