Mahatma Gandhi University
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Medical Sciences and Technology

Syllabus

B. Sc. Bioinformatics

(3 YEARS DEGREE COURSE)

NOTICE

1. Amendments made by the court of the management of the university in rules/regulations of Graduate Medical Courses shall automatically apply to the rules/ regulations of the Mahatma Gandhi University of Medical Sciences and Technology.

2. The university reserves the right to make changes in the syllabus /books/ guidelines, fee-structure or any other information at any time without prior notice. the decision of the university shall be binding on all.

3. The jurisdiction of all court cases Shall be Jaipur Bench of Honorable Rajasthan High Court only.

Introduction: Basic sequence and structural Bioinformatics as well as introduction to Bioinformatics algorithms. Pairwise and multiple sequence alignment. Methods for phylogenetic analysis and pattern recognition. Bioinformatics databases and servers. Classification and comparison of protein structures. Prediction of secondary and tertiary structure from sequence and homology modelling of the three-dimensional structure of proteins. Molecular dynamics simulations and molecular docking with applications to drug design. Applications of bioinformatic research. Computer exercises in bioinformatic scientific environment. Introduction to basic programming in R. Ethical aspects in education, research and development. Bioinformatics in Society

Student Learning Objectives:

The student will be able to:

1. Students will become familiar with a variety of currently available genomic and proteomic databases. Assessment will be based upon performance on computer assignments and exam questions.

2. Students will be able to search and retrieve information from genomic and proteomic databases (e.g. GenBank, Swiss-Prot), and to analyze their search results using software available on the internet (e.g. BLAST, ClustalW). Assessment will be based upon performance on computer assignments and exam questions.

3. Students will learn how to compare and analyze biological sequences and how to interpret the results of their analyses. Assessment will be based upon performance on computer assignments and exam questions.

4. Students will learn how to construct phylogenetic trees based on biological sequence data. Assessment will be based upon performance on computer assignments and exam questions.

5. Students will be able to locate consensus sequences, genes and open reading frames within biological sequences. Assessment will be based upon performance on computer assignments and exam questions.

6. Students will become familiar with the principles and applications of microarrays. Assessment will be based upon performance on exam questions.

7. Students will be able to perform elementary predictions of protein structure and function. Assessment will be based upon performance on computer assignments and exam questions.

8. Students will be able to perform elementary comparative genomic analysis. Assessment will be based upon performance on computer assignments and exam questions.

9. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

10. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

DURATION OF THE COURSE
Duration of the course: **3** academic years

MEDIUM OF INSTRUCTION
English shall be the medium of instruction for all the subjects of study and for examination of the course.

COMMENCEMENT OF THE COURSE
The Course shall commence from the 1st August of every Academic year.

ELIGIBILITY FOR ADMISSION:

- Pass in 12th class of 10 +2 system or equivalent with minimum aggregate of 50% marks in physics**,** chemistry and biology or mathematics, provided the candidate has passed in each subject separately.

<div align="center">**OR**</div>

- Diploma in Bioinformatics after Pass in 12th class of 10 +2 of CBSE or equivalent with minimum aggregate of 50% marks in physics chemistry and biology or Mathematics provided the candidate has passed in each subject separately.

<div align="center">**OR**</div>

- Candidates with two years diploma from a recognized Government Board in a subject for which the candidate desires to enroll, in the respective Allied Health Sciences course.

<div align="center">**OR**</div>

- Candidates with three years diploma or degree from a recognized institute, in the respective Allied Health Sciences courses.

RESERVATION:
Reservation of seats shall be applicable in accordance with Rajasthan State Government reservation policy.

CURRICULUM
The curriculum and the syllabus for the course shall be as prescribed by the academic Council from time to time.

SELECTION OF CANDIDATES:
1. Admission in B. Sc. Bioinformatics course shall be made on the basis of eligibility criteria set by University.

2. Successful candidates on the basis of 12th percentage obtained will be called for the University combined entrance examination. The interview board will include the Principal of Institute of Health Informatics and Head of the Institution, whose recommendations shall be final for the selection of the students.

