Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year Degree Program in Bioinformatics

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Bioinformatics) Part-I Semester -I

For Department of Bioinformatics

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2023-2024

(Eligibility : B.Sc. Botany/Zoology/Statistics/Microbiology/Com.Sci./ B.E./B.Tech./Pharmacy/ Medical Engineering/ Agriculture/ Veterinary Science)

Title of the Programme: M.Sc. (Bioinformatics)

Preamble

AES's Tuljaram Chaturchand College of Arts, Science and Commerce (Autonomous) has made the decision to change the syllabi of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Bioinformatics and related subjects, the Board of Studies in Botany at Tuljaram Chaturchand College of Arts, Science and Commerce (Autonomous), Baramati - Pune, has developed the curriculum for the first semester of M. Sc. Bioinformatics which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

A Bioinformatics Post Graduates degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Post Graduates in Bioinformatics find opportunities in various fields, including urban planning, teaching, environmental science, all

plant sciences, disease management, Genetic Engineering, Biostatistics, Plant Biotechnology, Database analysis, plant tissue culture method and many other domains. Throughout their Two-year degree program, students explore the significance of advanced knowledge of Bioinformatics. They learn tool, techniques, which is required analyze the huge gene data with the help of different softwares and also able to use the artificial intelligence in gene analysis. The knowledge of Bioinformatics helpful to analyze remedies for various diseases. They became expert in discovery and development of many new therapeutic compounds by advanced methodologies.

Overall, constructing Bioinformatics syllabi in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

M.Sc. Bioinformatics

Programme Specific Outcomes (PSOs)

PSO1.**Knowledge and understanding of:** 1. The range of plant diversity in terms of structure, anatomy, function and environmental relationships. 2. The evaluation of plant diversity. 3. Identification and classification and understand evolutionary trends in plants and animals and microbes. 4. The role of plants in the functioning of the global ecosystem. 5. A selection of more specialized, optional topics. 6. Application of Computer and statistics to solve biological problems.

PSO2.**Intellectual skills–able to:** 1.Think logically and organize tasks into a structured form 2. Assimilate knowledge and ideas based on wide reading and through the internet. 3. Transfer of appropriate knowledge and methods from one concept to another within the subject. 4. Understand the evolving state of knowledge in a rapidly developing research field. 5. Construct and test hypothesis. 6. Plan, conduct and write a report on an independent term project.

PSO3.**Practical skills:** Students learn to carry out practical work, in the field and in the laboratory, with minimal risk. They gain introductory experience in applying each of the following skills and gain greater proficiency in a selection of them depending on their choice of optional modules.1.Interpreting plant morphology and anatomy.2.Plant identification. 3.Evolutionary studies in vegetation study techniques. 4. Analysis of chemical compounds in plant materials in the context of plant physiology and biochemistry. 5. Analyze data using appropriate statistical as well as computational softwares.

PSO4. **Transferable skills:** 1. Use of IT (word-processing, use of internet, statistical packages and databases). 2. Communication of scientific ideas in writing and orally. 3. Ability to co-ordinate as part of team. 4. Ability to use library resources. 5. Time management. 6. Career planning.

PSO5.**Scientific Knowledge:** Apply the knowledge of basic plant science, life sciences biostatistics and fundamental databases process of data to study and analyze any plant animal and microbe forms.

PSO6.**Problem analysis**:Identify the taxonomic position of plants, formulate the research literature and analyze RET structure and non-reported organisms with substantiated conclusions using first principles and

methods of nomenclature and classification in Botany, Zoology and microbiology with gene data.

PSO7. **Design /development of solutions**: Design solutions from medicinal plants bioactive molecules to solve health problems, disorders and disease of human beings and animals which fulfill the specified needs to appropriate consideration for the public and animal health.

PSO8. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and development of the information to provide scientific conclusions.

PSO9. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern instruments and equipment for Biochemical estimation, Molecular Biology, Biotechnology, Biophysics, Biostatistics, genetic engineering, cellular and physiological activities of plants and animals and microbes with an understanding of the application and limitations.

PSO10. **The Bioinformatics Application:** An ability to get an innovative perspective on Biology by providing support in terms of hardware, software and Big Data-handling.

PSO11. **Environment and sustainability**: Understand the impact of the plant and animal diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable agricultural health and environmental development.

PSO12. **Ethics**:Apply ethical principles and commit to environmental ethics and responsibilities and norms of the biodiversity and soil conservation.

PSO13. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary task settings.

PSO14. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and interpret effective reports and design documentation, make effective presentations, and give and receive clear

instructions.

PSO15. **Project management and finance**: Apply knowledge and understanding of the engineering and management principles use these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary eco-friendly environments.

