Department of Microbiology

Faculty of Allied Health Sciences SGT

UNIVERSITY

Shree Guru Gobind Singh Tricentenary University
Gurugram-122505

Syllabus &Bye-laws

M.Sc. (Biotechnology& Bioinformatics)

Duration: 2 years (4 Semesters)

W.e.f. Academic Session 2022-23

M.Sc(Biotechnology& Bioinformatics)

Semester I

Paper	Subject	Paper Code	Theory Examination		Practical Examination		Total Marks	Credits
			Univ. Exam.	Int. Assess-ment	Uni v. Exa	Int. Asses s -ment		
1	Cell and Molecular Biology	05530101	60	40			100	4
2	Biochemistry & Enzymology	05530102	60	40			100	4
3	Microbiology & Virology	05530103	60	40			100	4
4	Research Methodology & Biostatistics	05530104	60	40			100	4
5	Basic Bioinformatics & Computer Programming	05530105	60	40			100	4
6	Practical I (Cell & Molecular Biology, Biochemistry & Microbiology)	05530106			20	30	50	2
7	Practical II Basic Bioinformatics & Computer Programming	05530107	-	-	20	30	50	2
8	Critical Research Appraisal	05530108	-	-		50	50	2
	Total		**300**	**200**	**40**	**110**	**650**	**26**

Semester II

9	Genetics	05530201	60	40			100	4
10	Genomics & Proteomics	05530202	60	40	-	-	100	4
11	Plant and Animal Biotechnology	05530203	60	40			100	4
12	Advanced Computer Programming	05530204	60	40	-	-	100	4
13	Advanced Bioinformatics	05530205	60	40			100	4
14	Practical III (Genetics, Plant & Animal Biotechnology)	05530206			20	30	50	2
15	Practical IV (Practical Bioinformatics &Programming)	05530207			20	30	50	2
16	Project Development & Seminar	05530208				50	50	2

	Total		**300**	**200**	**40**	**110**	**650**	**26**
SemesterIII								
17	Immunology	05530301	60	40			100	4
18	Nanobiotechnology	05530302	60	40			100	4
19	Fermentation & Bioprocess Technology	05530303	60	40			100	4
20	Data Analysis in Genomics &Transcriptomics	05530304	60	40			100	4
21	Structural Bioinformatics & Drug Design	05530305	60	40			100	4
22	Practical V (Immunology, Nanobiotechnology, Fermentation & Bioprocess Technology)	05530306			20	30	50	2
23	Practical VI (Structural Bioinformatics and Drug Design)	05530307			20	30	50	2
24	Technical Writing and Seminar	05530308	60	40			100	4
	TOTAL		**360**	**240**	**40**	**60**	**700**	**28**
Semester IV								
25	Intellectual Property Rights, Bioethics & Bio-entrepreneurship	05530401	60	40			100	4
26	Project & Dissertation	05530402			120	180	300	12
	TOTAL		**60**	**40**	**120**	**180**	**400**	**16**

Total Credits: 96

VISION

To produce the best students in the field of Biotechnology and Bioinformatics byimpartingqualityeducationandtrainingtothestudents.Departmentvisualizes the scholastic achievements of its students in order to fulfill thedemandoffood,fuel,fiberandmedicinesforever-increasingglobalpopulation in a sustainable manner.

MISSION

- To develop trained human resource in the field of biotechnology.
- To develop the Department as an internationally reputed center for research in biotechnology.
- To develop the Department as a resource centre for providing instrumentation and training facility to the researchers and students in the region.

Programme Educational Objectives (PEOs)

After completing M.Sc. Biotechnology & Bioinformatics, student will be able to:

PEO No.	Education Objective
PEO1	StudentsWill develop the high skills, globally in field of Biotechnology and Bioinformatics and enable students to pursue the career in research institute, industry and academia.
PEO2	Studentswill be empowered with theoretical and practical (research) skills tonurture entrepreneurial endeavors and to prepare a competent generation ofBiotechnologists and Bioinformatician capableofexcellingin career in this field.
PEO3	Post graduate students will train in basic and applied molecular biology, immunology, industrial biotechnology, bioinformatics.
PEO4	The post graduate students will be able to choose a decent career option either as entrepreneur or having a high degree of employability by empowering students with basic interpersonal skills, ability to handle critical situations.
PEO5	Will develop the better understanding of new technologies using modern, resources Develop new technologies, protocols, resources, using modern molecular biology, biotechnology and bioinformatics tools and apply it to solve complex human health problems.
PEO6	The post graduate students will provide sustainable solutions of global problems through research and innovation capabilities with their expertise.

PROGRAMME OBJECTIVES (POs)

PO No.	Attribute	Competency
PO1	Technical skills	Post graduate students apply deep knowledge of Biotechnology and Bioinformatics and their role in as health, food, Pharmaceutical Biotechnology, Environmental Biotechnology, Agriculture Biotechnology, Drug Designing and Bioinformatics.
PO2	Ethical value and professionalism	Students apply knowledge the Biotechnology and Bioinformatics for human and animal welfare and apply ethical principles established by different governmentagenciesandcommittoresearchethics,responsibilities,andnormstoundertaketheircurrent and future researchanddevelopment.
PO3	Life-long learning	To enable to the post-graduate students with deep knowledge of theoretical and practical in field of biotechnology, molecular biology, immunology, Bioinformatics with international standard.
PO4	Professional knowledge	To prepare the post students in basic and applied knowledge and enable to handle Biotechnology in its various domains including, health, nutrition, agriculture, biodiversity conservation, Bio safety etc.
PO5	Entrepreneurship, leadership and mentorship	Students apply gained knowledge to address society and choose a decent career option for either as Entrepreneur or having a high degree of employability work as independent thinker and researcher effectively as an individual, and as a member or leader of different teams, and in multidisciplinary research Institutions and Universities, Pharmaceutical industries etc.

Semester I
M.Sc. (Biotechnology& Bioinformatics)

1. Cell and Molecular Biology (05530101)

COURSE OBJECTIVES: The purpose of this course is to introduce the student to the advanced concepts in molecular biology. Student will gain an understanding of Cell structural and functional organization and also DNA a carrier of genetic information, Chemical structure and base composition of DNA.

LTP Credits-4 Examination: 60Marks
Total: 100 marks Int.Assessment: 40Marks

Course Outcomes (COs)

CO 1: Students understand cell structure and Methods in Cell Biology.
CO 2: Understand the organization and properties of cell and cell signaling.
CO 3: To know the concept of cell cycle and cell death.

CO 4: To understand the Protein synthesis and processing.

Unit-I: Cell Structure and Methods in CellBiology

Cell: structural and functional organization, Cell motility, other sub cellular organelle like Nucleus, Endoplasmic reticulum, Golgi, Mitochondria, Lysosomes; Fractionation of sub cellular organelles, Principles and applications of the microscopy, Cell counting.

Unit-II: Bio-membrane structure andFunction

Plasma Membrane: organization and properties, Dynamics transport across membrane, Cell signaling: Types of receptors (Intracellular and cell surface), signal transduction by membrane bound, cytosolic and nuclear receptors via various pathways.

Unit-III: Cell Cycle & Cell Death

Mitosis, Meiosis, Eukaryotic Cell cycle and its regulation, Apoptosis, Cancer biology - Mechanism of carcinogenesis, tumor suppressor genes and oncogene.