3. During subsequent counseling (s) the seat will be allotted as per the merit of the candidate depending on the availability of seats on that particular day.

4. Candidate who fails to attend the Medical Examination on the notified date(s) will forfeit the claim for admission and placement in the waiting list except permitted by the competent authority under special circumstances.

5. The name of the student(s) who remain(s) absent from classes for more than 15 days at a stretch after joining the said course will be struck off from the college rolls without giving any notice.

PROVISION OF LATERAL ENTRY:

Lateral entry to second year for allied health science courses for candidates who have passed diploma program from the Government Boards and recognized by State/Central University, fulfilling the conditions specified and these students are eligible to take admission on lateral entry system only in the same subject studied at diploma level.

ATTENDANCE

No candidate shall be permitted to appear for any one of the parts of B. Sc. Bioinformatics degree course examinations, unless he/ she has attended the course in the subject for the prescribed period in an affiliated Institution recognized by this University and produces the necessary certificate of study, attendance, satisfactory conduct and progress from the Head of the Institution.

A candidate is required to put in a minimum of 75% of attendance in both theory papers practical separately in each subject before admission to the examination. This relaxation in attendance includes for medical & any other reasons approved by the head of the Institution.

A candidate lacking in the prescribed attendance and progress in any one of the subjects in theory and practical in the first appearance shall not be permitted for admission to the entire examination.

ENROLMENT:
Every candidate who is admitted to B. Sc. Bioinformatics Course in Mahatma Gandhi institute of Health Informatics shall be required to get himself/herself enrolled with the Mahatma Gandhi University of Medical Sciences & Technology after paying the prescribed eligibility/enrollment fees.

The candidate shall have to submit the application form duly filled in and forwarded to the University through Principal of the College for the enrollment/eligibility along with the original documents with the prescribed fees (up to November 30 of the year of admission without late fees and up to December 31 of the year of admission with late fees)

SCHEME OF EXAMINATION

1. Theory

a. Each theory paper examination shall be of 3 hours duration and of maximum marks 80.

b. There will be three question papers for each year and shall be in accordance with the different subjects/area covered during each of the B. Sc. Bioinformatics three years course.

c. For the First and Second year examinations - these respective above question papers shall be set by the Internal examiners covering their respective areas of syllabus. The answer book shall be evaluated by the concerned internal examiners.

d. In Third (Final) year examination, one of the papers shall be set and evaluated by an External Examiner. In other words, one of the Internal has to be substituted by the External Examiner. There shall be two internal and one External Examiner. The External examiner shall evaluate his /her paper.

e. The Paper setter shall set the questions within the prescribed course of study of the concerned paper. There will be a set pattern of question papers duly approved by Academic Council. Model question paper is annexed herewith.

f. It is to be noted that the internal examiners of all the three years shall be appointed by the President of the university in consultation with the respective course coordinator of the course. This exercise shall be conducted by through the office of the Controller of the Examination of the University. The External examiner shall be appointed by the President out of the panel of names submitted by the Coordinator of the course through the Controller of Examinations to the President. The President may or may not be consult the Coordinator before the appointment of the External examiner.

g. Internal Assessment – Internal assessment shall be of 20 marks for each theory paper.

h. Passing mark - A candidate will have to obtain at least 50% marks in each Theory paper to pass. This means that he will have to score 50 marks in each paper. This shall include the marks obtained in Theory paper of 80 marks and internal assessment for that paper of 20 marks. (Marks obtained in Theory paper + marks obtained in internal assessment = the Total Marks obtained in respect of each paper).

PRACTICAL EXAMINATION FORMAT.
First year – 300 Marks
Second year – 300 Marks
Third year – 300 Marks

PRACTICAL EXAMINERS
Practical & viva-voce:

First year – Two internals and one external

Second year – Two internals and one external

Third year – Two internals and one external

It shall be left to the examiners – Internals and the Externals, as the case may be, to examine and evaluate the students in the way they wish and award the marks without giving any specific details. The total marks obtained by the candidate in the Project assignment and viva shall be the aggregate of the marks awarded by all the examiners put together as one figure.