PSO16. **Life-long learning:** Identify the necessity, and have the preparation and ability to engage in independent and life long learning in the broadest context to upcoming advanced technological.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati
(Autonomous)
Board of Studies (BOS) in Bioinformatics

Sr. No.	Name	Designation
1.	Prof. Dr. Bhagwan Mali	Chairman
2.	Prof. Dr. Mahadev Kanade	Member
3.	Prof. Dr. Ajit Telave	Member
4.	Dr. Rupali Chitale	Member
5.	Dr. Madhuri Patil	Member
6.	Mr. Sauraj N. Torane	Member
7.	Ms. Ashwini B. Dudhal	Member
8.	Mr. Prasad J. Bankar	Member
9.	Mr. Sourabh R. Chandankar	Member
10.	Prof. Dr. B. M. Gaykar	Expert from SPPU, Pune
11.	Prof. D. K. Gaikwad	Expert from other university
12.	Dr. Jay Chavan	Expert from other university
13.	Dr. S. Gurumurthy	Expert from allied area
14.	Mr. Gore Nitin Anil	Meritorious Student
15.	Ms. Ligade Komal Sambhaji	Meritorious Student
16.	Mr. Zodage Ram Sanjay	Meritorious Student
17.	Ms. Gargade Rutuja Hanumant	Meritorious Student

Structure and Credit Distribution of PG Degree Programme
Illustrative Credit Distribution structure for Two Years/One Year P.G. (M.Sc.- Bioinformatics)

2 Year PG)	Level	Sem. (2 Yr.)	Major		Research Methodology (RM)	OJT/FP	RP	Cum. Cr.	Degree
			Mandatory	**Electives**					
I	6.0	Sem-I	BIN -501-MJM: Cell biology and Virology **(Credit 04)**	BIN -511-MJE (A): Molecular Biology **(Credit 04)** OR BIN -511-MJE(B) Biomathematics and Biostatistics **(Credit 04)**	BIN -521-RM Research Methodology **(Credit 04)**	--	--	20	PG Diploma (after 3 Year Degree)
			BIN -502-MJM: Biomolecules **(Credit 04)**						
			BIN -503-MJM: Bioinformatics Laboratory-I **(Credit 02)**						
			BIN -504-MJM: Bioinformatics Laboratory-II (**Credit 02)**						
		Sem- II	BIN -551 –MJM: Computer Basics **(Credit 04)**	BIN -561-MJE (A.) Genomics and Proteomics BIN -561-MJE (B). Structural Bioinformatics **(Credit 04)**	--	BIN - 581— OJT/FP **(Credit 04)**	--	20	
			BIN -552-MJM :Introduction to Bioinformatics **(Credit 04)**						
			BIN -553-MJM: Bioinformatics Laboratory-I **(Credit 02)**						
			BIN -554-MJM: Bioinformatics Laboratory-II **(Credit 02)**						
Cum. Cr. For PG Diploma			**24**	**8**	**4**	**4**	**--**	**40**	

*** 1 Credit = 15 hr.**

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Autonomous)
Credit DistributionStructure for M. Sc. Part: I (Bioinformatics)
(CBCS as per NEP 2020)
WEF: June 2023

Sem.	Course Type	Course Code	Course Title	Theory/ Practical	No. of Credits
I	Major (Mandatory)	BIN -501-MJM	Cell biology and Virology	Theory	4
	Major (Mandatory)	BIN -502-MJM	Biomolecules	Theory	4
	Major (Mandatory)	BIN -503-MJM	Bioinformatics Laboratory-I	Practical	2
	Major (Mandatory)	BIN -504-MJM	Bioinformatics Laboratory-II	Practical	2
	Major (Elective)	BIN -511-MJE(A)	Molecular Biology	Theory	4
		BIN -511-MJE(B)	Biomathematics and Biostatistics	Theory	
	Research Methodology (RM)	BIN -521-RM	Research Methodology	Theory	4
	Total Credits Sem. I				**20**
II	Major (Mandatory)	BIN -551-MJM	Computer Basics	Theory	4
	Major (Mandatory)	BIN -552-MJM	Introduction to Bioinformatics	Theory	4
	Major (Mandatory)	BIN -553-MJM	Bioinformatics Laboratory-I	Practical	2
	Major (Mandatory)	BIN -554-MJM	Bioinformatics Laboratory-II	Practical	2
	Major (Elective)	BIN -561-MJE(A)	Genomics and Proteomics	Theory	4
		BIN -561-MJE(B)	Structural Bioinformatics	Theory	4
	On Job Training (OJT)/Field Project (FP)	BIN -581- OJT/FP	On Job Training/ Field Project	Training /Project	4
	Total Credits Sem. II				**20**
	Cumulative credits Sem I and II				**40**