Unit-IV: Structure and Functions of Nucleic Acids:

DNA: A carrier of genetic information, Chemical structure and base composition of DNA, Watson-Crick model, supercoiled DNA, Conformation of nucleic acids: A-, B-, Z- DNA, Stability of nucleic acid structure, DNA replication, enzymes involved, DNA damage and repair mechanisms. RNA structure, functions and transcription.

Unit-V: Protein synthesis and processing:

Translation: formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, posttranslational modification of proteins, translational inhibitors,.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	2	2	-
CO2	1	-	2	3	-
CO3	1	-	2	2	-
CO4	2	-	2	2	-
Average	1.25	-	2	2.25	-

Suggested readings:

1. Lewin, B. Gene X, Oxford University Press.
2. Brown, T.A. Genomes, John Wiley and Sons Inc.
3. Brown. T.A. Molecular Biology LabFax, Bios Scientific Ltd.
Oxford.
4. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. Molecular Biology of the Cell, Garland Publishing.
5.Lodish, H., Berk, A., Zipursky, S., Matsudaira, P., Baltimore, D. and Darnell, J.E Molecular Cell Biology, W.H. Freeman and Company.

Semester I

2. Biochemistry &Enzymology (05530102)

COURSEOBJECTIVES:Attheendofthecourse,thestudentshouldbeabletounderstand thevariousbiochemicalpathwaysinvolvedinpropagationoflife,understandtheworkingof enzymes as biocatalysts and use of enzymes-based technology and carbohydrates metabolism.

LTP Credits-4 Examination: 60Marks

Total: 100 marks Int.Assessment: 40Mark

Course Outcomes (COs)

CO 1: Gain the deep knowledge of carbohydrates, proteins and lipids.
CO 2: Understanding of carbohydrates metabolism and its role.
CO 3: To know the concept of pH, buffer and nucleic acid.
CO 4: Enhance the knowledge of enzymes, factor affecting and applications.

UNIT I:

Carbohydrates: Structure and function, classification: mono-, di- and polysaccharide glycoproteins. Metabolism of carbohydrates- Glycolysis, Citric acid cycle, Gluconeogenesis ar Pentose phosphate pathways and their regulations.

UNIT II:

Lipids: Structure of fatty acids, Classification of lipids, essential fatty acids, Structure ar functions of major lipids, subclasses- Acylglycerols, Phospholipids, Glycolipids, lipoprotein Sphingholipids, and Steroids. Fatty acids: oxidation.

Unit III:

Proteins: Structure and classification of amino acids, non-protein and rare amino acid Metabolism of amino acids, urea cycle.Structural organization of proteins, Protein seconda structure, tertiary structure, quaternary structure with examples, protein denaturing ar renaturing.Role of chaperons in protein folding.

Unit IV:

Ph, buffers and Nucleic acids: pH, buffers, Henderson-Hasselbalch equation. Nucleic Acid Structure and properties of nucleic acid bases, nucleosides and nucleotides. Biosynthesis ar regulation of purines and pyrimidines.

Unit-V:

Introduction to Enzymes & Enzyme Kinetics

Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactor Co-enzyme and Prosthetic group, Nature of active site, Activation energy, Lock and Key Mode Induced fit Theory, Enzyme activity, Factors affecting enzyme activity. Determination of K and Vmax values, Enzyme inhibition: reversible and irreversible inhibition.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	3	-
CO2	2	-	3	2	-
CO3	2	-	3	3	-
CO4	2	-	3	2	-
Average	2	-	3	2.5	-

Suggested readings:

1.Biochemistry by Geoffrey L. Zubay. Fourth Edition, Addison-Wesley educational publishers Inc.,2008

2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox. Fifth Edition, W.H.Freeman and Company; 2008.

Semester I

3. Microbiology & Virology(05530103)

COURSE OBJECTIVES: The purpose of this course is to understand students about the viruses, their replication and pathogenesis of various diseases caused viruses.

LTP Credits-4	Examination: 60Marks
Total: 100 marks	Int.Assessment:40Marks

Course Outcomes (COs)

CO 1: Gain the theoretical knowledge of Historical background and scope of microbiology.
CO 2: To know the different types of culture media different phases of bacterial growth.
CO 3: Understand of Different recombination methods in bacteria.
CO 4: Gain theknowledge of detail classification and cultivation of viruses .

UNIT I: Introduction to Microbiology:

Historical background and scope of Microbiology. Structure of prokaryotic and eukaryotic cell.Differences between Eubacteria, Archaebacteriaand Eukaryotes. Salient features of different groups of microorganisms - bacteria, fungi, protozoa, virus and algae including mode of reproduction. Nutrition and Classification: Principles of microbial nutrition- Chemoautotrophs, chemoheterotrophs, photoautotrophs and photoheterotrophs.

UNIT II: Microbial Growth: Culture media and its types: Microbial growth: definition and different phases of growth. Measurement of microbial growth.Bacterial growth curve.Factorsaffecting microbial growth.Culture collection and maintenance of microbial cultures.

UNIT III: Genetic recombination in Bacteria: Conjugation, transformation, Transduction. DNA replication, repair and recombination.RNA synthesis and processing.Protein synthesis and processing.Control of gene expression at transcription and translation level.

UNIT IV: General Virology: Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctiveproperties of viruses; morphology &ultra structure; virus related agents (viroids, prions).Cultivation of viruses in embryonated eggs, experimental animals, and cell culture.

UNIT V: Viral vaccines: conventional vaccines, genetic recombinant vaccines used in national immunization programmes with examples, newer generation vaccines including DNA Vaccines with examples) interferons, and antiviral drugs.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	-	-	3	1	-
CO2	2	-	3	3	-
CO3	2	-	3	2	-
CO4	1	-	3	2	-

Average	1.25	-	3	2	-

Recommended Books:

1. Morang C and Timbury M.C (1994) medical virology-X- Edition. Churchill Livingstone, London.
2. Dimmock NJ, Primrose SB (1994). Introduction to modern Virology, IV Edition, Blackwell Scientific Publication, Oxford.
3. Topley and Wilson's (1995) Text Book on Principles of Bacteriology, Virology and immunology. Edward Arnold, London.

4. Research Methodology & Biostatistics(05530104)

COURSE OBJECTIVES: The purpose of this course is to understand students about the basic concept of research methodology and biostatistics.

LTP Credits-4 Examination: 60Marks
Total: 100 marks Int. Assessment: 40Marks

COURSE OUTCOMES (COs)

CO1: Students able to understand how to derive a research problem and specific objectives that will help them in writing research projects/hypothesis in future.
CO2: To understand the ethical obligations associated with the conduction of a good and honest research.
CO3: Students will learn how to arrange and analyse data and the mistakes to be avoided while inferring the results
CO4: Students understand the importance of statistics in the research andgain the knowledge particular statistical concepts.

UNIT-I: Introduction and Some Basic Concepts: Sample and population. Statistical definitions.Randomsampling.Testingofhypothesis.Statisticaltoolsforcollection,presentationandan alysis of data relating to causes and incidence of diseases. Measurement of central tendency. Measures of variation. Frequency distribution.

