MAHATMA GANDHI UNIVERSITY
of
MEDICAL SCIENCES & TECHNOLOGY
JAIPUR

Syllabus

M. Sc. in Bioinformatics

(4 SEMESTERS P.G. DEGREE PROGRAM)

2023-24

Recommended by BOS/Committee of Courses Health Informatics at its meeting held on 03/03/2023 and approved by Academic Council at its meeting held on 28/04/2023.

NOTICE

1. 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.

2. The jurisdiction of all court cases shall be Jaipur Bench of Hon'ble Rajasthan High Court only.

RULES & REGULATIONS OF

M. Sc. in Bioinformatics

PROGRAM CODE: - **MSC0223**

(4 SEMESTERS P.G. DEGREE PROGRAM)

1.INTRODUCTION:

Bioinformatics is a rapidly maturing field at the confluence of biology, mathematics and computer science. It strives to better understand the molecules essential for life, by harnessing the power and speed of computers. Mathematical models and software are developed by computational biologists, who must have good skills in math and computer science. However, the working (experimental) biologist is generally a user of "black box" bio informatics software and databases, with little knowledge of the underlying algorithms. While there's no need for the working biologist to be able to be able to develop sophisticated mathematical models or design and implement novel algorithms, there is a need to understand the broad ideas of algorithms underlying the tools the biologist uses. As a working professional in the medical and life sciences, this knowledge is important to understand the scope, applicability, and limitations of certain tools -- and, who knows, you may become turned on by the idea of ferreting out biological insights by applying mathematics and computer science, and so choose to pursue further courses to become a computational biologist.

This introductory course requires that you have a basic understanding of molecular biology, genetics, and use of Internet, but does not require that you have any background in mathematics or programming -- nevertheless, if you have had a course in probability theory and statistics, then you'll understand more easily some of the approaches. Nevertheless, the class will be self-contained, and I will not assume that anyone has had any math beyond calculus.

Program Outcomes

1. Bioinformation Analyst -Development of algorithms and software to determine the cure for diseases by studying their pathology. It also involves analyzing complex life forms, as well as other biological data.
2. Team Leader-Heads a research group of Bioinformatics graduates as well as organizes the process of both study and analysis.
3. Research Associate-Performs tasks related to research, study and innovation in the field of Bio informatics.
4. Bio Statistician- Deals with the collection, study and interpretation of data using the methods of statistics to come up with results in the field of bio informatics.
5. Computational Biologist-Study of biological systems using biological data that has been analyzed with the use of the software.
6. Bio informatics Software Developer-Helps with the creation and handling of software that is used to process and analyze biological data.

7. Pharmaceutical Research Statistician, Clinical Trials Coordinator, Data Manager-Provides data management services in order to meet customer needs. Manages projects, staff, and timelines.

8. Information Technology System Analyst, Project Manager, Data Manager-Works with software vendors to design clinical software, provides training to end-user staff, assists with system installations, provides system support.

9. Medical Software Companies Software Designer Software Tester-Designs and develops databases, performs various software testing, assists clients with system installations.

2. TITLE OF THE PROGRAM:

M.Sc. in Bioinformatics

3. DURATION OF THE COURSE:

Duration of the course: 2 Years (4 Semesters PG Degree Program)

4. MEDIUM OF INSTRUCTION:

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

5. ELIGIBILITY FOR ADMISSION:

1.Any health science graduate with MBBS/ BAMS/ BHMS/BDS/B. Sc. Nursing/Allied Health Sciences or equivalent with minimum aggregate of **50%** marks for general category and **45%** marks for reserved category candidates.

OR

Pass in any undergraduate program of 3- or 4-years duration or equivalent or any post graduate program of 2- or 3-year duration or equivalent with minimum aggregate of **50%** for general category and **45%** marks for reserved category candidates marks in any science group or public health/Health administration or computer science/technology group.

2. Candidates will be required to produce evidence of their passing graduation latest by the day of personal interview.

3. Candidates with relevant work experience are encouraged to apply. Working professionals will be considered for admission only after submitting NOC from their employer.

6. PROCESS OF ADMISSION:

Admission to M. Sc. in Bioinformatics Program shall be made on the basis of written entrance examination conducted for the purpose.

7. RESERVATION POLICY:

Reservation in admissions shall be applicable as per policy of the State Government.

8. ENROLLMENT:

Every candidate who is admitted to M.Sc. in Bioinformatics Degree Program in Mahatma Gandhi Institute of Health Informatics shall be required to get himself/herself enrolled with the Mahatma Gandhi University of Medical Sciences & Technology (MGUMST) after paying the prescribed eligibility and enrolment fees.

A candidate shall deposit enrolment fees along with tuition fees at the time of his/her admission to the course. Such a candidate who fails to submit, to the college Principal, duly filled enrolment form along with original documents including migration certificate required for enrolment within prescribed period then after he/she shall pay late fee applicable at that time. No student will be allowed to appear in the university examination without his/her enrollment.

9. ATTENDANCE:

Minimum 75 % attendance is required in each Semester, both for theory and practical classes separately, student with deficient attendance will not be permitted to appear in university examination.

10. WORKING DAYS:

Each semester shall consist 120 working days including examination.

11. CONDUCTION OF THE UNIVERSITY EXAMINATION:

University semester examination shall be conducted twice in a year with an interval of six months. Even Semester examination shall be conducted after 6 months of odd semester examination

12. ELIGIBILITY TO APPEAR FOR UNIVERSITY EXAMINATION

Student is required to have minimum 75% attendance (in theory and practical separately) /to make him/her eligible to Candidates failing in one or more, subject in a semester will be required to appear in their failing subject in the next examination of the same semester next year.

A candidate will have to clear all the subjects of First to Third semester before appearing at Fourth semester university examination.

13. APPOINTMENT OF EXAMINER & PAPER SETTER

- All the examiners - Paper setters, Theory examination answer books evaluators, External and internal Examiners for Practical examinations shall be appointed by the president of the University from the panel submitted by HOD/Convener of the respective COC through concerned dean of faculty.
- Paper setters shall be external.
- Practical examiner can be appointed to evaluate answers sheets.
- Professor/ Assoc. Professor /Assistant Professor/Lecturer/Allied Health Professional having PG qualification and 5 years' teaching experience after PG in respective field is eligible to act as Internal/External examiner of theory/practical examination.

14. SCHEME OF EXAMINATION

The University Examination (End of Semester Examination or EOSE) for the Course shall be conducted semester wise at the end of every semester.

i. Theory

(a) There shall be five Theory papers in each semester of the study.

(b) Each Theory paper examination shall be of 3 hours duration and of maximum 70 marks.

(c) Internal assessment (Continuous Assessment or CA) shall be of 30 marks for each Theory Paper.

(d) 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.

Pattern of question papers (Annexure 1)

(g) Passing Marks: A candidate will have to obtain at least 50% marks including internal assessment in each theory paper to pass.