CBCS Syllabus as per NEP 2020) For M. Sc. I Bioinformatics

(w. e. from June, 2023)

Name of the Programme : M.Sc. Bioinformatics
Program Code : PSBIN
Class : M.Sc.
Semester : I
Course Type : Major Mandatory Theory
Course Code **: BIN 501-MJM**
Course Title **:** Cell Biology and Virology
No. of Credits **:** 04
No. of Teaching Hours : 60

A) Course objectives:

1. To know structural organization of prokaryotic and eukaryotic cells.
2. To understand the structure and function of Photosynthetic metabolism.
3 To understand the function of genome and DNA.
4. To give idea about plant, animal and bacterial viruses.
5. To give knowledge about cultivation of cell culture**.**
6. To impart the career opportunities in cell biology and virology.
7. To impart the basic skills in the field of virology.

B) Course outcomes:

By the end of course students will be able to

CO1. Understand basics of cell biology.
CO2. Knowledge of different cell organellies.
CO3. Students will get scope of the virology.
CO4. Training of cell culture techniques.
CO5. Knowledge about the applications of DNA sequencing.
CO6. Apply knowledge of virus culture.
CO7. Analyze host virus interactions.

UNIT- 1 15 L

1.1 Molecules of life – structural organization of prokaryotic and eukaryotic cells- Concept of a composite cell and Molecular composition of cells. Biomembranes- Structural organization - Models of a plasma membrane, Membrane permeability - Transport across cell membranes - Transmembrane signals - Artificial membranes - liposome, Eukaryotic Cell Cycle : mitosis and meiosis. 8L

1.2Cellular Organelles – Cytoskeleton – components of Cytoskeleton, Microtubules, Intermediate filaments – Microfilaments, Endoplasmic reticulum, Golgi complex, Types of vesicles - transport and their functions, Lysosomes. Nucleus - Internal organization, Nuclear

pore complex,Nucleosomes, Chromatin. 7 L

UNIT- 2

2.1 Chloroplast structure and function – An overview of photosynthetic Metabolism The absorption of light – Photosynthetic units and reaction centers, Photophosphorylation Carbondioxide fixation and the synthesis of carbohydrates. Chloroplast and its genome study. 8L

2.2 **Mitochondrial Genome, Structure and Function** – Oxidative Metabolism in the Mitochondrion– The Role of Mitochondria in the formation of ATP – Translocation of Protons and the Establishment of a proton-motive force – The Machinery for ATP formation – Peroxisomes. Genome studies of Mitochondria. 7 L

UNIT- 3

3.1 DNA and Protein Synthesis – Structure of DNA - evidence for DNA as genetic material. Gene transfer in microorganisms – conjugation, transformation, transduction - protoplasmic fusion. The genomes of bacteria, viruses, plasmids. 7L

3.2 DNA Structural organization - DNA replication, Transcription – mRNA processing, Translation. Protein synthesis – Ribosomes, enzymes, Protein processing, Introduction to the methods of DNA sequencing – Gene Regulation 8L

UNIT- 4

4.1 Virology

Classification and General properties of plant, animal and bacterial viruses, Bacteriophages - lytic cycle & lysogeny. Structure of viruses, assembly of viral membrane. Life cycle and replication of viruses: RNA-negative strand (VSV), positive strand (Polio), segmented [Influenza], Retrovirus- RSV and HIV, DNA- adenovirus and SV-40. 8L

4.2 Cultivation in cell culture, chick embryo and animal inoculation. Persistent chronic and acute viral infections.Mechanism of interferon and antiviral therapy. Host virus interactions; plant and animal. 7 L

References

1. Cell and Molecular Biology – Concepts and Experiments by Gerald Karp. Wiley International Student Version. 2008
2. Lewin B. (2004); Genes VIII, Pearson Education International.
3. De Robertes and De Robertis (2002); Cell and Molecular Biology, Saunders College,

Philadelphia,USA.

4. Gurevitch, J., Scheiner, S. M., Fox, G. A. (2006). The Ecology of Plants, Sinauer Associates.
5. Mukherjee, B. (1996). Environmental Biology, 1st edition, Tata Mc Graw Hill.
6. Mukherjee, B. (2000). Environmental Management: Basic and Applied Aspects of Management of Ecological Environmental System, 1st edition, Vikas Publication.