This shall then be submitted to the university student shall be required to obtain a minimum of **50%** pass mark in the Dissertation and Viva Voce examination. A candidate who fails to obtain **50%** marks shall be declared failed.

RESULT:

Result – Division: Successful candidates will be categorized as under.

1	Those securing 50% and above but less than 60% in the aggregate marks of First, Second & Third year taken together	**Pass**
2	Those securing 60% and above but less than 75% in the aggregate marks of First, Second & Third year taken together	**Pass with First Division**
3	Those securing 75% and above in the aggregate marks of First, Second & Third year taken together	**Pass with Honors**

SUPPLEMENTARY EXAMINATION:
   (a) Eligibility for the failed candidates to appear at the supplementary examination shall be as below
      i. Failed in Theory Paper(s) and failed in Practical – shall reappear in the respective failed Theory paper(s) and Practical examination.
      ii. Failed in Theory paper/papers and passed in Practical examination – shall reappear only in the concerned failed Theory paper(s).
      iii. Passed Theory papers but failed in Practical – shall reappear
          only in the Practical Examination.
   (b) There shall be a supplementary examination within six months of the declaration of the result of the main examination. Internal assessment marks obtained in main examination in the concerned failed paper/papers shall be carried forward for working out the result of supplementary Theory paper(s) examination. Such candidate who has secured less than 50% marks in the internal

assessment will be allowed to improve his internal assessment marks in the repeat supplementary internal assessment examination.

(c) Marks secured by the candidate in passed main examination/supplementary examination Theory paper(s) and/or practicals, as the case may be, will be carried forward for working out his result.

PROMOTION TO 2ND /3RD YEAR OF THE PROGRAM

A candidate if failed in one or more subjects in in first and second year of the B. Sc. Bioinformatics program can be promoted up to final year a candidate can take any number of attempts with condition that maximum period allowed to complete the the B. Sc. Bioinformatics course Shall be 6 years.

REVALUATION / SCRUTINY
Re-evaluation of answer book(s) of the B. Sc. Bioinformatics course may be permissible in not more than two theory papers within 15 days from the date of declaration of examination result on submission of his/her application on the prescribed form along with the requisite fees. Such answer book(s) shall be re-evaluated as per University rules. Reevaluation of answer book(s) shall not be permitted for second attempt in any paper.

Scrutiny (re-totaling) of answer book(s) of the B. Sc. in Bioinformatics course may be permissible within 15 days from the date of declaration of examination result on submission of his/her application on the prescribed form along with the requisite fees as per University Rules.

GRACE MARKS

1. A student who appears in the whole examination in first attempt and obtains the required minimum pass marks in the total aggregate of an examination but fails to obtain the minimum pass marks in one subject (in theory and / or practical as the case may be) will be awarded the grace marks up to a maximum of 05 marks according to the following scale, provided the candidate passes the examination by award of such grace marks:

Marks obtained by the candidate above the required minimum aggregate pass marks	Grace marks can be given up to
Up to 6 marks	02
Up to 12 marks	03
Up to 18 marks	04
19 marks and above	05

2. No grace marks would be awarded to a candidate who appears in part/ supplementary/remand examination. Non-appearance of a candidate in any part of the examination on account of any reason will make him ineligible for grace marks.
3. A candidate who passes the examination after the award of grace marks in a paper/practical or the aggregate will be shown in the marks sheet to have passed the examination by grace. Grace marks will not be added to the marks obtained by a candidate from the examiners.
4. A candidate who is awarded grace marks in any subject to pass the examination will not be entitled for distinction in any subject.

AUTHORITY TO ISSUE TRANSCRIPT

The Controller of Examination of the University shall be the authority for issuing transcript after receiving the described fee from the candidate.