II. Practical and Viva-Voce Examination

(a) At the end of each semester there shall be practical and viva-voce examination of 200 marks. It shall be conducted after the Theory examination is over. A candidate will have to obtain at least 50% marks in practical and viva-voce examination

(b) practical and viva-voce examination shall be of 140 marks (Practical 100 marks + viva voce 40 marks) and internal assessment of sixty marks.

(c) The pattern of practical examination shall be as follows –

Semester	Practical Marks			Total Marks	Min. Pass Marks	Practical Examiners
	EOSE (End of Semester Examination)					
	Practical	viva-voce	CA			
I to IV Each	100	40	60	200	100	One Internal & one External Examiner

III Result

1. candidate have to obtain at least 50% marks separately in each Theory paper including continuous assessment and a minimum of 50% marks in the practical examination including viva-voce for him to be declared pass.
2. A Candidate who has failed in a Paper (s) will reappear in respective paper(s) in next examination of the same semester next year.
3. Candidate who has failed in Practical examination will reappear in practical examination only in next practical examination of the same semester.

IV. Supplementary Examination.

(a) There shall be a supplementary examination of IV semester only within two months of the declaration of the result of the main examination of IV Semester.
(b) Continuous assessment marks obtained in the concerned failed paper(s)/practical shall be carried forward for working out the result of next Theory paper(s) and/or practical examination.
(c) If A failing candidate, wants to improve his/her Continuous assessment marks shall be allow to do so. In case he does appear for improvement or gets lesser marks in internal assessment, his earlier marks will be considered for working out the result of the failing subject.

V. Promotion to the Next Semester

1. A candidate who has passed or failed in one or more subjects shall be promoted to respective next semester.

2. A candidate will be allowed to appear for the IV semester examination only when the backlog of all papers (theory papers and practical) of I semester to III semester exams including elective papers (if any) is cleared.

3. The student is required to clear all the End of Semester Examination within 4 years from the year of joining of the Program otherwise he/she will have to leave the course.

M. Sc. in Bioinformatics Semester – I Examination

Course/Paper Name	**Course/Paper Code**	**Credits**	**Theory/ Practical/Viva**			
CORE COURSES			EOSE	CA	Total	Pass Marks
Fundamental of Bioinformatics	MSC0223S101T	7	70	30	100	50 % aggregate including continuous assessment marks separately in theory and practical.
Biostatistics & Research Methodology	MSC0223S102T	7	70	30	100	
Clinical Sciences	MSC0223S103T	7	70	30	100	
ELECTIVE COURSES (ANY TWO)						
Medical Terminology	MSC0223S104T	6	70	30	100	
Computer applications	MSC0223S105T	6	70	30	100	
Introductory Mathematics	MSC0223S106T	6	70	30	100	
PRACTICAL/ABILITY ENHANCEMENT COURSE						
Practical & Viva	MSC0223S107P	7	140	60	200	
TOTAL	**06 (05 Theory Paper 01 Practical)**	**40**	**490**	**210**	**700**	

M. Sc. in Bioinformatics Semester – II Examination

Course/Paper Name	**Course/Paper Code**	**Credits**	**Theory/ Practical/Viva**			
CORE COURSES			UE	IA	Total	Pass Marks
Genetic Engineering	MSC0223S201T	7	70	30	100	50 % aggregate including continuous assessment marks separately in theory and practical.
Programming with Perl	MSC0223S202T	7	70	30	100	
Molecular Biology	MSC0223S203T	7	70	30	100	
ELECTIVE COURSES (ANY TWO)						
Database Management System	MSC0223S204T	6	70	30	100	
Data Analysis & Visualisation	MSC0223S205T	6	70	30	100	
Internet Technology	MSC0223S206T	6	70	30	100	
PRACTICAL/ABILITY ENHANCEMENT COURSE						
Practical & Viva	MSC0223S207P	7	140	60	200	
TOTAL	**06 (05 Theory Paper 01 Practical)**	**40**	**490**	**210**	**700**	

M. Sc. in Bioinformatics Semester – III Examination

Course/Paper Name	**Course/Paper Code**	**Credits**	**Theory/ Practical/Viva**			
CORE COURSES			UE	IA	Total	Pass Marks
Biomolecular Modelling and Computational Drug Design	MSC0223S301T	7	70	30	100	50 % aggregate including continuous assessment marks separately in theory and practical.
Genomics and Proteomics	MSC0223S302T	7	70	30	100	
Sequence analysis and Phylogenetics	MSC0223S303T	7	70	30	100	
ELECTIVE COURSES (ANY TWO)						
Human Genetics and Disease	MSC0223S304T	6	70	30	100	
Hospital Organization and Management	MSC0223S305T	6	70	30	100	
Legal and Medical issues in hospital	MSC0223S306T	6	70	30	100	
PRACTICAL/ABILITY ENHANCEMENT COURSE						
Practical & Viva	MSC0223S307P	7	140	60	200	
TOTAL	**06 (05 Theory Paper 01 Practical)**	**40**	**490**	**210**	**700**	

M. Sc. in Bioinformatics Marks Distribution of Semester – IV Examination

Course/Paper Name	**Course/Paper Code**	**Credits**	**Theory/ Practical/Viva**			
CORE COURSES			UE	IA	Total	Pass Marks
Algorithms in computational Biology	MSC0223S401T	7	70	30	100	50 % aggregate including continuous assessment marks separately in theory and practical.
Structural Biology	MSC0223S402T	7	70	30	100	
Bioinformatics Tools	MSC0223S403T	7	70	30	100	
ELECTIVE COURSES (ANY TWO)						
Artificial Intelligence and Machine Learning	MSC0223S404T	6	70	30	100	
Healthcare Technology	MSC0223S405T	6	70	30	100	
Organisational Behaviour	MSC0223S406T	6	70	30	100	
PRACTICAL/ABILITY ENHANCEMENT COURSE						
Dissertation and Viva	MSC0223S407P	7	140	60	200	
TOTAL	**06 (05 Theory Paper 01 Practical)**	**40**	**490**	**210**	**700**	

18. LETTER GRADES AND GRADE POINTS

ETTER GRADE	GRADE	PERCENTAGE OF MARKS
O (Outstanding)	10	100 %
A+(Excellent)	9	90-99.99 %
A (Very Good)	8	80-89.99 %
B+(Good)	7	70-79.99 %
B (Above Average)	6	60-69.99 %
C(Average)	5	50-59.99 %
F(Fail)	0	0 Less than 50 %
Ab (Absent)	0	0 Absent

19. Grades Qualifying for Pass:

Theory and Practical Examination

1. Minimum 5 Grade in the university examination and **5 Grade** in internal assessment evaluated by the department are required to pass **who fails to obtain 5 Grade shall be declared failed.**

2. A student obtaining **Grade F** shall be considered **failed** and will be required to reappear in the examination.

3. Letter Grade **Ab (Absent)** will be showing the absent of the candidate in examination and will be required to reappear in the examination.