Name of the Programme : M.Sc. Bioinformatics
Program Code : PSBIN
Class : M.Sc.
Semester : I
Course Type : Major Mandatory Theory
Course Code : **BIN 502-MJM**
Course Title : Biomolecules
No. of Credits : 04
No. of Teaching Hours : 60

A) Course Objectives:

1. To understand structures and functions of biomolecules.
2. To analyze the role in metabolic pathways of carbohydrates, proteins, lipids and nucleic acids.
3. To apply the kinetics of Enzymes.
4. To remember research terminologies.
5. To apply energetics of biomolecules.
6. To aware laboratory techniques.
7. To design scientific methods for research experiments.

B) Course Outcomes:

By the end of course students will be able to

CO1. Recall structures and functions of biomolecules Such as carbohydrates, proteins, lipids and nucleic acids.
CO2. Know the biomolecules in metabolic pathways.
CO3. Know the role of biomolecules in metabolic pathways
CO4. Apply knowledge of Enzymes, kinetics and energetics.
CO5. Utilize research in life sciences.
CO6. Gain proficiency in basic laboratory techniques.
CO7. Apply the scientific method in the processes of experimentation and hypothesistesting.

UNIT- 1

1. 1 Classification, Structures and Carbohydrate Metabolism 15L

Classification, characteristics and functions of monosaccharides, disaccharides -polysaccharides. Epimers, isomers, anomers, chiral carbon atom, chair and boat form, glucopyranose andfructopyranose. 6L

1.2 General scheme of metabolism, historical and experimental details in derivation of a metabolic pathway, Glycolysis - aerobic and anaerobic, regulation of glycolysis, Krebs cycle and its regulation, Hexose monophosphate shunt. Pathways of Carbohydrate Metabolism and ComplexCarbohydrates. 6L

1.3 Regulation of blood glucose and homeostasis. Glycogenesis and glycogenolysis and their regulation. 3L

UNIT- 2

2.1 Amino acids: Classification, properties and reactions, ninhydrin reaction, Peptide bond, formation, End group analysis and sequencing, Ramachandran plot. 4L

2.2 Protein structure: Primary structure and its importance, Secondary structure- X ray diffraction, alpha-helix, beta-helix 5L

2.3 Tertiary structure: Myoglobin, Forces stabilizing, unfolding and refolding, Quaternary structure- haemoglobin. 5L

2.4 Biological Roles of Proteins 1L

UNIT-3 15L

3.1 Definition and classification of lipids. 2L

3.2 Fatty acids – general formula, nomenclature and chemical properties Structure, function and properties of simple, complex, acylglycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins. 6L

3.3 Beta oxidation - pathway and regulation. 3L

3.2 Synthesis of fatty acid - structure and composition of fatty acid synthetase complex, pathway and regulation. 4L

UNIT-4 15L

4.1 Classification of enzymes, IUB system, enzyme substrate complex, active site of enzymes,stereo specificity and ES complex formation. 3L

4.2.Effect of temperature and pH and substrate concentration on reaction rate. 4L

4.3 Activation energy, transition state theory, enzyme activity. Michaelis-Menten equation, significance of Vmax and Km. 4L

4.4 Enzyme inhibition, types of inhibitors and mode of action. Chemical modification of enzymes, Structure and functions of Ribonuclease, trypsin, chymotrypsin, Enzyme regulation, feedback control, product inhibition. 4L

References:

1. Bruce Alberts (2002); Molecular Biology of the cell, Garland publishing Inc.
2. Strausbaugh, Perry D.; Weimer and Bernal R. General Biology by John Wiley and Sons Inc.
3. Cooper. G. M. (2000); Cell - A molecular approach, Oxford University Press.
4. Robert E. Ricklefs and Rick Relyea, The Economy of Nature by. Publisher- W. H. Freeman 6th edition.
5. Palmer Trevor, (2001); Enzymes: Biochemistry, Biotechnology and Clinical chemistry,

Publisher: Horword Pub. Co., England.

6. Robert Murray (2003); Harper's Illustrated Biochemistry 26th Ed.
7. Nelson D. L. and Cox M. M., W. H. Freeman and Co. NY (2005); Lehninger's Principles of Biochemistry, 4th edition.
8. Berg Jeremy, Tymoczko John, StryerLubert, (2007); Biochemistry 6th Ed, Publisher: W. H. Freeman, New York.

Name of the Programme	: M.Sc. Bioinformatics
Program Code	: PSBIN
Class	: M.Sc.
Semester	: I
Course Type	: Major Mandatory Practical
Course Code	**: BIN- 503-MJM**
Course Title	: Bioinformatics Laboratory-I
No. of Credits	: 02
No. of Teaching Hours	: 60

A) Course Objectives:

1. To know structural organization of prokaryotic and eukaryotic cells.
2. To understand the structure and function of Photosynthetic metabolism
3. To understand the function of genome and DNA.
4. To give idea about plant, animal and bacterial viruses.
5. To give knowledge about cultivation of cell culture**.**
6. To impart the career opportunities in cell biology and virology.
7. To impart the basic skills in the field of virology.