WEIGHTAGE DISTRIBUTION

Item	weightage (%)
Class participation/presentation	10.00%
Assignment &quizzes	10.00%
Year-end University exam	80.00%
Total	**100%**

EVALUATION MARKS DISTRIBUTION FOR FIRST,SECOND AND THIRD YEAR
B.Sc. Bioinformatics

| Paper | Theory | | | Practical | | | Total |
	University examination	Internal assessment	Pass Marks	Internal	External	Pass Marks	
Paper 1	80	20	50 % in each IA & UE	50	50	50 % in each IA & UE	200
Paper 2	80	20		50	50		200
Paper 3	80	20		50	50		200
Total							**600**

NOMENCLATURE OF PAPERS

B. Sc. Bioinformatics First Year	
Paper Ist	**Introduction to Information Technology**
Paper IInd	**Basic of Bioinformatics**
Paper IIIrd	**Mathematics- I**
B. Sc. Bioinformatics Second Year	
Paper Ist	**Structural Bioinformatics**
Paper IInd	**Mathematics II**
Paper IIIrd	**Research methodology**
B. Sc. Bioinformatics Third Year	
Paper Ist	**cell biology**
Paper IInd	**Computer graphics, Machine learning and Bio-Perl**
Paper IIIrd	**Informatics in Omics and its application**

B.Sc. Bioinformatics

Theory

Part-I - B.Sc. Bioinformatics

Part-I : Paper I : Introduction to Information Technology

Unit I

Information Technology: historic evolution of computers, classification of computers, micro computer,mini computer, main frames, super computers, personal computers, desktop, laptops, Palmtop, tablet PC, hardware & software.

Unit II

Hardware CPU, memory, input device, output device, memory Modules, RAM;ROM-different types: Flash memory, Auxiliary storage, Magnetic device, optical device, floppy device, hard disk, CD ,DVD, input devices-keyboard mouse, scanner, joystick, optical readers, bar code reader, output device: display device, size, and resolution, CRT, LCD, Printers: Dot-matrix, inkjet, plotters, sound cards & speakers.

Unit III

Software: System software, Application software, introduction to operating system, programming language, Application softwares,compiler,interpreter,assembler,linker,databases;different types of operating systems; single user, multitasking, time sharing ,multi user, booting, POST, generic features of word processors, spreadsheets and presentation software, computer viruses and protection.

Unit IV

Computer networks- requirements for a network server, work station hub/switch, network interface card ;internet -brief history, www, websites, url, browsers, search engines.internet.

Unit V

Database development and management systems,Data abstraction, Data models, Instances and schemes,E-R model: Entity and entity sets, Relations and relationship sets, E-R diagrams, Reducing E-R diagrams to tables,Network data model (basic concepts), Hierarchical data model (basic concepts),Multimedia databases- Basic concepts and applications.

Part-I : Paper II : Basic of Bioinformatics

Unit I
What is Bioinformatics and its relation with molecular biology Examples of related tools(FASTA, BLAST, BLAT, RASMOL), databases(GENBANK, Pubmed, PDB) and software(RASMOL,Ligand Explorer), Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray).Applications of Bioinformatics.

Unit II

Biological Database and its Types ,Introduction to data types and Source. Population and sample,Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases;
Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary).Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum).

Unit III

Data storage and retrieval and Interoperability, Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search.The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts.General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.

Unit IV

Sequence Alignments and Visualization, Introduction to Sequences, alignments and Dynamic Programming,Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.

Unit V

Gene Expression and Representation of patterns and relationship,General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS.Introduction to Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes).Genetic variability and connections to clinical data.

Part-I : Paper III – Mathematics- I

Unit I
Sets, Types of Sets, Subsets, Complement of Sets, union and Intersection of Sets, Difference of Sets, Demorgan's Law, Cartesian product of Sets. Basics of Probability, Permutation and Combination.

Unit II
Measure of central tendency and dispersion: Mean, median, mode, range, standard deviation, variance

Unit III
Correlation and Regression: Types, Karl-Pearson's correlation, Spearman's Rank correlation, Regression equation and fitting

Unit IV
Probability Distribution: Basics of Binomial, Poisson and Normal distributions and their application in biology. Random Variable; Discrete and Continuous Probability Distribution, Probability mass function, probability Density function, Mathematical Expectation.