Continuous Assessment

Continuous assessments will be conducted two times in a semester. **Continuous** assessments will consist of departmental examinations, assignments, departmental posting, and evaluations. The objective is to allow students to have hands on experience. It would also help students to develop and formulate the data collection process and data analysis.

End of Semester Examination

a. Each theory paper examination shall be of 3 hours duration.

b. There will be Five theory papers in Each Semester.

20. Credit Weightage Distribution (%)

Item	Credit Weight (%)
1. Continuous Assessment	
Class participation/presentation, study records	10.00%
Assignment, quizzes and summer training report	10.00%
Departmental Postings, case studies, project reports	10.00%
2. End of Semester Examination	
70.00%	
Total	**100%**

21. 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.

22. Working Hours/Days

Duration	**3 Years (6 Semesters)**
Working Days	6 Days in A Week
Working Hours	36 Hours in A Week

23. Distribution of Courses Semester-Wise

Semester	**Core Course Component (CCC)**	**Elective Course Component (ECC)**	**Ability Enhance Component (AEC)/Practical**	**Total No. Of Courses/Papers**
Semester I	**3**	**2**	**1**	**6**
Semester II	**3**	**2**	**1**	**6**
Semester III	**3**	**2**	**1**	**6**
Semester IV	**3**	**2**	**1**	**6**

Total	**12**	**8**	**4**	**24**

24. Distribution of Courses in Each Semester

Sr. No.	**Type of Course**	**Numbers**
1	**Core Course**	**3**
2	**Elective Course**	**2**
Total (Five)		**05**

25. Types of Courses in M. Sc. Bioinformatics: -

1. Core Course-course designed under this category aim to cover the basics that a student is expected to imbibe in the discipline of M.Sc. in Bioinformatics. A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. Elective Course-it is a course which can be chosen from a pool of courses it is specific or specialized or advanced or supportive to the discipline of M. Sc. in Bioinformatics. Students have to **CHOOSE ANY TWO COURSE IN EACHSEMSTER** from the pool of course given to that semester.

3. Ability Enhancement Courses (AEC) /Practical: The Ability Enhancement (AE) Courses or practical are the courses based upon the content that leads to Knowledge enhancement. They are skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade PointAverage (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

SGPA (Si) = $\sum(C_i \times G_i) / \sum C_i$

where C_i is the number of credits of the ith course and G_i is the grade point scored by thestudent in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.

CGPA = $\sum(C_i \times S_i) / \sum C_i$

where Si is the SGPA of the semester and Ci is the total number of credits in thatsemester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration of Computation of SGPA and CGPA and Format for Transcripts

i. Computation of SGPA and CGPA
Illustration for **SGPA**

Course	**Credit**	**Grade letter**	**Grade point**	**Credit Point** (Credit x Grade
Course 1	3	A	8	3 X 8 = 24
Course 2	4	B+	7	4 X 7 = 28
Course 3	3	B	6	3 X 6 = 18
Course 4	3	O	10	3 X 10 = 30
Course 5	3	C	5	3 X 5 = 15
Course 6	4	B	6	4 X 6 = 24
	20			139

Thus, **SGPA =139/20 =6.95**

Illustration for **CGPA**

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
Credit : 20 SGPA:6.9	Credit : 22 SGPA:7.8	Credit : 25 SGPA: 5.6	Credit : 26 SGPA:6.0

Semester 5	**Semester 6**		
Credit : 26 SGPA:6.3	Credit : 25 SGPA: 8.0		

Thus, **CGPA =** 20 x 6.9 + 22 x 7.8 + 25 x 5.6 + 26 x 6.0 + 26 x 6.3 + 25 x 8.0 = **6.73**

SEMESTER I

Placement Semester	Semester I
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Fundamental of Bioinformatics
Course Code	MSC0223S101T
Course Type	Core
Credits	7
Hours per Semester	105

Introduction to Bioinformatics, Overview of bioinformatics and its applications, Biological databases and data retrieval,Introduction to sequence analysis and genome annotation, Biological Sequence Analysis.

Sequence alignment algorithms (Pairwise and Multiple), Sequence similarity and homology, Sequence databases (GenBank, UniProt),Database search tools (BLAST, FASTA),Genome Analysis, Genomic data analysis and interpretation,Gene prediction and annotation, Functional analysis and gene ontology,Protein Structure Analysis,Protein structure prediction methods,Protein structure databases (PDB).

Structure visualization tools (PyMOL, Rasmol),Protein structure analysis algorithms (secondary structure prediction, motif/domain identification),Gene Expression Analysis,Microarray data analysis,RNA-seq data analysis,Differential gene expression analysis,Clustering and visualization of expression data,Phylogenetic Analysis,Phylogenetic tree construction,Sequence alignment for phylogenetics,Molecular evolution and substitution models,Phylogenetic inference methods (Maximum Likelihood, Neighbor Joining)

Placement Semester	Semester I
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Biostatistics & Research Methodology
Course Code	MSC0223S102T
Course Type	Core
Credits	7
Hours per Semester	105

Biostatistics & Research Methodology

Introduction to Biostatistics & research methodology, Types of variables & scales of measurements, Measures of central tendency and dispersion, Rate, Ratio, Proportion, Incidence & Prevalence Sampling Random & non- random sampling, Various methods of sampling, Simple random sampling, Stratified, Systematic, Cluster, Multistage, Sampling & Non sampling errors, Methods of minimizing errors, Structure of research protocol -Structure of thesis/ research report- Formats of reporting in scientific journals - Systematic review - Meta-analysis

Basic probability distribution & Sampling distributions

Concept of probability distribution- Normal, Poisson & Binomial Distribution-Parameters & Applications-Concepts of sampling distribution-Standard Error & Confidence Interval Skewness & Kurtosis Tests of Significance

Basics of Testing of Hypothesis- Null & Alternate Hypothesis- Level of significance (Parametric) & power of test-p Value- Tests of significance- test (Paired & Unpaired),Chi- Square test**,** Test of Proportion- One-way analysis of variance- Repeated measures of analysis of variance- Test of significance (non-parametric), Mann- Whitney U test**,** Wilcoxon test**,** Kruskal- Wallis analysis of variance**,** Friedmann's analysis of variance Correlation & Regression Simple correlation- Pearson's & Spearman's Testing the significance of correlation coefficient linear & multiple regression

Correlation & Regression

Simple correlation- Pearson's & Spearman's Testing the significance of correlation coefficient linear & multiple regression Sample size determination General concepts- Sample size for estimating the means & proportion Testing the difference in means and proportion of two groups **Study Designs** Descriptive Epidemiological Methods- Case series analysis and prevalence studies Analytical epidemiological methods- Case- Control & Cohort studies Clinical trials/ Interventional studies Odds ratio & Relative risk Stratified Analysis Multivariate Analysis Concept of multivariate analysis- Introduction to logistic regression & survival analysis Reliability & Validity evaluation of diagnostic tests Format of scientific document .