UNIT-II Concept of Probability: Laws of Probability. Probability Distribution Binomial, Normal and Chi-square distribution Commonly used procedures and test of significance and estimation Correlation and regression Test of significance namely Z test, T test, Chi square test, F test Analysis of variance.

UNIT-III Research Statistics: Research Statistics pertaining to medical laboratory technology Testing the efficacy of manufacturing drugs Medicines and injections for curbing and controlling specific diseases Statistical analysis of instrumental data and comparison of various biological techniques used in hospitals.

UNIT-IV Health care – an overview: Functions of Hospital administration Modern techniques in Hospital management Challenges and strategies of Hospital management Administrative

Functions– Planning, Organizing, Staffing, Leading and Controlling Organizational Structure, Motivation and leadership. Designing health care organization.

Hospital Management: Medical record, House-keeping services. Laboratory performance.Management of biomedical waste.

Total patient care – indoor and outdoor.Nursing and ambulance resources, Evaluation ofhospitalservices.Qualityassurance.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	3	-
CO2	1	3	3	2	-
CO3	2	-	3	2	-
CO4	1	-	2	2	-
Average	1.5	0.75	2.5	2.25	-

Semester I

5. Basic Bioinformatics & Computer (05530105)

COURSE OBJECTIVES: The purpose of this course is to familiarize students about the conceptsandapplicationsofbioinformaticsandtounderstandtypesofliteraturedatabases, Sequencing analysis and their uses to understand to biology.

LTP Credits-4	Examination: 60Marks
Total: 100 marks	Int.Assessment:40Marks

Course Outcomes (COs)

CO 1: Gain the knowledge of the data mining and its application.
CO 2: To know the biological data bases, protein and nucleic acid data bases.
CO 3: Understand of sequence analysis .
CO 4: Know the bioinformatics application and basic concept of phython and application in biomedical studies.

Unit I
Introduction to Bioinformatics

Definition and History of Bioinformatics, Introduction to Data Mining and used Technologies, Applications of Data Mining to Bioinformatics.

Unit II. Biological Databases

Different types of Genebank databases, Database searches: sequence retrieval systems; Similarity searching: BLAST, FASTA, Protein and nucleic acid databases.

Unit III. Sequence Analysis

Collecting and storing the sequence, Sequence alignment, Pair wise alignment techniques, Dot matrix method, Multiple sequence alignment, CLUSTAL W and CLUSTAL X.

Unit IV. Applications of Bioinformatics

Phylogenetic analysis: Sequences alignment and construction of phylogenetic tree, Role of phylogenetic tree in evolutionary studies, Protein structure prediction: primary and secondary.

Unit V
Computer Programming

Basic concept of phython and application in biomedical studies.Numbers, lists, strings, tuples, dictionary; functions in Python; modules in Python; files and file operations in Python.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	3	-
CO2	2	-	3	3	-
CO3	2	-	2	3	-
CO4	2	-	3	3	-
Average	2	-	2.5	3	-

REFERENCES:

1. David W. Mount, Bioinformatics Sequence and Genome Analysis, CBS Publishers Distributors
2. S. C. Rastogiet. al. Bioinformatics- Concepts Skill and Applications, CBS Publishers and Distributors
3. T. E. Creighton, Protein Structure and Molecular Properties, W.H.Freeman and Company
4. Andreas D. Baxevanis, B. F. Francis Ouellette, Bioinformatics; A Practical Guide to the Analysis of Genes and Proteins, John Wiley & Sons, Inc.
5. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press.

Textbooks and Reference books:

1. B. W. Kernighan and D. Ritchie; The C Programming Language; Pearson Education India, 2nd edition,2015.
2. Balagurusamy; Programming in ANSI C; McGraw Hill Education India Private Ltd, 7th edition,2017.
3. H.Schildt;C- TheComplete Reference;McGrawHill,4th edition,2017.

Semester I

6. Practical I (Cell & Molecular biology, Biochemistry and Microbiology) (05530106)

LTP Credits-2 Examination: 20 Marks
Total: 50 marks Int. Assessment: 30 Marks

Course Outcomes (COs)

CO 1: Gain the practical knowledge and handing cell culture techniques.
CO 2: Know the extraction of DNA and RNA.
CO 3: Understand the techniques like PCR, Agarose gel electrophoresis .
CO 4: Gain the knowledge different biochemistry and microbiology techniques .

- **Cell & Molecular Biology:** Subcellular fractionations of tissue by centrifugation, Microscopy: Bright field. Animal tissue culture, cell counting, cell viability, cell cycle by flow cytometer,

immnuofluroscence by florescence.

- Extraction of DNA andRNA.
- Isolation and purification ofplasmid
- Agarose gelelectrophoresis.
- Polymerase chainreaction (PCR)
- Cloning of specific gene.

- **Biochemistry:** Qualitative analysis of carbohydrates.
- Identification tests for Proteins
- Preparation of buffer and measurement of pH
- Qualitative analysis of urine for abnormal constituents

- **Microbiology:** Isolation of microorganism: Serial dilution, pure culture techniques
- Perform gram's staining procedure
- Preparation of important microbiological media
- Isolation of bacteria from water samples.
- Perform antibiotic sensitivity test
- Study of important viruses (photographic demo)
- Study of important protozoa (photographic demo)

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	-
CO2	3	-	3	2	-
CO3	3	-	2	3	-
CO4	3	-	2	3	-
Average	3	-	2.5	2.75	-

Semester I

7. Practical II (Basic Bioinformatics & Computer Programming) (05530107)

LTP Credits-2 Examination: 20 Marks
Total: 50 marks Int. Assessment: 30 Marks

Course Outcomes (COs)

CO 1: Gain the basic knowledge of database searching and phylogenetic analysis .
CO 2: Understand the primer design using softwares.
CO 3:Knowledge of multi threading dxception handling .
CO 4: Understand of tools application like Motif and domain prediction.

1.Database searching 2. Phylogenetic analysis 3.Sequence analysis methods 4.Protein structure prediction 5.Primer design using softwares.6.CGI programming; multi threading; dxceptionhandling;XMLprocessing;GUI programming.7.Application tools: Motif and Domain prediction: PROSITE,Emotif, ProDom,Pfam, primer designing,

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	3	-
CO2	2	-	2	3	-
CO3	2	-	2	3	-
CO4	2	-	2	2	-
Average	1.75	-	2.25	2.75	-

Semester I

8. Critical Research Appraisal (Report Submission)

(05530108)

Course Outcomes (COs): On successful completion of this course, students will able to:

CO 1. Gain the basic knowledge of review and research article.
CO 2. Develop writing skills of research and review article.
CO3. Gain the knowledge of original research papers.
CO4. Knowledge of target of particular inhibitors for research.

The student is expected to read and critically evaluate minimum of 5 papers and present the inference of every part in a clear and precise manner in the form of a report and short seminar at the end of semester based on which the student will be evaluated.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	-	-	3	3	-
CO2	2	-	3	3	-
CO3	-	-	2	2	-
CO4	-	-	2	2	-
Average	0.5	-	2.5	2.5	-

Semester II

9. Genetics (05530201)

LTP Credits-4 | Examination: 60Marks
Total: 100 marks | Int. Assessment: 40Mark

Course Outcomes (COs)

CO 1: Theoretical knowledge of Mendelian principles and concept of gene .
CO 2: Gain the Knowledge of the Gene mapping methods like Linkage maps,tetradanalysis.
CO 3: Know the Mutation, types and causes.
CO 4: know the homologous and non-homologous recombination including the transposition .