Unit V

Matrices, Types of Matrices, Addition of matrices, Subtraction of matrices and Product of matrices. Properties of Matrix Multiplication. Transpose of Matrix, Symmetric and Skew-symmetric Matrices, Inverse of Matrix connections-isp, dialup, cable modem, WLL, DSL, Leased line , EMAIL, Email software features(send,receive,filter,attach,forward,copy,blindcopy)internet security and privacy.

Part-II - Year B. Sc. Bioinformatics

Part-II: Paper I–Structural Bioinformatics

Unit I
Fundamentals of X-ray diffraction, NMR spectroscopy of macromolecules ,Protein Structure: Primary, Secondary, Super Secondary, Domains, Tertiary, Quaternary, Ramachandran plot.

Unit II
Protein secondary structure classification databases: HSSP, FSSP, CATH, SCOP,Protein secondary structure prediction methods: GOR, Chou-Fasman, PHD, PSI- PRED, J-Pred.

Unit III

Protein Tertiary structure prediction methods: Homology Modeling, Fold Recognition, Ab- intio Method,Protein folding, Molecular Dynamics of Protein, Molecular Docking of Protein, Small molecule and Nucleotide, Concepts of Force Field

Unit IV
Motif and Domain: Motif databases and analysis tools,Domain databases (CDD, SMART, ProDom) and Analysis tools. HMM (Hidden Markov Model): Introduction to HMM, its application in Sequence alignment and Structure prediction, HMM based Softwares (HMMER and HMMSTR)

Unit V
Structural features of RNA: Primary, Secondary, Tertiary. Introduction to RNA Secondary structure prediction, Methods for RNA Secondary structure prediction, Limitation of RNA Secondary structure prediction

Paper II- Mathematics II

Unit I
Law of Indices, trigonometric ratios, Inverse trigonometric functions.   Binomial theorem.

Unit II
Sequences and series AP, GP, HP, Logrithmic and Exponential Series.

Unit III
Basics of Functions and Limits, Elementary Differentiation and Integration Fourier transform, Laplace transform and other standard transform.

Unit IV
Coordinate geometry: Distance between two points, section formula, Locus of points. Equation of lines, Circle, Ellipse, Parabola, Hyperbola

Unit V

Vector: Addition, subtraction, dot product, cross product, scalar triple product,

Vector differentiation and vector integration, gradient, divergence, curl of a vector, equation of normal

PAPER III- RESEARCH METHODOLOGY

UNIT I

Introduction to Research- Definition, Objectives and Characteristics of research, Types of Research- Basic, Applied and Action research, Exploratory and Descriptive, Ex-post facto research.

UNIT II

Identification of Research Problem Sources of research problem, Criteria for the selection of research problem. Research design, Rationale, Statement of problem, Setting objectives. Definition of concepts
Hypothesis - Meaning and importance, types of hypotheses.

UNIT III
Research Methods and Tools Methods of Collecting Primary Data - Questionnaire, preparation of schedules, interview method, case study method, experimentation method and sources of secondary data. Editing and Coding the Data Organization of Data - Classification - meaning and objectives, types of classification. Representation of Methods - Survey, observation, interview, experimental, clinical methods. Tools Questionnaire, Schedule (for interview and observation) Rating Scales, Attitude Scales. Reliability and validity.

UNIT IV
Data collection and presentation: Introduction to Biostatistics: Variable and attribute; Population vs.sample; Census vs sample survey; Arrangement of data; Frequency distribution. Graphical presentation of data: Line diagram; Bar diagram; Pie chart; Histogram.

UNIT V

Scientific writing. Basics in Scientific Grammar. Importance of abbreviations and acronyms. Types of scientific publications-magazines, journals, reviews,news letters, Structure of Scientific paper. Various reference styles.

Part-III : B. Sc. Bioinformatics

Part-III : Paper I: cell biology

UNIT I
Cell: An introduction and classification of organism by cell structure, cytosol, compartmentalization of eukaryotic cells, Cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and fluid Mosaic Model.