Placement Semester	Semester I
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Clinical Sciences
Course Code	MSC0223S103T
Course Type	Core
Credits	7
Hours per Semester	105

Microbiology:

Structure, classification and general characteristics of Bacteria, (including ribotyping) ,Micoplasma, Protozoa, Archea and yeast,Fungi. Association of bacteria.,Methods in microbiology: Pure culture techniques, principles of,microbial nutrition, construction of culture media, enrichment culture, techniques for isolation of chemoautotrophs, chemoheterotrophs and,photosynthetic microorganisms.

Sterilization-Application of sterilization methods in biotechnology, Various sterilization methods, Microbial contamination control and Sterility testing. Microbial growth: The definition of growth, mathematical, expression of growth, growth curve, measurement of growth and growth yield, synchronous growth, continuous culture.

Pharmacology:

General Pharmacology • Introduction • Route of Drug Administration • Pharmacokinetics • Pharmacodynamics • Drug Toxicity and Safety

Central Nervous System • Sedatives and Hypnotics • Antiepileptic drugs • Local anaesthetics • General anaesthetics • Opioids • NSAIDs • Psychopharmacology.

• **Introduction to Pathology:**

Cell Injury, Cell Growth and Differentiation, • Inflammation • Infection, • Degeneration • Neoplasia • Blood groups, cross-matching, transfusions • Tests done on various body fluids and tissues • Infectious Disease •Disease of white cells and lymph nodes

Biochemistry

.Chemistry of the human body fluids in health and diseases ii. Cerebrospinal fluid iii. Clotting mechanism of the blood, iv. Enzymes produced in the G.I.Tract, v. Vitamins, Hormones, Proteins and Non-proteins, vi. Nitrogenous substances, lipids, carbohydrates, vii. Electrolytes viii.Metabolism, acid-base balance, ix. Normal values and ranges of biochemistry investigations.

Placement Semester	Semester I
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Medical Terminology
Course Code	MSC0223S104T
Course Type	Elective
Credits	6
Hours per Semester	90

Origin of medical terms historical perspective, Various uses and application of medical terms, Purpose of learning medical terminology Stem Words/Root,Musculo-skeletal system, Respiratory system ,Cardiovascular system ,Digestive system Endocrine system ,CNS system, Urinary system, Reproductive system ,Organs of special sense, Integumentary system.

Prefixes, Definition, Various Prefixes, meaning and example terms ,Pseudo Prefixes – meaning & Example terms Suffixes, Definition & Types of suffixes, Various Suffixes, meaning and example terms Surgical procedures (System wise) concepts of body systems.

components within individual systems, and relationships between systems, division of the body into body cavities and planes. Disease, disorders and dysfunctions, terminology of body systems to issues of disease, diagnostic and therapeutic tests, and procedures. Common sign and symptoms of disease conditions, Common Medical Terms.

Common medical terms and meaning of those terms, Signsand Symptoms,Evolution of Death Registration, Multiple Cause-of-death Statistics Related Health.

Placement Semester	Semester I
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Computer applications
Course Code	MSC0223S105T
Course Type	Elective
Credits	6
Hours per Semester	90

COMPUTER- 1.0 Introduction 1.1 Objectives 1.2 what is Computer? 1.2.1 Basic Applications of Computer 1.3 Components of Computer System 1.3.1 Central Processing Unit 1.3.2 Keyboard, mouse and VDU 1.3.3 Other Input devices 1.3.4 Other Output devices 1.3.5 Computer Memory 1.4 Concept of Hardware and Software 1.4.1 Hardware 1.4.2 Software 1.4.2.1 Application Software 1.4.2.2 Systems software 1.5 Concept of computing, data and information 1.6 Applications of IECT 1.6.1 e-governance 1.6.2 Entertainment 1.7 Bringing computer to life 1.7.1 Connecting keyboard, mouse, monitor and printer to CPU 1.7.2 Checking power supply.

OPERATING COMPUTER USING GUI BASED OPERATING SYSTEM-2.0 Introduction 2.1 Objectives 2.2 Basics of Operating System 2.2.1 Operating system 2.2.2 Basics of popular operating system (LINUX, WINDOWS) 2.3 The User Interface 2.3.1 Task Bar 2.3.2 Icons 2.3.3 Menu 2.3.4 Running an Application 2.4 Operating System Simple Setting 2.4.1 Changing System Date And Time 2.4.2 Changing Display Properties 2.4.3 To Add Or Remove A Windows Component 2.4.4 Changing Mouse Properties 2.4.5 Adding and removing Printers 2.5 File and Directory Management 2.5.1 Creating and renaming of files and directories.

UNDERSTANDING WORD PROCESSING-3.0 Introduction 3.1 Objectives 3.2 Word Processing Basics 3.2.1 Opening Word Processing Package 3.2.2 Menu Bar 3.2.3 Using The Help 3.2.4 Using The Icons Below Menu Bar 3.3 Opening and closing Documents 3.3.1 Opening Documents 3.3.2 Save and Save as 3.3.3 Page Setup 3.3.4 Print Preview 3.3.5 Printing of Documents 3.4 Text Creation and manipulation 3.4.1 Document Creation 3.4.2 Editing Text 3.4.3 Text Selection 3.4.4 Cut, Copy and Paste 3.4.5 Spell check 3.4.6 Thesaurus 3.5 Formatting the Text 3.5.1 Font and Size selection 3.5.2 Alignment of Text 3.5.3 Paragraph Indenting 3.5.4 Bullets and Numbering 3.5.5 Changing case 3.6 Table Manipulation 3.6.1 Draw Table 3.6.2 Changing cell width and height 3.6.3 Alignment of Text in cell 3.6.4 Delete / Insertion of row and column 3.6.5 Border and shading.

USING SPREAD SHEET-4.0 Introduction 4.1 Objectives 4.2 Elements of Electronic Spread Sheet 4.2.1 Opening of Spread Sheet 4.2.2 Addressing of Cells 4.2.3 Printing of Spread Sheet 4.2.4 Saving Workbooks 4.3 Manipulation of Cells 4.3.1 Entering Text, Numbers and Dates 4.3.2 Creating Text, Number and Date Series 4.3.3 Editing Worksheet Data 4.3.4 Inserting and Deleting Rows, Column 4.3.5 Changing Cell Height and Width 4.4 Formulas and Function 4.4.1 Using Formulas 4.4.2 Function

Placement Semester	Semester I
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Introductory Mathematics
Course Code	MSC0223S106T
Course Type	Elective
Credits	6
Hours per Semester	90

Set Theory

Introduction to sets and elements, Universal, and empty sets, subsets. Venn diagrams, Set operations and algebra of sets, ordered sets, cartesian product of sets, Classes of sets, power sets and partition. Relations; product sets, equivalence relations, partial ordering relations. Logarithms- Definition and laws regarding product, quotient, power and change of base. Introduction to complex numbers; algebra of complex number, modulus and conjugate of a complex number. Introduction to Matrix: types, Order and transpose of matrix. Operations on matrix; addition, subtraction, multiplication. Associative and distributive laws of matrix, Inverse of Matrix and matrix division; determinant of a matrix, Eigen values and Eigenvectors of matrix.