Unit-I

Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance.

Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests.

Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit-II

Genemappingmethods:Linkagemaps,tetradanalysis,mappingwithmolecularmarkers,mapping by using somatic cellhybrids.

Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Unit-III

Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Recombination: Homologous and non-homologous recombination, including transposition, site-specific recombination

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	-	-	3	2	-
CO2	-	-	3	3	-
CO3	-	-	2	2	-
CO4	-	-	2	2	-
Average	-	-	2.5	2.25	-

Recommended Books: -

1. Lewin: Genes, Vol. VII Oxford, 1998,Indeed.
2. Snustad et al: Principles of Genetics 1997, John Wiley &Sons,
3. De Robertes & Robertis: Cell & Molecular Biology, 1987, Lee & FabigerPhiladelplna
4. Strickberger: Genetics, 1996, PrenticeHall
5. Friefelder: Molecular Biology (2nd ed.), 1996 Narosa Publ.House,
6. Alberts et al: Molecular biology of the cell (4th ed.) 1994, Garland Publ. NewYork.
7. Elliott & Elliott: Biochemistry and Molecular Biology, 1996,Oxford

Semester II

10. Genomics and Proteomics (05530202)

LTP Credits-4 — Examination: 60 Marks
Total: 100 marks — Int. Assessment: 40 Marks

Course Outcomes (COs)

CO 1: Theoretical knowledge of genome analysis and genome sequencing.
CO 2: Understand theGene mapping methods like Linkage maps,tetradanalysis.
CO 3: Gain the knowledge theDNA chips and their use in transcriptome analysis.
CO 4: know the-bio-informatics in proteomics and Proteome analysis.

Unit I

Structural genomics: Classical ways of genome analysis, large fragment genomic libraries; Physical mapping of genomes; Genome sequencing, sequence assembly and annotation; Comparative genomics, etc.

Unit II

Functional genomics: DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics; Metabolomics and ionomics for elucidating metabolic pathways, etc.

Unit III

Proteomics - Protein structure, function and purification; Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis, etc.

Unit IV

Applications of genomics and proteomics in agriculture, human health and industry.

Suggested Readings

Azuaje F &Dopazo J. 2005.Data Analysis and Visualization in Genomics and Proteomics.John Wiley & Sons.
Brown TA. 2007. Genome III. Garland Science Publ.
Campbell AM &Heyer L. 2004.Discovery Genomics, Proteomics and Bioinformatics.Pearson Education.
Gibson G & Muse SV. 2004. A Primer of Genome Science. Sinauer Associates.
Jollès P &Jörnvall H. 2000. Proteomics in Functional Genomics: Protein Structure Analysis. Birkhäuser.
Kamp RM. 2004.Methods in Proteome and Protein Analysis.Springer.Primrose SB &Twyman RM. 2007. Principles of Genome Analysis and
Genomics. Blackwell.
Sensen CW. 2005. Handbook of Genome Research.Vols.I, II.Wiley CVH.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	3	-
CO2	1	-	3	2	-
CO3	1	-	3	2	-
CO4	2	-	3	3	-
Average	1.5	-	3	2.5	-

Semester II

11. Plant and Animal Biotechnology (05530203)

LTP Credits-4 — Examination: 60 Marks
Total: 100 marks — Int. Assessment: 40 Marks

Course Outcomes (COs)

CO 1: Understand of plant tissue culture and techniques.

CO 2: Know the Protoplast isolation, Culture and its applications and also somatic hybridizaods and applications.

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CO 3: Know the viral resistance, fungal resistance, Insects and pathogen resistance.
CO 4:Know the animal tissue culture like primary and secondary cultures

Unit-I

Plant Tissue Culture

Historical perspective; Totipotency; Organogenesis; Somatic embryogenesis; Artificial seed production; Micropropagation; Somaclonal variation; Androgenesis and its

applications in genetics and plant breeding; Germplasm conservation.

Unit-II

Protoplast culture and SomaticHybridization

Protoplast isolation; Culture and its applications; somatic hybridizaods and applications;

Unit-III

Biotic and Abiotic Stress Resistance/Tolerance in plants

Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogen resistance; Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance.

Unit-IV
Animal Tissue Culture

Primary and secondary cultures, Nutrient requirements of mammalian cells.Media for culturing cells.Established cell lines.Suspension culture techniques.Generation of immortal cellines.Cell separation techniques.karyotyping, cryopreservation and revival, Detection and prevention of contaminants in cell cultures. Commercial applications of animal tissue culture

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	2	2
CO2	2	-	3	2	1
CO3	1	-	3	1	-
CO4	1	-	3	2	1
Average	1.5	-	3	1.75	1

Text books/ References:

1) Animal Cell Culture Technique, Ed. Martin, Clynes. Springer,1998
2) Animal Cell Culture-Practical Approach, 3rd Edition, Ed. John R.W. Masters, Oxford University Press,2000
3) Stem Cells, C.S.Potten, Elsevier,2006
4) Stem Cell Biology and Gene Therapy, Peter J. Quesenberry, 1st Edition, Willy – Less, 1998

Semester II

12. Advanced Computer Programming (05530204)

LTP Credits-4 Examination: 60Marks
Total: 100 marks Int.Assessment:40Mark

Course Outcomes (COs)

CO 1: Understanding of the advanced computer programming like C++Programming.

CO 2: Know the string manipulation; control statements/looping; functions – different types like recursive function.

. CO 3: Know the Basic Java and learning the basics of Java in comparison to C++.

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CO 4: Know the packages and spplets.

Unit I

Advanced C

Dynamic memory allocation; function pointers; advanced data structures–list, stack,queue.

C++Programming

Introductiontoobjectorientation;challengesofmovingontoOOPfromotherparadigms;OOADvsOOP ; How C++ supports OOP; other paradigms C++ supports; approach towards problem solving under OOAD and OOP.

Unit II

Headers; directives; moving towards a class; structure of C vs class of C++; access specifiers; effectof access specifiers at class level; creation of objects from classes; effect of access specifiers atobject level; memory space of an object; data types and data structures under C++; arrays,vectors, string manipulation; control statements/looping; functions – different types like recursivefunction,parameterpassing.

Unit III

BasicJava

HistoryofJava,FeaturesofJava,JVM,JREandJDK.

JavaQuickStart:LearningthebasicsofJavaincomparisontoC++.Objectorientedprogrammingin Java: Classes, interfaces and packages; access modifiers; constructors; the this and superreferences; inner classesandnestedclasses; anonymousclasses. Object derivations.

UnitIV

Packages and spplets; The java.lang and java.util: object class; class class and the reflection API;dystem and tuntime classes; properties class; wrapper classes; overview of other classes..

The java.io Package inputstream, outputstream, reader, writer, and their sub-classes; file class;randomaccess file class, streamtokenizer. Applets: applications of applet; the applet lifecycle;loadingapplets.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	3	2
CO2	2	-	2	2	-
CO3	2	-	2	2	1
CO4	1	-	2	3	1
Average	1.75	-	2	2.5	1

Text books and Reference books:

1. B. W. Kernighan and D. Ritchie; The C Programming Language; Pearson Education India, 2nd edition,2015.
2. E. Balagurusamy; Programming in ANSI C; McGraw Hill Education India Private Ltd, 7th edition,2017.
3. H.Schildt;C –TheComplete Reference;McGrawHillEducation,4th edition,2017.
4. B.J.Stroustrup;TheC++ProgrammingLanguage;AddisonWesley,4th edition,2013.
5. H.Schildt;TheCompleteReferenceC++;TataMcGraw Hill,1998.