B) Course Outcomes:

By the end of course students will be able to

CO1. Understand basics of cell biology.
CO2. Get knowledge of different cell organellies.
CO3. Get scope of the virology.
CO4. Get knowledge about cell culture techniques.
CO5. Get knowledge about the applications of DNA sequencing.
CO6. Apply knowledge of virus culture.
CO7. Analyze knowledge of host virus interactions.

Practicals

1. Estimation of Chlorophyll pigments.	01
2. Paper Chromatography of Chlorophyll pigments	01
3. Quantitative estimation of Glucose by DNSA method.	01
4. Study of Mitosis in onion/ Lily root.	02
5. Study of Mitotic index of given material.	01
6. Study of meiosis in *Rhoeo* buds	01
7. Effect of temperature and alkali on absorption of DNA: hyperchromicity	02
8. Study of plant viral diseases.	01
9. Study of growth curve of bacteria.	02

10. Study of Electron Micrographs of cell organelles. 01
11. Study of DNA sequencing. 01

References

1. Plummer, D.T. (2005); An Introduction to Practical Biochemistry, Tata-McGraw-Hill Publishing Co., New Delhi.
2. Wilson, K. and Walker, J., (2005); Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, New York.
3. Voet Donald and Voet Judith G. John, (2005); Biochemistry, 3rd Ed., Publisher: Wiley andsons, New York.
4. Segel Irvin H., (1997); *Biochemical Calculations*, 2nd Ed., Publisher: John Wiley and Sons, New York.

Name of the Programme	: M.Sc. Bioinformatics
Program Code	: PSBIN
Class	: M.Sc.
Semester	: I
Course Type	: Major Mandatory Practical
Course Code	**: BIN: 504-MJM**
Course Title	: Bioinformatics Laboratory-II
No. of Credits	**:** 02
No. of Teaching Hours	: 60

A) Course Objectives:

1. To understand structures and functions of biomolecules.
2. To analyze the role in metabolic pathways of carbohydrates, proteins, lipids and nucleic acids.
3. To apply the kinetics of Enzymes.
4. To remember research terminologies.
5. To apply energetics of biomolecules.
6. To aware laboratory techniques.
7. To design scientific methods for research experiments.

B) Course Outcomes:

By the end of course students will be able to

CO1. Recall structures and functions of biomolecules.

CO2. Know the biomolecules in metabolic pathways.

CO3. Know the role of biomolecules in metabolic pathways

CO4. Apply knowledge of Enzymes, kinetics and energetics.

CO5. Utilize research in life sciences.

CO6. Gain proficiency in basic laboratory techniques

CO7. Apply the scientific method of experimentation and hypothesis testing.

Practical's

1. Preparation of solution of different concentrations, Buffers. 02
2. Measurements of electrical Conductivity and pH 01
3. Estimation of enzyme activity- Catalase/peroxidase. 01
4. Estimation of Crabohydrates by DNSA method. 01
5. Estimation of soluble proteins in germinating seeds by Lowry's method. 01
6. Estimation of ascorbic acid in ripe and unripe fruits. 01
7. Determination of acid value or saponification value with reference to fatty acids. 02
8. Extraction of triglycerides from oilseeds. 01
9. Estimation of proline. 01
10. Effect of different concentrations of pH on enzyme activity. 01
11. Study of Hill reaction to measure intactness of chlorophyll. 01
12. Measurement of Blood Glucose Level Using Glucometer. 01

Name of the Programme : M.Sc. Bioinformatics
Program Code : PSBIN
Class : M.Sc.
Semester :I
Course Type : Major Elective Theory
Course Code : BIN-511-MJE(A)
Course Title : Molecular Biology
No. of Credits :04
No. of Teaching Hours :60

A) Course objectives:

1. To understand structural, physical and chemical properties of genetic materials.
2. To understand the mechanism behind the replication of genetic material.
3. To learn about molecular techniques.
4. To study the causes and repair mechanism of DNA damage.
5. To study correlation between variables for making conclusions.
6. To study parametric and non-parametric tests for comparison of numerical data.
7. To study importance of statistical tests for scientific communications like research papers.

B) Course outcomes:

By the end of course students will be able to

CO1. Understand the central dogma of molecular biology.
CO2.Know about the process like replication, transcription and translation.

CO3. Recall basic principle, advanced techniques in molecular biology.
CO4. Study how to analyze and represent the numerical data.

CO5. Learn to compare the variables and to predict unknown from known data.
CO6. Understand the parametric and non-parametric tests.