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, Area under curve. Trigonometric ratios, De Moivre's theorem. 21 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 equations of a Circle, Parabola, Ellipse, Hyperbola, Cylinder, Cone and Sphere.

Placement Semester	Semester I
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Practical & Viva
Course Code	MSC0223S107P
Course Type	Practical/Ability Enhancement
Credits	7
Hours per Semester	210

ANALYTICAL TECHNIQUES Bioscience Lab-I

- Demonstration: Working principle & applications of
- Centrifuges (high speed refrigerated centrifuge & ultracentrifuge)
- Fluorescence microscope
- Separation of protein by SDS PAGE.
- Estimation of fats (cholesterol). MICROBIOLOGY
- Isolation and enumeration of microbes from soil and water.
- Staining of selected bacterial and fungal strains
- Estimation of bacterial growth
- Database Search: Use and analysis of BLAST tool for protein and DNA sequences.
- Structure Prediction: Protein secondary and tertiary structure prediction using online tools.
- Learning to use MS office
- MS word, MS PowerPoint, MS Excel. 2. To install different software., Data entry efficiency

SEMESTER II

Placement Semester	Semester II
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Genetic Engineering
Course Code	MSC0223S201T
Course Type	Core
Credits	7
Hours per Semester	105

Basic concepts of DNA structure and properties, restriction enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, Cohesive and blunt end ligation, Linkers, Adapters, Homo polymeric tailing, Labeling of DNA, Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques, Northern, Southern and Colony Hybridization, Chromatin immunoprecipitation, DNA-Protein Interaction-Electromobility shift assay, DNaseI footprinting, Methyl interference assay, Isolation of genomic DNA from prokaryotes and eukaryotes, Isolation of Plasmid DNA and Bacteriophage DNA. Isolation of total RNA and mRNA.
Plasmids, Bacteriophages, pBR322 and pUC series of vectors, M13 and P2 phage based vectors, High capacity vectors:Cosmids, phagemid, BAC, Animal and Plant virus based cloning vectors, Shuttle vectors, Expression vectors, pMal, GST, pET-based vectors, Constructions of libraries, cDNA and genomic libraries, cDNA and genomic cloning, Expression cloning, Jumping and hopping libraries, South-western and Far-western cloning, Protein-protein interactive cloning and Yeast two hybrid system, Phage display.

Primer designing, Fidelity of thermostable enzymes, Types of PCRmultiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, in situ PCR, cloning of PCR products, Tvectors, Principles in maximizing gene expression, Gene expression analyses, differential gene expression methods, Introduction of DNA into mammalian cells, transfection techniques.

Placement Semester	Semester II
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Programming with Perl
Course Code	MSC0223S202T
Course Type	Core
Credits	7
Hours per Semester	105

Perl Data types: Scalar variables, scalar operations and functions, array variables, array representation, array operations and functions, hash variables and its representation, hash functions.

Application of hashes to write genetic code and gene expression data. Perl regular expression: 34 Concepts and use of regular expression for biological data. Metacharacters, Pattern-matching, Substitutions, Transliteration, split and join functions. Subroutines and its advantage, arguments, passing data to subroutines.

Concept of file handling, opening, rading editing and closing a File. Directory handling: opening reading and closing a directory.

Bioperl: Introduction to Bioperl and its installation. Bioperl architecture: general classes, Sequences -Bio::Seq Class, sequence manipulation, alignments -AlignIO, Analysis -Blast.

Databases- Database Classes. Introduction to common gateway interface module (CGI.pm), CGI program in Context, Perl and the Web. Introduction to R language; R Objects and data structures – Variable classes, Vectors and matrices, Data frames and lists, Data sets included in R packages, Summarizing and exploring data, Reading data from external files, Storing data to external files, Creating and storing R workspaces.

Placement Semester	Semester II
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Molecular Biology
Course Code	MSC0223S203T
Course Type	Core
Credits	7
Hours per Semester	105

Genome Organization of bacterial genome, Structure of eukaryotic, Chromosomes, Role of nuclear matrix in chromosome organization and function, matrix binding proteins, heterochromatin and euchromatin, molecular components, DNA reassociation kinetics (Cot curve analysis), repetitive and unique sequences, kinetics and sequence complexities, Satellite DNA, DNA melting and buoyant density, packing and organization of chromatin, nucleosome phasing, DNase I hypersensitive regions, DNA methylation & Imprinting, Mutation:-Nonsense, missense and point mutations, intragenic and intergenic suppression, frameshift mutations, physical, chemical and biological mutagens.

DNA Replication, Repair & Recombination ,Concepts of replication initiation, elongation and termination in prokaryotes and eukaryotes, enzymes and accessory proteins involved in DNA replication, Fidelity in replication, replication of single stranded circular DNA,Gene stability and DNA repair, DNA repair enzymes, photoreactivation, nucleotide excision repair, mismatch correction.

,Recombination:- homologous and non-homologous recombination, site specific recombination, Holliday structure,resolution, chi sequences in prokaryotes, gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination RecA and otherrecombinases.

Placement Semester	Semester II
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Database Management System
Course Code	MSC0223S204T
Course Type	Elective
Credits	6
Hours per Semester	90

Introduction: - Data base system concepts, Comparison between traditional file system and DBMS, Database Users, Data models, schemas and instances, Data independence, 3-level architecture of DBMS, Overall data base structure. Data modeling using Entity Relationship Model: - ER model, mapping constraints, Concept of super key, candidate key, primary key, Generalization, aggregation, reducing ER diagrams to tables. Relational Data Model: concepts, integrity constraints, relational algebra, SQL queries.

Data Base design: - Functional Dependency and its types, normal forms: first, second, third and BCNF, multi-valued dependency, fourth normal form, join dependency and fifth normal form. Steps in database design. Transaction processing: Introduction, ACID properties, Concurrency control techniques: Locking techniques, Time stamping, Optimistic approach, Multi-version. Management of deadlocks, Query processing and optimization.

Recovery, Integrity and security of Databases. Distributed Database systems: Introduction, Fragmentation, Replication, Transparency, Consistency and Concurrency control, Homogeneous Vs Heterogeneous systems. Advanced topic in databases: temporal database, spatial database, data mining, data warehousing and its applications.