Semester II

13. Advance Bioinformatics (05530205)

LTP Credits-4 | Examination: 60 Marks
Total: 100 marks | Int.Assessment:40 Marks

Course Outcomes (COs)

CO 1: Understanding of the asymptotic analysis of algorithms and NP complete problems.
CO 2: Know the advanced sequence analysis like PAM and BLOSUM matrices.
. CO 3: Know the basic concept and definition of sequence patterns, motifs.
. CO 4: Know the Protein secondary structure calculation – DSSP, membrane topology prediction.

Unit I
Algorithms

Algorithms; asymptotic analysis of algorithms; NP complete problems; algorithm types; bruteforce; divide and conquer; sorting algorithms – string matching – naïve, KMP and approximatestringmatchingalgorithms.

Unit II
Advanced sequence analysis

Dynamic programming algorithm: Introduction to PAM and BLOSUM matrices; differencesbetween distance and similarity matrices. Global and local pairwise alignment methods –SmithWaterman and Needleman-Wunsch algorithms.Concepts behind multiple sequencealignment; ClustalW, TCoffee.BLAST, sequence search, difference versions of BLAST, gappedBLASTandBLAT.

Unit III
Motifs and phylogeny

Basic concept and definition of sequence patterns, motifs and profiles, various types of patternrepresentations viz. consensus, regular expression (prosite-type) and profiles.Use of HiddenMarkov model (HMM) in assigning homology. Phylogeny: sequence evolution, distance matrices,phylogeny construction by UPGMA, neighbour joining and parsimony methods. Derivation of PAMandBLOSUMmatrices,evolutionmodelfornucleic acids.

Unit IV
Protein structure analysis

Protein secondary structure calculation – DSSP, membrane topology prediction, ligand-receptor interactions, composition of active sites in functional proteins, conformational change and activity,allostery,effectsofpointmutationsonproteinsstructureandfunction.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	2	-
CO2	1	-	3	2	-
CO3	1	-	3	3	-
CO4	1	-	3	2	-
Average	1	-	3	2.25	-

Reference books:

1. A.M.Lesk; Introduction to Bioinformatics; OxfordUniversityPress,2002.
2. N.Gautham;Bioinformatics:DatabasesandAlgorithms;AlphaScience,2006.
3. D.W.Mount;BioinformaticsSequenceandGenomeAnalysis;ColdSpringLaboratoryPress,2001.
4. J.Bedell;I.Korf,M.Yandell; BLAST;O'ReillyPress,2003.
5. F. J. Burkowski; Structural Bioinformatics An Algorithmic Approach; CRC Press, 2009. 6. J. M.Keith;BioinformaticsVol.1,Data,sequenceanalysis & evolution;HumanaPress,2008.
7. R.Durbin;Biologicalsequenceanalysis;CambridgeUniversityPress,1998.
8. R.M.Holmes;Acellbiologists'guidetomodelingandbioinformatics;WileyInterscience, 2007.

Semester II

14. Practical III (Genetics, Plant & Animal Biotechnology)
(05530206)

LTP Credits-2 Examination: 20 Marks
Total: 50 marks Int. Assessment: 30 Mark

Course Outcomes (COs)

CO 1: Understanding of extraction and quantification of genomic DNA and isolation of plasmid DNA from bacteria.

CO 2:Know the Restriction digestion of isolated DNA and agarose gel electrophoresis.
CO 3: Understanding of Cloning and transformation experiment.
CO 4: Understanding of Isolation of protein from bacteria and analysis by SDS-PAGE.

Genetics

- Extraction and quantification of genomic DNA.
- Isolation of plasmid DNA from bacteria.
- Agarose gel electrophoresis for genomic and plasmid DNA.

- Restriction digestion of isolated DNA and agarose gel electrophoresis of restricted samples.
- Cloning and transformation experiment.
- Identification and characterization of transformed colonies.

- Isolation of protein from bacteria and analysis by SDS-polyacrylamide gel electrophoresis (SDS-PAGE) technique.

Plant and Animal Biotechnology

- Tissue culture media composition and preparation.
- Preparation of synthetic seeds and in vitro germination.
- Isolation and culture of protoplast.
- Isolation of total plant genomic DNA from different samples.
- Quantitative and Qualitative analysis of plant genomic DNA.
- Kanamycin sensitivity test in leaf segments.
- Semi-solid and liquid cultures of Agrobacterium tumefaciens.
- Agrobacterium mediated transformation of foreign genes into host plants.
- Composition and Preparation of different media for mammalian cell culture.
- Mammalian cell culture (Primary & cell line) technique.
- Revival and maintenance of animal cell culture.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	-
CO2	3	-	3	3	-
CO3	3	-	3	3	-
CO4	3	-	3	3	-
Average	3	-	3	3	-

Semester II

15. Practical IV (Computer Programming & Bioinformatics)
(05530207)

LTP Credits-4	Examination: 60 Marks
Total: 100 marks	Int. Assessment: 40 Marks

Course Outcomes (COs)

CO 1: Gain the knowledge of the various databases website and gene sequences retrieved from data bases
CO 2: Know the designing of gene specific primers for PCR amplification and cloning.
CO 3: Understand of Molecular docking study of protein-protein and protein-inhibitor.
CO 4: Gain the knowledge of different computer languages including Advanced C, C++, JAVA and R Program.

- Exploring the various databases website for information, accession of data and use of available tools.
- Gene sequences retrieved from data bases and multiple sequence alignment.
- Prediction of the structural components of a gene using bioinformatics tools.
- Phylogenetic analysis of gene sequences.
- Designing of gene specific primers for PCR amplification and cloning.
- Prediction of 2D and 3D structure of protein structure by homology modeling and energy minimization methods.
- Docking study: Molecular docking study of protein-protein, protein-inhibitor, protein-ligand and protein-drugs using Auto Dock program. Virtual screening from ligand database, QSAR and ADMET Properties Prediction.
- Molecular Dynamics of biomolecules: MD simulation study of proteins, protein-ligand complexes, and RNA-peptide complexes.
- Practice learning of different computer languages including Advanced C, C++, JAVA and R Programming.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	2	3	-
CO2	1	-	3	3	-
CO3	1	-	2	3	-
CO4	1	-	3	3	-
Average	1	-	2.5	3	-

Semester II

16. Project Development & Seminar (05530208)

Course Outcomes (COs)

CO 1: Explore the various databases website for research articles.