UNIT II
Membrane vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion
Lysosomes: Vacuoles and microbodies: Structure and functions. Ribosomes: Structure and function including role in protein synthesis. Mitochondria: Structure, Genomes, biogenesis. Chloroplasts: Structures, Genomes, biogenesis.

UNIT III
Nucleus: Structure, Cell cycle (Interphase & M Phases), Mitosis, Meiosis, Regulation of cell cycle, Chromosome-Structure and characteristics Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics of cancer cells, molecular basis of cancer.

UNIT IV
Introduction to Biochemistry: a historical perspective, structural classification & properties of major biomolecules-cabohydrates, fats, proteins, Water. **Amino acids & Proteins** - Structure & function. Structure and properties of aminoacids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different level of structural organization of proteins, Purification of proteins and criteria of their purity. Denaturation and renaturation of proteins. Fibrous and globular proteins. **Carbohydrates** - Structure and properties of monosaccharides, Oligosaccharides and Polysaccharides. Homo & hetero Polysaccharides, Mucopolysaccharides. **Lipids** - Structure & functions-Classification, structures, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids structure and properties of different types of phospholipids, sphingomyelins, glycolipids, cerebrosides, gangliosides, Prostaglandins.

UNIT V
Nomenclature and classification of Enzymes, Holoenzymes, Apoenzymes, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes,activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types and theories, ribozymes,abzymes, Biocatalysts from extreme thermophilicand hyper thermophilic archea and bacteria.Role of cofactors in enzyme catalysis: NAD+, NADP+, FMN/FAD, coenzymesA, VitminB12, lipoic acid, biotin,tetrahydofolate and metallic ions. Carbohydrate metabolism: Glycolysis: reactions, energetics and regulation, Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogenesis. TCA cycle: ETC, Oxidative phosphorylation Beta oxidation of fatty acids Biochemistry of photosynthesis.

Part-III : Paper II- Computer graphics, Machine learning and Bio-Perl

Unit I
Color models: CMY, HSV, RGB, Visualization techniques. Graphics display devices, Raster and Random scan devices, color CRT monitors, LCD and LED.

Unit II

Artificial Neural Networks, Genetic algorithm, Bayesian modeling, Monte Carlo Simulation Method, Markov Models and their application.

Unit III
Perl basic: Variables, Perl operations, A Program to store DNA sequence, Concatenating DNA fragment, Transcription: DNA to RNA, Subroutines, scoping and subroutines, command-line arguments and arrays passing data to subroutines, modules and libraries of subroutines, fixing bugs.

Unit IV

Random number generators a program using randomization, a program to simulate DNA Mutation, generating random DNA, analyzing DNA, Hashes, data structures and algorithms for biology, the genetic code,

Unit V

Translating DNA into proteins reading DNA from files in FASTA format, reading frames, Regular expressions, restriction maps and restriction enzymes, Genbank files, Genbank libraries, separating sequence and annotation parsing, Annotations indexing, parsing PDB files, parsing BLAST files.

Part-III : Paper III- Informatics in Omics and its application

Unit I:
Genomics: Genome Annotation, Genome Assembly, Structural and Functional Genomics. Comparative Genomics ,Microarray: technique, Design, Analysis, Drug target identification.

Unit II
System biology: Introduction, Associated disciplines, Interactomics (PPI), Fluxomics, Biomics. Metagenomics: Introduction, metagenome, shotgun metagenomics (pyrosequencing). Tool's in metagnomics, MEGAN, MG- RAST, and SEED.Application: Gene survey, Enviornmental genomes, Microbial diversity.

Unit III
Metabolic pathway database (KEGG pathway database), Concept of metabolome and metabolomics.Drug Discovery and design : Target identification , Target Validation , Lead Identification , lead optimization , preclinical Pharmacology & Taxology.

Unit IV
Chemoinformatics: Cheminformatics tools for drug discovery.Chemical Structure Representation (SMILE & SMART).Chemical databases: CSD, ACD, WDI, ChemBank, hazardous chemical database, PUBCHEM.