Placement Semester	Semester II
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Data Analysis & Visualisation
Course Code	MSC0223S205T
Course Type	Elective
Credits	6
Hours per Semester	90

Introduction to Data Analytics: Overview of data analytics and its applications in various industries, Understanding the data analytics process and lifecycle, Exploring different types of data (structured, unstructured, big data)

Data Collection and Preprocessing:Methods for data collection and data sources (surveys, APIs, web scraping), Data cleaning and preprocessing techniques (missing data handling, data transformation, outlier detection), Data integration and data quality assessment

Exploratory Data Analysis (EDA):Descriptive statistics and data summarization techniques,Data visualization techniques (bar charts, histograms, scatter plots, box plots),Data exploration using statistical measures (correlation, distribution analysis)

Data Mining Techniques: Introduction to data mining concepts and algorithms,Association rule mining,Clustering algorithms (k-means, hierarchical clustering),Classification algorithms (decision trees, random forests, support vector machines)

Predictive Analytics: Predictive modeling techniques,Evaluation and validation of predictive models,Time series analysis and forecasting

Data Visualization: Principles of effective data visualization,Visualization tools and libraries (Tableau, ggplot, D3.js)

Interactive and dynamic visualizations,Visualizing geospatial and network data,Data visualization in Python and R.

Placement Semester	Semester II
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Internet Technology
Course Code	MSC0223S206T
Course Type	Elective
Credits	6
Hours per Semester	90

Introduction to Internet Technology, History and evolution of the Internet, Internet architecture and protocols, Internet service providers (ISPs) and their role, Internet Communication Protocols Transmission Control Protocol/Internet Protocol (TCP/IP),Hypertext Transfer Protocol (HTTP) and HTTPS, Domain Name System (DNS),Simple Mail Transfer Protocol (SMTP) and Post Office Protocol (POP),Internet Security, Introduction to cybersecurity, Secure Socket Layer (SSL) and Transport Layer Security (TLS)

E-commerce and Online Business, E-commerce fundamentals and models, Online payment systems, Digital marketing and search engine optimization (SEO),Privacy and legal considerations in online transactions, Cloud Computing and Internet Services

Internet of Things (IoT) and its applications , Social Media and Online Collaboration ,Social media platforms and their features, Online collaboration tools (e.g., project management, video conferencing),Social media marketing and analytics, Emerging Trends in Internet Technology

Placement Semester	Semester II
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Practical & Viva
Course Code	MSC0223S207P
Course Type	Practical/Ability Enhancement
Credits	7
Hours per Semester	210

Database Management system: Create relational databases.

- Manage databases for biological purposes.
- Basic DDL commands (create, drop, alter) with integrity constraints.
- DML and DCL commands (Insert, Update, Delete, Select, Commit, Rollback)
- , Operators (Arithmatic, Logical, Relational etc.)
- Assignment based on DDL and DML with conditions also join (Self join, inner join, outer join, equi join)
- Complex queries (Retrieval of data from more than one table)

Programming with Perl Understanding various functions of Perl 14 Installing Perl on your PC.

- Create Perl script.
- Write a program to store protein sequence.
- Write a program to store DNA sequence.
- Write a program to store RNA sequence.
- Use Perl to concatenation of DNA
- Use Perl to concatenation of protein sequence.
- Perl script for to simulate DNA mutation.
- Write the perl programs for string manipulations.
- Develop and use simple perl modules.
- Perl subroutines.
- Introduction to Perl modules, construction of simple modul

SEMESTER III

Placement Semester	Semester III
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Biomolecular Modelling and Computational Drug Design
Course Code	MSC0223S301T
Course Type	Core
Credits	7
Hours per Semester	105

Homology modeling, Protein Threading and abinitio methods. Introduction to Molecular mechanics. Optimization of modeled protein 3D structure. Energy minimization (steepest descent, conjugate gradient and NewtonRaphson methods). Molecular dynamics simulation: Equation of motion, integration schemes; Introduction to force fields, its popular variants; Ergodic Hypothesis, Ensembles (Canonical and Micro-Canonical) and their control in MD simulation, periodic boundary conditions and calculation of long range potentials (Particle – Mesh and Ewald summation methods). Potential energy surface: Convergence Criteria, Characterizing Stationary Points, Search for Transition States.

Computational Drug design; Drug likeness: Lipinski's rules, ligand efficiency and lipophilic ligand efficiency. Molecular recognition: affinity determination, intermolecular binding free energy. Ligand based drug design: - pharmacophore, constrained systematic search and genetic algorithm. Structure based drug design: Molecular docking and virtual screening. Introduction to QSPR and QSAR. Molecular descriptors used in QSAR studies: electronic; topological and quantum chemical. QSAR models: Free Wilson and Hansch equation. Statistical methods for QSAR modeling: regression, principle component and partial least squares analysis. Bioisosteres, Hammet substituent constant.

Placement Semester	Semester III
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Genomics and Proteomics
Course Code	MSC0223S302T
Course Type	Core
Credits	7
Hours per Semester	105

Genomics – Introduction to genome and genomics; genetics vs genomics. DNA microarray; prepration, understanding of microarray data, normalizing microarray data, detecting differential gene expression, correlation of gene expression data to biological process and analysis tools. Gene Expression Omnibus (GEO). Genomics and Metagenomics – Large scale genome sequencing strategies. Genome assembly and annotation. Genome databases of Plants, animals and pathogens. Metagenomics: Gene networks: basic concepts, computational model such as Lambda receptor and lac operon. Prediction of genes, promoters, splice sites, regulatory regions: basic principles, application of methods to prokaryotic and eukaryotic genomes.

Proteomics – Introduction to proteome and proteomics; protein chemistry vs proteomics. Analytical techniques of proteomics; working principles of 2D – gel electrophoresis, mass spectrometry with their merits and demerits. Mass spectrometers for protein and peptide sequencing; MALDI – TOF, Electospray Ionization coupled tendem Mass spectrometry.Tendem mass analyzer, triple quadrupole mass analyzer, ion – trap mass analyzer and FT 40 – ion cyclotron resonance MS.

Next Generation sequencing & assembly: Elements of big data analysis, NGS Platforms based on pyrosequencing, sequencing by synthesis, emulsion PCR approach with small magnetic beads and single molecule real time (SMRT) sequencing; Genome assembly algorithms, De-novo assembly algorithms, Sequence Alignment formats: Sequence Alignment/Map (SAM) format, Binary Alignment/Map (BAM) format. Protein function prediction using Machine learning tools: supervised/unsupervised learning, Neural network, SVM. Protein-protein interactions: databases such as STRINGS, DIP, PPI server and tools for analysis of protein-protein interactions.