CO 2: Know the how the write research and review articles.
CO 3: Understand of research and review article.
CO 4: Gain the knowledge of different literature survey, sources and concept of research project.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	1	3	3	-
CO2	2	1	3	2	-
CO3	1	1	3	2	-
CO4	2	3	3	2	-
Average	1.5	1.5	3	2.25	-

In this semester the student is expected to work on finalising the topic and methodology with a detailed review of literature work to be submitted in the form of a synopsis along with a seminar to be held. Allotment of guide will also be carried out. It will involve a comprehensive literature survey of the chosen research area.Through regular meetings,the student and advisordiscussthis literature in detail and the topic for research project

Semester III

17. Immunology (05530301)

LTP Credits-4 Examination: 60Marks
Total: 100 marks Int. Assessment: 40Marks

Course Outcomes (COs)

CO 1: Theoretical knowledgeof the immune system.
CO 2: Understanding of the antigen and antibodies and role in health and disease.
. CO 3: Know the basic concept antigen-antibody reactions.
. CO 4: Know the major histocompatibility complex.

Unit I

Immune System and immunity: History of immunology; innate and acquired immunity. Cells and organs involved in immune system – T-cells, B-cells, lymphoid organ, spleen and bone marrow. Antigenic properties, T and B cell epitopes, chimeric peptides, macrophages,antigen-processing cells, eosinophils, neutrophils, mast cells and natural killer cells; immune responses – cell mediated and humoral, clonal selection and nature of immune response.

Unit II

Antigen and antibodies: Types, structure and properties of antigens, haptens; adjuvant -antigen specificity. Immunoglobulins – structure, types and subtypes, properties, primaryand secondary responses, Antibody diversity. Complement system – Structure, components,properties and functions, complement fixation and complement pathways, biologicalconsequences. Inflammation-effector mechanisms.

Unit III

Antigen-antibody reactions: Agglutination, precipitation, immunoelectrophoresis, immunofluorescence,ELISA, RIA; Flow cytometry, Montaux test. Applications of these methods indiagnosis of microbial infections, autoimmunity mechanisms, altered antigens, systemiclupuserythematosus, Graves‟s diseases, rheumatoid arthritis, myasthenia gravis, multiplesclerosis.Concept of Immunodeficiency.

Unit IV

Hypersensitivity reactions: Allergy, Type I- Anaphylaxis; Type II- Antibody dependent cell cytotoxicity, Type III- Immune complex mediated reactions, Type IV- delayed typehypersensitivity. Symptoms and Immunological methods of diagnosis of hypersensitivereactions.Lymphokines and cytokines

Unit V

Major histocompatibility complex(MHC): Structure and functions of MHC and the HLA systems. Tissue typingmethods for transplantations in humans; graft versus host reaction and rejection.**Tumor immunology:** tumor specific antigens, Immune response to tumors,immunodiagnosis of tumors – detection of tumor markers – alphafoetalproteins,carcinoembryonic antigen, Cancer therapeutics.

Unit VI

Immunization: Common immunization practice, types of vaccines and its application.Ediblevaccines.Production of Polyclonal and monoclonal antibodies; antibody engineering.Plantibodies.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	3	-
CO2	1	-	3	2	-
CO3	1	-	3	2	-
CO4	1	-	2	2	-
Average	1	-	2.75	2.25	-

Suggested readings:

1.Clark, W.R., "The Experimental Foundations of Modern Immunology (1991): John Wiley and Sons.Inc.
2. Roitt, I.M: Essential Immunology (1995): Blackwell Scientific Publications, Oxford.
3. Roth, J.A. (1985): Virulence Mechanism of Bacterial Pathogens. American Society for Microbiology, Washington D.C.
4.Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 8th Edition, Freeman, 2012.

Semester III

18. Nanobiotechnology (05530302)

LTP Credits-4 Examination: 60Marks
Total: 100 marks Int.Assessment:40Mark

Course Outcomes (COs)

CO 1: Know the concept of Nanotechnology.
CO 2: Know the synthesis of Nanoparticles using different approaches.
. CO 3: Gain thetheoretical knowledge of characterization of Nanoparticles andUV-Vis spectroscopy.
. CO 4:Know the Nanostructures for drug delivery.

Unit I

Introduction of Nano-Biotechnology; Nanotechnology definition and concepts; Cellular Nanostructures; Nanopores; Criteria for suitability of nanostructures for biological applications

Unit II

Synthesis of nanoparticles using physical, chemical and biological approaches, advantages of synthesis through green approaches. Using of microbes for synthesis of nanoparticles.

Unit III:

Characterization of nanoparticles: UV-Vis spectroscopy, FTIR, XRD, EDX, TEM, SEM, AFM.

Application of nanotechnology: Thin films; Colloidal nanostructures; Nanovesicles; Nanospheres;Nanocapsules, Nanostructures for drug delivery, concepts, targeting, routes of delivery andadvantagesNanostructuresfor diagnostics and biosensors.

Texts books/References

1. Multilayer Thin Films, Editor(s): GeroDecher, Joseph B. Schlenoff Publisher: Wiley-VCH Verlag GmbH & Co. KGaA ISBN:3527304401
2. Bionanotechnology: Lessons from Nature Author: David S.Goodsell Publisher: Wiley- Liss ISBN: 047141719X

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	2	3	-
CO2	1	-	2	3	-
CO3	1	-	2	3	-
CO4	2	-	2	3	-
Average	1.25	-	2	3	-

Semester III
19. Fermentation & Bioprocess Technology (05530303)

LTP Credits-4 Examination: 60Marks
Total: 100 marks Int. Assessment: 40Marks

Course Outcomes (COs)

CO 1: Theoretical knowledge of the fermentation its types, isolation screening.
CO 2: Know the bioreactors and application.
. CO 3: Understanding of the basic concept Industrial production like Ethanol, Butanol, Antibiotics.

. CO 4: Know the fermentation and its applications.

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Unit I

Introduction to fermentation and its types, Isolation, screening,improvementand preservation of Industrially important microbes; Microbial growth kinetics in batch, continuous and fed-batch processes.

Unit II

Media formulation for industrial fermentation, Requirement ofprecursors,inducers and antifoam agents as media additives; Medium optimization; Volumetric mass-transfer coefficient and its measurement, Kinetics of sterilization.

Unit III

Types of bioreactors (CSTR, bubble column, airlift, fluidized bed,packedbed):General configuration and applications; Scale up and scale down; Measurement and control of bioprocess parameters

Unit IV

Down Stream Processing: Cell disruption techniques;Separationtechniques:filtration, centrifugation, sedimentation, flocculation, liquid-liquid extraction, precipitation, reverse osmosis, ultrafiltration; Drying; Crystallization; Storage and packaging.

Unit V.

Industrial production (Microorganisms and raw material/mediaused,fermentationconditions and purification steps) and uses of fermentation products: Ethanol, Butanol, Antibiotics (Penicillin, Tetracycline), Alcoholic beverages, Enzymes (Glucose isomerase, Protease), Xanthan gum, Baker's yeast. Solid state fermentation and its applications

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	2	3	-
CO2	2	-	2	3	1
CO3	2	-	3	3	1
CO4	1	-	2	3	1
Average	1.5	-	2.25	3	0.75

Recommended Books: -

1. Shuler, M. L., &Kargi, F. (2002). Bioprocess Engineering: Basic Concepts.Upper Saddle River,NJ: PrenticeHall.
2. Stanbury, P. F. & Whitaker, A. (2010). Principles of Fermentation Technology. Oxford: Pergamon Press.
3. Blanch, H. W., & Clark, D. S. (1997). Biochemical Engineering. New York: M.Dekker.
4. Bailey, J. E., &Ollis, D. F. (1986). Biochemical Engineering Fundamentals. New York:McGraw-Hill.