Unit V
Quantitative Structure Activity Relationship (2D & 3D). Combinatorial libraries & their design. High throughput screening, virtual screening, Lipinski's rule of five.

MODEL PAPER

B. Sc. Bioinformatics…….   IIT-I

B. Sc. Bioinformatics

Part – l (Main) Examination (Month Year)

Paper-I

Introduction to IT

Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q. No.1 What is information technology ? explain DOT – matrix.   **(20)**

OR

Explain application software and computer virus ?

Q No. 2 What is computer network ? explain work station hub/ network interface card.   **(20)**

OR

What is computer search ? explain www and web site.

Q. No. 3 Write short notes on: (any five)   **(40)**

   (a) Explain micro and mini computer.

   (b) What is E-R Model ?

   (c) What is computer network ?

   (d) What is Browsers.

   (e) What is multimedia database?

(f) Explain Computer Virus and Protection ?

(g) What is health information technology ?

MODEL PAPER

B. Sc. Bioinformatics…….   BB-II

B. Sc. Bioinformatics

Part – l (Main) Examination (Month Year)

Paper-II

Basic of Bioinformatics

Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q. No.1 What is bio informatics ? Explain biology example FAST - RESMOL ?   **(20)**

OR

Explain specialized genome data base.

Q No. 2: Introduction to meta data and search . short note of XML ,uml?   **(20)**

OR

Define introduction to gene expression in prokaryotic.

Q. No. 3 Write short notes on: (any five)   **(40)**

(α) What is multiple sequence alignment ?

(β) Explain nucleic acid data base

(χ) What was the basic challenges in data exchange and integration ?

(δ) General introduction of SNP, EST, ?

(ε) Explain local alignment ? gives some examples.

(ϕ) What is hierarchies models ?

(γ) Genetic variability and connections to clinical data ?

MODEL PAPER

B. Sc. Bioinformatics……. MM-I:III

B. Sc. Bioinformatics

Part – l (Main) Examination (Month Year)

Paper-III

Mathematics I

Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q. No.1: Types of Data, explain with example? (20)

OR

Explain Variables: Qualitative & Quantitative?

Q No. 2: What is sampling? Describe various sampling methods. **(20)**

OR

Define Probability and enumerate rules of Probability?

Q. No. 3 Write short notes on: (any five) **(40)**

(α) Statistics

(β) Biomedical wastage

(χ) Scale of measurement

(δ) Uses and Limitations of Hospital Statistics

(ε) Research question.

(ϕ) Planning tools & Techniques.

(γ) Time management.

B. Sc. Bioinformatics

Part – II (Main) Examination (Month Year)

Paper-I

Structural Bioinformatics
Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q No. 1 Define primary and secondary structure of protein ?   **(20)**

OR

Define protein secondary structure classification databases?

Q No.2: Define protein tertiary structure methods (Homo-logy Modeling)?

OR

Define motif analysis tools (CDD, SMART).   **(20)**

Q. No. 3 Write short notes on: (any five)   **(40)**

   a) Define Ramachandran plot.

   b) What is the concept of force field?

   c) Define HMM based software.

   d) Define molecular Docking of protein.

   e) Method of RNA Secondary structure.

   f) What is FTTP? Explain it.

   g) What is HSSP ? Explain it.

B. Sc. Bioinformatics

Part – II (Main) Examination (Month Year)

Paper-II

Mathematics II
Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q. No.1: (i). Prove that the sum of degrees of the vertices of a graph G is equal to twice the   **(20)**
number of edges in G.

(ii). Prove that the sum of degrees of the regions of a map is equal to twice the number of edges.

OR

Calculate the coefficient of correlation for the following data.
Series X: 2 3 4 5 6 7 8
Series Y: 4 5 6 12 9 5 4

Q No. 2: Prove the following identities

(i) $(A \cup B) \cap (A \cup B \ C) = A$

(ii)   (ii) $(A \cup B) \setminus (A \cap B) = (A \setminus B) \cup (B \setminus A)$ 1. (20)

OR

i) Construct the truth table for the proposition
$[p \rightarrow q) \wedge (q \rightarrow r)] \vdash (p \rightarrow r)$
ii)What are the types of quantifiers? Explain.