Placement Semester	Semester III
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Sequence analysis and Phylogenetics
Course Code	MSC0223S303T
Course Type	Core
Credits	7
Hours per Semester	105

Sequence Analysis – concepts of sequence similarity, Sequence identity vs homology. Definitions of homologues, orthologues, paralogues and xenologues. Basic methods of sequence analysis; Dot plot method, 29 sequence distance calculation (Hamming and Levinshtein), their merits and demerits. Scoring matrices: basic concept and construction of a scoring matrix; PAM and BLOSUM matrix and their derivatives. Pairwise sequence alignment: Global and Local alignment algorithms; gap penalties, ends free alignment. Statistical significance of alignment score.

Sequence-based database searches: algorithm of BLAST and FASTA and interpretation of results. Algorithms for generation of sequence profiles; profile-based database searches using PSI-BLAST, analysis and interpretation of profile-based searches. Multiple sequence alignments (MSA): the need for MSA. Theory and application of various approaches for MSA; progressive and hierarchical. Algorithm of CLUSTALW and PileUp and their application for sequence analysis.

The concept of evolutionary tree; types of phylogenetic trees (rooted vs. unrooted trees), Molecular Clock, Newick format of tree representation. Introduction to evolutionary models; Jukes Cantor and Kimura two parameter. Algorithms of Phylogenetic Tree Construction: UPGMA, Neighbor-Joining, Maximum Parsimony, Maximum likelihood, and Bayesian Inference. Statistical assessments of phylogenetic methods (Consistency, Efficiency, Robustness, & Computational speed). Evaluvation of phylogenetic tree: Bootstrapping, Randomized and jackknifing methods.

Placement Semester	Semester III
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Human Genetics and Disease
Course Code	MSC0223S304T
Course Type	Elective
Credits	6
Hours per Semester	90

Understanding the genetic basis behind human disease , human chromosome structure, human karyotype, banding techniques, chromosome identification and nomenclature (ISCN).

Classical genetics , monogenetic traits, autosomal dominant, autosomal recessive, sex linked dominant, sex linked recessive and sex influenced traits.

The impact of consanguinity in causing sex linked anomalies (haemophilia, colour blindness and Duchenne Muscular Dystrophy) in human population. chromosomal disorders, structural and numerical chromosomal anomalies (Klinefelter syndrome, Down’s syndrome, Turner syndrome, Achondroplasia), inborn errors of metabolism (Phenylketonuria (PKU), Alkaptonuria, Albinism, Galactosemia), haemoglobinopathies, Thalassemia syndromes, multifactorial disorders (diabetes, schizophrenia, huntington disease).

Placement Semester	Semester III
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Hospital Organization and Management
Course Code	MSC0223S305T
Course Type	Elective
Credits	6
Hours per Semester	90

Definitionofmanagement;Productivity,EfficiencyandEffectiveness;ManagerialSkills, Evolution ofmanagementthought:FredericW.Taylor'sscientificmanagement,HenryFayol'sprinciplesofmanagement,concep tfbureaucracy, human relations approach, Behavioral approach, systems theory of organization, contingencytheoryoforganization,management byobjectives(MBO), **Managementfunctions:** Natureofmanagement processandmanagerialfunctions – **Planning:**Types(mission,purpose,objectiveorgoals,strategies,policies,procedures,rules,programs,budgets), Stepsinplanning., DecisionMaking

Organizing- Meaningand purpose**,** Types:a)formalandinformal**,** functionalandmatrix**,** line and staffd)departmentation**,** Authority&Power**,** Centralization&Decentralization**,** DelegationofAuthority

Staffing- Recruitment & Selection (Basic Concepts)Directing Manager vsLeaderMotivation(Concept)**,**Leadership(Concept)

Controlling:
Basiccontrolprocess,Controlasafeedbacksystem,Realtimeinformationandcontrol,Controltechniques,Conceptofbudgeting

Behavioral concepts andtheories:,ConceptofOB.,Challenges and opportunity for OBMotivationalTheories,Maslow'sNeedhierarchy,TheoryXandTheoryY,,Twofactortheory**,**McClellandstheoryofneeds**,**EquityTheory**,**Expectancytheory

Placement Semester	Semester III
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Legal and Medical issues in hospital
Course Code	MSC0223S306T
Course Type	Elective
Credits	6
Hours per Semester	90

Law and establishment of hospitals-private / public hospitals, legal requirements under medicalcouncilActs.WestBengal ClinicalestablishmentAct andrules2,,7(as amendedtilldate).

Essentials of contract Act. Contractual obligations in hospital services - requisites of a validcontract - hospital as ' bailer' - sale and purchase of'' goods- duties towards patients - code ofethics-violation legal consequences.

Legal aspects relating to organ transplantation, MTP Act, ,97,, Basics of Drugs and CosmeticActs, anesthesia. ESI Act, PNDT Act, AERB, ICMR Guideline of Scientific Research Members,clinicaltrials.

Legal liability of hospitals- criminal, civil andtortuous; liability for negligence,consumerprotection law, absolute liability and vicarious liability, legal remedies available to patients:remediesundercontractlaw,tort,criminallawandconsumerprotection'Act.MedicalJurisprudence.

Medical ethics – basic issues, importance, process of developing and implementing ethics andvalues in an institution – codes of conduct: Hippocrates oath and declaration of Geneva 2,,6 –NMCregulation – professional conduct, etiquetteand ethics.

Placement Semester	Semester III
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Legal and Medical issues in hospital
Course Code	MSC0223S307P
Course Type	Practical/Ability Enhancement
Credits	7
Hours per Semester	210

Biomolecular Modelling & Computational Drug Design

Identification of different structural motifs in proteins. : Analysis of PDB (NMR and X-ray) structures (Quality of structure, analyzing molecular interactions, protein-ligand/protein-protein if any, from PDB).

:Homology based protein structure prediction.,Quality estimation of modeled protein structure (ProCheck, PROSA, Verify 3D, Errat etc.). , Energy minimization based mutational analysis of proteins (using SwissPDB-Viewer), Protein-Ligand docking Autodock and MGL Tools and Pharmacophore analysis.

Basics of R And Python Programming Lab

- Write python programs for studying biological samples. 1. Introduction to variables and various arithmetic & logic operations. 2. Introduction to strings and lists , Conditionals and Loops in python. 4. Working with files and directories in python. 5. Working with Molecular biology problems such as transcription, translation, GC island identification. 6. Working with sequence analysis problems such as global alignment, local alignment Parsing Blast output etc. 7. Accessing biological databases with Python.

Object Manipulating using R – Mathematical operations (recycling rules, propagation of names, dimensional attributes, NA handling), Basic matrix computation (element-wise multiplication, matrix multiplication, outer product, transpose, eigenvalues, eigenvectors), Textual operations, Basic graphics (high-level plotting, low-level plotting, interacting with graphics). Introduction to Big data in Bioinformatics: Characteristics, data structures and data repositories; exploratory analysis of big data in R environment, Bioconductor, Microarray and next-generation sequencing (NGS) data analysis in R environment.