Semester III

20. Data Analysis in Genomics &Transcriptomics (05530304)

LTP Credits-4 Examination: 60Marks
Total: 100 marks Int.Assessment: 40Marks

Course Outcomes (COs)

CO 1:.Understanding of transcriptome analysis like microarray data analysis using RNA-seq data.

CO 2: Knowof Genome analysis Sequence assembly concepts and challenges in assembling short reads

.

. CO 3: Understanding of the basic concepts and algorithms to measure transcriptional regulation.

. CO 4: Understanding of themeta genome and meta transcriptome analysis.

Unit I

Transcriptome analysis

Gene expression; microarray data analysis: analysis using RNA-seq data, lncRNA, siRNA fromRNA-seq data.

Unit II

Genome analysis

Sequence assembly concepts and challenges in assembling short reads; algorithms for assemblingshort reads using graph theory such as Hamiltonian cycle and de Bruijn; writing code forassemblingreads.Geneprediction and annotation;geneontology(GO);Identificationsomaticandgermline variations from genome resequence: SNPs, SNVs, translocation, copy number variation.Conceptsbehind genome-wideassociation studies.

Unit III

Computational Epigenomics

Concepts and algorithms to measure transcriptional regulation; methylation and alternativesplicing;CHiP-seqandbisulfite-seq;smallRNAanalysis,validationofwhole-genomedatasets.

Unit IV

Metagenomeandmetatranscriptomeanalysis

16SrRNA data analysis, clustering/phylogenetic tree based of alignment, clustering based oncomposition. Concepts behind self-organizing maps, principal component and other clusteringtools.Annotation of metagenome by various properties including phage, plasmid, crispr-spacer,anti-microbialgenes.

Unit V

Proteomics analysis

Isolation of proteins,
2Dgelanalysis,spectrumtoassemblingpeptidesequence,comparisonwithreferencedatabasesand annotation, differential protein expression, mass-spec protein sequencing, proteome annotation and analysis.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	2	3	-
CO2	1	-	2	3	-
CO3	1	-	2	2	-
CO4	1	-	2	3	-
Average	1	-	2	2.75	-

Text books and Reference books:

1. G.P.QuinnandM.J.Keough;Experimentaldesignanddataanalysisforbiologists;Cambridge University Press, 2002.
2. S.Knudsen;GuidetoanalysisofDNAmicroarraydata; Wiley,2nd edition,2004.
3. E. D. Hoffmann and V. Stroobant; Mass spectrometry: Principles and applications; Wiley, 3rd edition,2007.
4. A. Zhang; Advanced analysis of gene expression microarray data; World ScientificPublishing,2006.

Semester III
21. Structural Bioinformatics & Drug Design
(05530305)

LTP Credits-4 Examination: 60 Marks

Total: 100 marks Int. Assessment: 40 Marks

Course Outcomes (COs)

CO 1: Know the structural biology and structural data bases like nucleic acid structures, RNA folding .

CO 2: Theoretical knowledge of Protein structure prediction like homology modeling prediction of protein structure.

CO 3: Know the drug design and discovery and the role of Bioinformatics in drug development.

CO 4: Understanding of the Drug Designing in the areas of Molecular Biology, Pharmacogenomics.

Unit 1. Structural biology and structural databases

Nucleic acid structures, RNA folding, RNA loops, conformationalstudy.

various ribose ring conformations, ribose-ringpuckering.

protein-protein interactions, protein ligandinteractions.

DNA-binding proteins, RNA-bindingproteins.

Ramachandran plot, 3-dimensional structures of membrane proteins,importanceof310helixandloops,biophysicalaspects of proteins and nucleicacids.Struturaldatabases:- Protein Data bank (PDB), NucleicAcidDataBank(NDB),MolecularmodelingDataBank(MMDB).

Secondary structure, three-dimensional structure prediction, proteinfoldingandfunctionalsites,proteinfoldingclasses.

Unit II

Protein structure prediction

ProteinStructurePrediction:-Homologymodeling,predictionof protein structure from sequences, functionalsites.

Protein folding problem, protein foldingclasses,protein identification and characterization:- AACompIdent, TagIdent, PepIdent and MultiIdent, PROSEARCH, PepSea, PepMAPPER,FindPept,Predictingtransmembranehelices, Primary structure analysis and prediction,Secondary structure analysis and prediction, motifs, profiles, patterns and fingerprints search. Methods of sequence based proteinprediction.

Unit III

Pharmaceutical Biotechnology

Introduction: - Antibacterial antibiotics; narrow spectrum and broad spectrumantibiotics.
Mechanism of action of antibiotic, antifungal antibiotics, antiviral agents, antitumoragents.
Chemicaldisinfectants,antiseptics,preservatives.Sulfadrugs.
Recent advances in pharmaceutical Biotechnology: synthetic vaccines, DNA vaccines, ediblevaccines.
Policies in drug designing:- Quality assurance: ISO, WHO, certification, Good manufacturing practices, GMP,GLPGovernmentregulations, policies, Food and drug administration.IPR

Unit IV

Introduction drug design and discovery

Introduction: - Natural product, Drugs; principles of drug Development.
Bioinformatics in drug development, Chemoinformatics and Pharmacoinformatics.Applications of Drug Discovery and In-Silico Drug Designing, Area influencing drug discovery; Molecular Biology, pharmacogenomics andpharmacoproteomics.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	3	-
CO2	1	-	2	3	-
CO3	1	-	2	3	-
CO4	2	-	3	3	-
Average	1.5	-	2.5	3	-

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Text books and Reference books:

1. David W. Mount, Bioinformatics Sequence and Genome Analysis, CBS Publishers Distributors
2. S. C. Rastogiet. al. Bioinformatics- Concepts Skill and Applications, CBS Publishers and Distributors
3. T. E. Creighton, Protein Structure and Molecular Properties, W.H.Freeman and Company
4. Andreas D. Baxevanis, B. F. Francis Ouellette, Bioinformatics; A Practical Guide to the Analysis of Genes and Proteins, John Wiley & Sons, Inc.
5. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press.

22. Practical V (Immunology, Nanobiotechnology, Fermentation & Bioprocess Technology) (05530306)

LTP Credits-2 Examination: 20 Marks

Total: 100 marks Int. Assessment: 30 Marks

Course Outcomes (COs)

CO 1: Know the Immunology techniques like DOT ELISA, Immunoelectrophoresis.

CO 2: Learn the basic characterization techniques, Electron microscopy, Atomic force microscopy.

CO 3: Know the drug design and discovery and the role of Bioinformatics in drug development.

CO 4: Understand of the Fermentation & Bioprocess Technology.