CO7. Study the tests of comparison of data by various statistical tests.

UNIT- 1

1.1 DNA Structure and Topology: 15L

Chemical structure of DNA and base composition, Watson-Crick model, types of DNA - A,B,Z forms, Supercoiled DNA, Organelle DNA: mitochondria and chloroplast DNA.

Physical properties of DNA: Tm, hypo and hyper chromicity, solubility, mutarotation and buoyancy.

1.2 Structure of chromatin and Nucleosome**:** chromatin organization higher order organization, The nucleosome, Chromatin structure: euchromatin, heterochromatin, Constitutive and facultative heterochromatin, Regulation of chromatin structure and nucleosome assembly chromosome, centromere, telomere, Histones and its effect on structure and function of chromatin Chromosome Structure.

UNIT- 2

2.1Regulation of Gene Expression 5L

Operon model of gene regulation, negative and positive regulation in prokaryotes, lac operon. Tryptophan operons. Lytic cascade and lysogenic repression in lambda bacteriophage eukaryotic genes, role of chromatin in gene expression and gene silencing.

2.2 Techniques in Molecular Biology**:** **10 L**

Identification and characterization of DNA, RNA, plasmids. Agarose gel electrophoresis, ethidium bromide staining. Southern, Northern, Western Blotting, RAPD, RFLP, DGGE, TGGE, PCR.

UNIT 3:

3.1Mutation 05L

Types of mutations, somatic & germline mutations, effect of mutations, frequency of mutations, measuring mutation rate Physical and chemical mutagenic agents, Nonsense, missense and point mutations, intragenic and intergenic suppression, frame shift mutations, , role of mutations in evolution

3.2 DNA Replication, Damage and Repair: 10L

Modes of DNA replication, Meselson and Stahl experiment, Prokaryotic and eukaryotic DNA replication, Mechanism of DNA replication, DNA Polymerase, Enzymes and accessory proteins involved in DNA replication, Fidelity in replication.

Types of DNA damage, DNA repair systems: photoreactivation, Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair, error prone repair, SOS response.

UNIT 4

4.1 Genome organization: 5L

Organization of prokaryotic genome, Concept of gene ,Repetitive sequences, clusters and repeats, , Interrupted and uninterrupted genes, intron, exon and their relationships centromere and telomere, Genome sizes of different organisms, C Value C value paradox and genome size, Cot curves,

repetitive and non-repetitive DNA sequences, Cot ½, kinetic sequences complexity

4.2 Prokaryotic & Eukaryotic Transcription and Translation 10L

Transcriptional Unit in prokaryotes and eukaryotes, RNA polymerase, role and significance of promoter, enhancer, intron, exon, silencer, transcriptional factors. Mechanism of prokaryotic and eukaryotic transcription- Initiation, Elongation & Termination of transcription, post transcriptional modifications-5' capping, 3' polyadenylation, splicing and editing, self-splicing in eukaryotes. Inhibitors of transcription

Genetic code, mitochondrial and eukaryotic genetic codes Prokaryotic & eukaryotic translation, the translation machinery, mechanisms of chain initiation, elongation and termination, regulation of translation, co-and posttranslational modifications of proteins,

References

1. Lewin B. (2000); Genes VII. Oxford University Press, New York.
2. Alberts, B., Bray, D Lewis, J., Raff, M., Roberts, K and Walter (1999). Molecular Biology of the Cell. Garland Publishing, Inc., New York.
3. Wolfe S.L (1993); Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA. 4. Rost, T. et al (1998); Plant Biology. Wadsworth Publishing Company, California, USA.
4. Gene VII eigth edition 2000.
5. Krishnamurthy, K.V. (2000); Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
6. Buchanan B.B, Gruissm W. and Jones R.L (2000); Biochemistry and MolecularBiology of Plant. American Society of Plant Physiologist, Maryland, USA.
7. De D.N (2000); Plant Cell Vacuoles : An Introduction. CISRO Publication, Collingwood, Australia.
8. Kleinsmith L.J and Kish V.M (1995); Principles of Cell and Molecular Biology (Second Edition). Happer Collins College Publishers, New York, USA.
9. Lodish H., Berk A., Zipursky, S.L Matsudaira P., Baltimore D. and Darnell J. (2000); Molecular Cell Biology (Fourth Edition). W.H. Freeman and Company, New USA.
10. David Freifelder (1996); Essentials of Molecular Biology, Panima Publishing Company, New Delhi.

11. Brow T.A (2007); Genomes – 3 – Garland Science House, New York.
12. Malacinski G.M (2006); (Fourth Edition). Freifelders Essentials of Molecular Biology, Narosa Publishing House, New Delhi. 13. Rastogi V.B Concepts in Molecular Biology.
13. Twxman R.M (2003); (Third Reprint). Advanced Molecular Biology. Viva Books Pvt. Ltd., New Delhi.