Q. No. 3 Write short notes on: (any five)   **(40)**

a) If $U = \{1,2,3,…9\}$, A= $\{1,2,3,4,5\}$ and E=$\{2,4,6,8\}$, Find $(A \setminus E)c$

b) If U=$\{1,2,3…9\}$, A=$\{1,2,5,6\}$, B=$\{2,5,7\}$, Verify De-Morgan's laws.

c) Define the logical operations conjunction and disjunction.

d) What are tautologies and contradiction?

e) Define predicate and give example for it.

f) Explain isomorphism of graphs

g)What is an Euler graph

B. Sc. Bioinformatics…….   RM-III

B. Sc. Bioinformatics

Part – II (Main) Examination (Month Year)

Paper-III

Research Methodology
Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q. No.1 Define Research. Explain research methodology .   **(20)**
OR

What is Bio statistics, Discuss in brief ?

Q No. 2: Describe Types of variables & scales of measurements .   **(20)**

OR

What do you understand about Clinical trials/ International studies?
.

Q. No. 3 Write short notes on: (any five)   **(40)**

a)   Significance of correlation coefficient

b)   Cohort studies

c)   Reliability & Validity

d)   Multivariate Analysis

e)   What is Simple random sampling?

f)   What is Ex-post facto research?

g)   What is Definition of concepts Hypothesis?

MODEL PAPER

B. Sc. Bioinformatics

Part – III (Main) Examination (Month Year)

Paper-I

Cell biology
Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q. No.1 Explain Cell Membrane and Permeability.   **(20)**
OR

Explain Structure and function of microtubules.

Q No. 2: Describe Endoplasmic reticulum: Structure, function including role in protein segregation.**(20)**
OR

Define Chloroplasts: Structures, Genomes, biogenesis.
.

Q. No. 3 Write short notes on: (any five)   **(40)**

   a) What is Golgi complex: Structure?

   b) Explain Chromosome-Structure.

   c) What is characteristics of cancer cells?

   d) Define Chloroplasts: Structures, Genomes?

   e) Explain Endoplasmic reticulum function.

   f) What is Cell cycle (Interphase & M Phases)?

   g) What is fluid Mosaic Model?

MODEL PAPER

B. Sc. Bioinformatics

Part – III (Main) Examination (Month Year)

Paper-II

Computer graphics, Machine learning and Bioperl
Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q. No.1 Explain Process of Translating DNA into proteins reading DNA from files in   **(20)**
FASTA format.

OR

Explain restriction maps and restriction enzymes programmes.

Q No. 2: Describe Markov Models and their application.   **(20)**

OR

Define Visualization techniques(Graphics display devices, Raster and Random scan devices).

Q. No. 3 Write short notes on: (any five)   **(40)**

a) What is Genbank files?

b) Explain parsing BLAST files.

c) What is Annotations indexing?

d) Define parsing PDB files?

e) Explain Genbank libraries.

f) What is color CRT monitors?

g) What is Artificial Neural Networks?

MODEL PAPER

B. Sc. Bioinformatics

Part – III (Main) Examination (Month Year)

Paper-III

Informatics in omics and application
Time: Three Hours

Maximum Marks: 80

Attempt all Questions

All the parts of one question should be answered at one place.

Only one Supplementary Copy along with one main answer book is allowed

Q. No.1 Explain Structural and Functional Genomics.   **(20)**
OR

Explain Microarray technique, Design, Analysis,.

Q No. 2: Describe Drug Discovery and design   .**(20)**
OR

Define virtual screening, Lipinski's rule of five.

Q. No. 3 Write short notes on: (any five)   **(40)**

   a)   What is High throughput screening?

   b)   Explain Chemical databases: CSD, ACD, WDI.

   c)   What is Chemo informatics?

   d)   Define PUBCHEM.

   e)   Explain MEGAN Tool.

   f)   What is KEGG pathway database?

   g)   What is Chemical Structure Representation (SMILE & SMART)?