Immunology

1.To separate serum from the blood sample (demonstration).
2.To perform DOT ELISA.
3.To perform immunoelectrophoresis.
4.Blood grouping
5.Precipitation and agglutination reaction

Nanobiotechnology

1. Introduction to Nano-Biotechnology; Nanotechnology definition and concepts; Cellular Nanostructures; Nanopores; Biomolecular motors; Criteria for suitability of nanostructures for biological applications
2. Basic characterization techniques; Electron microscopy; Atomic force microscopy; Photon correlationspectroscopy
3. Thin films; Colloidal nanostructures; Nanovesicles; Nanospheres;Nanocapsules
4. Nanostructures for drug delivery, concepts, targeting, routes of delivery andadvantages

Fermentation & Bioprocess Technology

1. Fermentation technology: fermentation media, Design, operation & applications of fermentors.
2. Isolation and screening of commercially important microbes, media formulation, Strain improvement; microbial growth kinetics, effect of environmental conditions on microbialgrowth.
3. Industrial production of:ethanol, citric acid, acetic, fumaric and gluconic acid, solvents (glycerol, acetone and butanol), antibiotics (penicillin, streptomycin, tetracycline), amino acids (lysine & glutamic acid), pectolytic enzymes (Pectinases, Inverstase, proteases and lipases) and Vitamins (Vit B_{12},Riboflavin)

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	3	-
CO2	1	-	3	3	-
CO3	1	-	2	3	-
CO4	2	-	2	3	2
Average	1.25	-	2.5	3	0.5

Semester III

23. Practical VI (Structural Bioinformatics and Drug Design) (05530307)

Course Outcomes (COs)

CO 1: Learning of molecular modeling using physical kits and software tools..
CO 2: Understanding of the basic concepts calculation of RMSD between two protein structures using C-alpha.
CO 3: Know the Geometrical calculations in molecules.
CO 4: Understanding of theDomain movement analysis using DYNDOM.

. **Viewing, editing and analyzing molecules**

1. Molecularmodellingusingphysicalkitsandsoftwaretools.Graphicalrepresentationso fmoleculesusingopensource software.
2. Coordinateformatconversionusingshellscriptsorsoftwaretools.Building3Dstructuresof ligands and drug like molecules. Geometrical calculations in molecules, distances, angels,torsions,electrostaticsurface,hydrophilicity,B-factordistribution etc.

Comparing protein molecules

3. Calculation of RMSD between two protein structures using C-alpha, main chain atoms, all common atoms as equivalent pairs.
4. Domain movement analysis using DYNDOM.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	2	3	-
CO2	1	-	3	3	-
CO3	2	-	3	3	-
CO4	1	-	2	3	-
Average	1.25	-	2.5	3	-

24. Technical Writing & Seminar (05530308)

In this semesterthestudentwillstartworkingontheirresearchproposalandevaluatetheoutcome of the project along with a detailed seminar presentation on progress made. Each student must submit to the university with the signed approval of the advisor, a thesis proposal defining the thesis project, the methods and design of the experiments needed for completion, the progress to date and plans for completion in the fourth semester.

Course Outcomes:

On successful completion of this course, students will able to:

CO 1: Understand the process of scientifically research proposal writing

CO 2: Develop competence in research writing, abstracting and presentation

CO 3: Understand the ethical approval process of a research proposal

CO 4: Understand the basic concept of research article and review article.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	3	1
CO2	2	1	3	3	1
CO3	2	3	3	2	1
CO4	2	1	3	2	1
Average	2	1.5	3	2.5	1

Text books:

1. P.E.BourneandJ.Gu;Structuralbioinformatics2ndedition.;JohnWileyandSons.2009.
2. F.J.Burkowski;Structuralbioinformatics:Analgorithmicapproach;CRCPress.2008.
3. A.Leach;Molecularmodelling –principlesandapplications;PearsonEducationLtd,2001.

Reference books:

1. P.CloteandR.Backofen;Computationalmolecularbiology:anintroduction;Wiley&Son s,2000.
2. J.M.Keith;Bioinformaticsvol2:Structure,functionandapplications;HumanaPress,2008.3. A. K. Konopka and M. J. C. Crabb; Compact handbook of computational biology; Marcel Dekker,NewYork, 2004.

Semester IV

25. Intellectual Property Rights, Bioethics & Bio-entrepreneurship (05530401)

LTP Credits-4 Examination: 60Marks
Total: 100 marks Int.Assessment: 40Marks

Course Outcomes (COs)

CO 1: Gain the theoretical knowledge of intellectual property, intellectual property, Patents.

CO 2: Understand of the basic concepts International conventions and Treaties.

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. CO 3: Know theIPs of relevance to biotechnology.

CO 4: Gain the Knowledge of the bioethics, Bioethical issues in GMOs, Ethical issues in human cloning.

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UNIT - I

Introduction to intellectual property (IP); History andevolutionof patent law, types of IP: patents, trademarks, copyright & related rights, Idea-expression dichotomy, industrial design, traditional knowledge, geographical indications, Significance of IPR. Introduction & Classifications of Patents, Patentability criteria.

UNIT - II

International conventions and Treaties- History of GATT &TRIPSAgreement,
World Trade Organization, Indian Patent Act 1970 & recent Amendments, International framework for the protection of IP, India's IPR policy, World Intellectual Property Organization (WIPO)

UNIT - III

Discovery vs Invention, concept of 'prior art', invention in context of"priorart"
Complexity arising in IP of Biotechnology, Case studies- Diamond vsChakraborty IP as a factor in R&D; IPs of relevance to biotechnology, Legal and IPR issues in Biotechnology, Different Categories of IPR Instruments to Protect a Biotechnology IP, Licensing and compulsory licensing; Patent infringement, legal action,

UNIT - IV

Introduction to bioethics- definition, scope, Principles, significance.Issuesof- ownership, monopoly, biodiversity, traditional knowledge access & benefit sharing.Social ethical issues in biotechnology. Biological weapons and their social and ethical implications, Bioethical issues in GMOs, Ethical issues in human cloning.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	3	2	2	1
CO2	-	2	2	2	1
CO3	1	3	2	2	1
CO4	-	3	2	2	1
Average	0.5	2.75	2	2	1

Recommended Books: -

1. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. NewDelhi: Tata McGraw-HillPub.
2. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce,GoI
3. Complete Reference to Intellectual Property Rights Laws. (2007). Snow White PublicationOct.
4. Office of the Controller General of Patents, Design & Trademarks; Department of Industrial Policy& Promotion; Ministry of Commerce & Industry; Government of India.http://www.ipindia.nic.in/
5. Karen F. Greif and Jon F. Merz, Current Controversies in the Biological Sciences -Case Studies of Policy Challenges from New Technologies, MIT Press
6. World Trade Organisation.http://www.wto.org
7. World Intellectual Property Organisation.http://www.wipo.int

26. Project &Dissertation (05530402)

After completion of dissertation lab work, this involves preparation of the thesis. The thesis must include a cover page, abstract, table of contents, introduction of the thesis topic with a comprehensive review of literature, appropriately organized methods, results and discussion section for the experiment performed and final conclusions section summarizing the outcome of the project. The students should submit a draft of the thesis along with a manuscript draft(submitted or prepared for publication in Scopus indexed Journal) to the advisor by the end of the fourth semester. Also a draft of the review/research paper (submitted or prepared to be submitted) must be submitted to respective guide before seminar presentation.

Course Outcomes (COs):

Upon successful completion, students will have the knowledge and skills to:

CO 1: Gain the knowledge of how to do research plan independently and a choose relevant research topic to related course.

CO 2: Understand the Systematically research concepts, methodologies and apply appropriate techniques.

CO 3: Gain the knowledge forevaluation of original research data.

CO 4: Gain the knowledge how to communicate original research concepts clearly and effectively.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OBJECTVES

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	3	1
CO2	1	-	3	3	1
CO3	1	-	3	3	1
CO4	1	-	3	3	1
Average	1	-	3	3	1