Name of the Programme	: **M.Sc. Bioinformatics**
Program Code	: PSBIN
Class	**:** M.Sc.
Semester	**I**
Course Type	**:** Major Elective Theory
Course Code	: BIN-511-MJE(B)
Course Title	**:** Biomathematics and Biostatistics
No. of Credits	: **04**
No. of Teaching Hours	**:** 60

A) Course Objectives:

1. To understand basic statistical concepts.
2. To understand the methods of data representation.
3. To learn about central tendency.
4. To study the central dispersion.
5. To study correlation between variables for making conclusions.
6. To study parametric and non-parametric tests for comparison of numerical data.
7. To study importance of statistical tests for scientific communications like research papers.

B) Course outcomes:

By the end of course students will be able to

CO1.Recall and use formulae of basic biostatistics.

CO2.Analyze the data representation.

CO3. Remember modes of central tendency.

CO4. To analyze central dispersion.

CO5. Students will learn to compare the variables and to predict unknown from known data.

CO6. Students will understand the parametric and non-parametric tests.

CO7. Students will study the tests of comparison of data by various statistical tests.

UNIT 1:

1.1Sets: **5 L**

Finite set, infinite set, null or void set, subset, Intervals; closed and open, universal set, operations of set. Relations and functions.

1.2 Matrices **5L**

Types of matrices, properties of matrices, addition, substraction of matrices, matrix, multiplication, elementary transformation, inverse of matrices.

1.3 Determinants **5L**

Properties of Determinants, Minors and Cofactors, Multiplication of Determinants, Adjoint, Reciprocal, Symmetric Determinants, Cramer's rule, Different types of matrices, Matrix Operations, Transpose of a matrix, Adjoint of a square matrix, Inverse of a matrix, Eigen values and Eigen vector

UNIT -2

2.1 Trigonometry and Analytical Geometry – Trigonometric ratios, De Moivre's theorem, The general equation of a Straight line, slope of a line, intercepts of a line, Angle between two lines, Intersection of two lines, The general equation of a Circle **4L**

2.2 Calculus – Differential Calculus- Derivative of a function, Concept of limit, Continuity, Differentiation, Maxima and Minima of a function, Introduction to Partial Differentiation, Integral Calculus: The Idea of the Integral, The Definite Integrals, Indefinite Integrals. **5L**

2.3 Numerical Methods – Solution of algebraic and transcendental equations: Bisection method, Method of false position / Regula-falsi method, Newton-Raphson method. **4 L**

2.4 Applications To Mathematical Biology: Enzyme kinetics, Immunology, Population genetics, Tumor modeling, Applications of ordinary & partial differential equations to Biology. **2L**

UNIT- 3

3.1 **Introduction to Biostatistics:** 2L

Basic definitions, notations, Applications and uses, sampling: Representative sample, sample size, arable sampling, , statistical sampling, population,

3.2 Data collection and presentation: **4L**

Primary and secondary data, screening and representation of data frequency distribution, bar diagram, histogram. Pie diagram, cumulative frequency curves.

3.3 Central Tendancy 2L

Measures of Central Tendency, Mean, median, mode, Comparison between mean, median and mode

3.4 Measures of dispersion**:** **3L**

Range, variation, standard deviation, standard error ,Quartile deviation coefficient of variation, symmetry, probability distribution.

3.5 Analysis of Variance 4L

One-Way Analysis of Variance , Two-Way Analysis of Variance , Regression Models,

Simple Linear Regression, Logistic Regression.

UNIT- 4

4.1Probability and probability distribution: 7L

Definition of probability (mathematical and classical) conditional probability. Concept ofrandom variable, univariate probability distribution and its mathematical expectation. Some standard probability distributions (binomial, Poisson and normal) their probability distribution, mean, variance and properties of these distribution

4.2 Test of hypothesis: **8L**

Some important terms (hypothesis, types of hypothesis, Test, Critical region, acceptance region, type I error, type II error, level of significance, p-value)

Test for mean and equality of two population means, Test for proportion and equality of two population proportions.

Chi-square test for goodness of fit, Unpaired and paired 't'test,F test for equality of twopopulation variances.

References:

1. Serge A. Lang. (1988); Basic Mathematics by Springer Publisher.
2. Serge A. Lang (1986); A First Course in Calculus by. Springer publisher.
3. B.S. Grewal and J.S. Grewal (2007); Higher Engineering Mathematics (40th Ed), Khanna Publishers, New Delhi.
4. Khan and Khannum, Biostatistics
5. Principles And Practice of Biostatistics : Dr J.V. Dixit
6. Statistical Methods: Snedecor G.W. and Cochran W.G.
7. Statistical Methods : Dixon W.S. and Massey

Name of the Programme	: **M.Sc. Bioinformatics**
Program Code	:PSBIN
Class	**:** M.Sc.
Semester	**I**
Course Type	**:** Major Mandatory Theory
Course Code	: BIN-521-RM
Course Name	: Research Methodology
No. of Credits	:**04**
No. of Teaching Hours	**:**60

A) Course Objectives:

1. To understand basic principles of research.
2. To understand the designing of research experiment
3. To learn about types of scientific documents
4. To study the research project, proposals and research papers publication.
5. To study applications computer in biology
6. To study tools and software's used in research wok submission.
7. To study importance of techniques and applications of bioinformatics

B) Course outcomes:

By the end of course students will be able to

CO1. Recall research terminologies.
CO2.Use designing concept in research experiment.
CO3.Compile scientific document.

CO4. Study how to publish the research work
CO5. Learn to use data analysis using computer.
CO6. Apply software's for research document writing.
CO7. Study understand and use advanced techniques and applications in theirwork

UNIT- 1

1.1 Basic research terminologies:

Definition and basic concepts, objectives, significance and techniques of research, finding research materials – literature survey, compiling records. 3L

Research design: Meaning, Need, Features of Good Design, Concepts, Types, Basic principles of Experimental Design. 4L

1.2 Various methods of Research: Survey, Philosophical, Historical, Experimental, Case Studies. 4L

1.3 Data Collection: Methods of Data Collections : Observation, Experimental and questionnaire,Primary Data, Secondary Data, Selection of appropriate method for data collection. 4L

UNIT- 2

2.1Definition and kinds of scientific documents – research paper, review paper, book reviews, theses, conference and project reports (for the scientific community and for funding agencies).

6L

2.2 Components of a research paper– the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations. 4L

2.3Oral and poster presentation of research papers in conferences/symposia. 2L

2.4 Preparation and submission of research project proposals to funding agencies 3L

UNIT- 3

3.1 History of Computer, Concept of Computer hardware, Concept of Computer languages,Concept of Computer Softwares. 4L

3.2 Spreadsheet tools : Introduction to spreadsheet applications, features, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts / graph andother features, Tools – Microsoft Excel or similar. 6L

3.3 Presentation tools: Introduction, features and functions, Presentation of Power Point Presentation, Customizing presentation, Showing presentation, Tools – Microsoft Power Point. 5L

UNIT- 4

4.1 Bioinformatics applications**:** Agriculture, Molecular biology, Environment, Biotechnology, Food Science Neurobiology,Drug Designing, Biomedical genome medicines. 2L

4.2 Techniques in Molecular Biology: Identification and characterization of DNA, RNA, plasmids. Agarose gel electrophoresis, ethidium bromide staining. Southern, Northern, Western

Blotting, RAPD, RFLP, DGGE, TGGE, PCR. 7L

4.3 Applications of Software: Latex (Writing Paper, Thesis, Report, Bibliography), BEAMER for presentation. **6L**

References:

1. S. C. Rastogi, N. Mendiratta, and P. Rastogi Bioinformatics Methods and Applications Genomics, Proteomics, andDrug Discovery.
2. Atwood, T. K. and Parry-Smith, D. J Introduction to Bioinformatics.
3. Methods of Protein and Nucleic acid Research, Osterman Vol I – III
4. Bioinformatics by David Mound
5. Keith Wilson and Walker. Practical Biochemistry, Vth edition,
6. Robert Scopes (1982); Protein Purification by, Springer Verlag Publication.
7. Tools in Biochemistry David Cooper
8. Methods of Protein and Nucleic acid Research, Osterman Vol I – III
9. Sundar Rao and J Richards Introduction to biostatistics and research methods, PSS
10. Rastogi, S. C. and Mendiratta and Rastogi, P. Bioinformatics; Methods and applications; Genomics, Proteomics and DrugDiscovery;
11. M N Parikh and Nithya Gogtay ABC of Research Methodology and Applied Biostatistics,
12. Kothari, C.R. Research Methodology (Methods and Techniques), New Age Publisher.

Examination Pattern / Evaluation Pattern

Teaching and Evaluation (for Major, Minor, AEC, VEC, IKS courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	4 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Teaching and Evaluation (for VSC, SEC & CC courses)

- Evaluation to be done by Internal & External Experts
- No descriptive end semester written examination
- Evaluation to be done at Department level preferably prior to commencement of Theory /Practical Examinations
- Evaluation to be done on the Skills gained by student