SEMESTER IV

Placement Semester	Semester IV
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Algorithms in computational Biology
Course Code	MSC0223S401T
Course Type	Core
Credits	7
Hours per Semester	105

Algorithms and Data structures in Bioinformatics; Algorithms and complexity, Iterative and recursive algorithms, Fast versus slow algorithms, Big-O Notation, Algorithm design and analysis techniques, Greedy Algorithms, Randomized Algorithms, Divide-and-Conquer approach, Searching and Sorting algorithms.

Linear and non-linear data structure, Stack, Queues, Linked list, Trees-Terminologies, Binary trees, Tree traversal (Pre-order, In-order, post-order).

Brute Force, Dynamic programming: Shortest Superstring Problem, Random Walk (1D & 2D), Markov chain; Hidden markov models – Forward, Backward, Viterbi and Baum – Welch algorithm. Population dynamics algorithms; Intraspecies, Interspecies, and Pre – Predator (two species Lotka – Voltera). Fibonacci series, golden ratio. Introduction to chaos and fractals; Lorenz equation. Random sampling; Monte Carlo, Metropolis algorithms.

Placement Semester	Semester IV
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Structural Biology
Course Code	MSC0223S402T
Course Type	Core
Credits	7
Hours per Semester	105

Introduction to proteins:–

Amino acids classification and their physicochemical properties. Hierarchical organization of protein structures – primary, secondary, tertiary and quaternary structure of proteins. Ramachandran Map. Motifs and domains. Packing of protein structure Structures of oligomeric proteins and study of interaction interfaces Base pairing in nucleic acids – Watson-Crick and Hoogstein; geometrical and structural properties of A, B, & Z DNA. Secondary and Tertiary structures of RNA.

Principles and practices in Centrifugation, Chromatography and Electrophoresis for isolation & purification of biomacromolecules. 19 Circular Dichroism Spectroscopy. X-Ray crystallography: Introduction, Bragg's law; Crystal system, Bravais Lattices, Space group, symmetry. Protein crystallization, Phase problem and its solutions. Calculation and analysis of electron density map. Nuclear magnetic resonance: Introduction, chemical shift, NOE and coupling constant, spin – spin coupling and relaxation; 2D – NMR spectroscopy (COSY, NOESY).

Three-dimensional structure comparison and classification of proteins (VAST, DALI). Assignment of protein secondary structural elements; DSSP and STRIDE methods. Various types of weak interactions and their roles in stabilizing the biomolecular structures and their interactions. Macromolecular interactions. Protein-Protein, Protein – DNA and Protein – Ligand interactions

Placement Semester	Semester IV
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Bioinformatics Tools
Course Code	MSC0223S403T
Course Type	Core
Credits	7
Hours per Semester	105

Bioinformatics Sequence Databases–Primary Databases- GenBank, EMBL, DDBJ. Composite Databases- UniProt. Secondary databases - Prosite, ProDom, Pfam, InterPro, gene ontology; sequence file formats:- GenBank, FASTA, PIR, ALN/ClustalW2. Literature Databases- Open access and open sources, PubMed, PLoS, Biomed Central, NAR databases; Bioinformatics Resources- NCBI, EBI, ExPASy.

Structure database – Primary structure databases - PDB, NDB, MMDB. Secondary databases-Structural Classification of Proteins – SCOP, Class Architecture Topology Homology –CATH. Families of Structurally Similar Proteins –FSSP. Specialized Databases – Viral genome database-ICTVdb; Microbial genome database-MBGD; Genome browsers- Ensembl, VEGA genome browser, NCBI-NCBI map viewer, KEGG, MIPS, UCSC Genome Browser; Archeal Genomics, Eukaryotic genomes with special reference to model organisms-Yeast (SGD), Drosophila (FlyBase), C.elegans (WormBase), Mouse, Human (OMIM / OMIA), plants – Arabidopsis (TAIR).

Derived Databases- Catalytic Site Atlas –CSA; Databases of molecular functions /enzymatic catalysis databases - KEGG ENZYME database; Protein-Protein interaction database - STRING; chemical structure database - Pubchem; gene expression database - GEO, SAGE. Database search engines – Text-based search engines (Entrez, DBGET /LinkDB). Sequence similarity based search engines (BLAST and FASTA). Motif-based search engines (Scan Prosite and eMOTIF). Structure similarity based search engines (combinatorial extension, VAST and DALI). Proteomics tools- ExPASy server, EMBOSS.

Placement Semester	Semester IV
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Artificial Intelligence and Machine Learning
Course Code	MSC0223S404T
Course Type	ELECTIVE
Credits	6
Hours per Semester	90

Introduction to Artificial Intelligence (AI)

Overview of AI and its applications, Historical development and key milestones in AI, Different branches of AI (e.g., machine learning, natural language processing, computer vision)

Foundations of Machine Learning

Introduction to machine learning and its importance, Supervised, unsupervised, and reinforcement learning, Key concepts: features, labels, training data, and models, Neural Networks and Deep Learning,

Introduction to artificial neural networks (ANN)

Deep learning architectures: feedforward, convolutional, and recurrent neural networks, Training neural networks using backpropagation and optimization algorithms,Natural Language Processing (NLP)Fundamentals of NLP and its applications,Text preprocessing techniques (e.g., tokenization, stemming, stop-word removal),Language modeling, sentiment analysis, and named entity recognitionComputer VisionBasics of computer vision and image processing,Feature extraction methods (e.g., edge detection, corner detection),Object recognition and image classification using deep learning

Ethics and Responsible AI

Ethical considerations in AI and machine learning,Fairness, transparency, and bias in machine learning models,Privacy, security, and legal implications of AI applications

Artificial Intelligence & Machine Learning in their use in Health Care

Placement Semester	Semester IV
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Healthcare Technology
Course Code	MSC0223S405T
Course Type	ELECTIVE
Credits	6
Hours per Semester	90

Electronic Health records EHR

- Definitions – contents and examples of EHR practices
- Preliminary steps in implementation of HER
- Issues and challenges in implementation of EHR
- Planning for the introduction of EHR
- Factors to be considered when developing EHR & implementation plan
- Electronic Medical Record. Preliminary steps in implementation of EMR.
- Remote healthcare and telemedicine,
- PHR (Patient Health Record),
- Clinical Decision Support System,
- m-Health, e-Health and other healthcare tools and applications.

Placement Semester	Semester IV
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Organisational Behaviour
Course Code	MSC0223S406T
Course Type	ELECTIVE
Credits	6
Hours per Semester	90

Management & Organizational Behavior

Importance of Management - Definition of Management -Characteristic features of Management - Roles of Management-Role of a Manager-Levels of Management and their functions-Process of Management-Managerial Skills-Management and Administration-Management – Science or an Art? - Management – a profession? Nature of Management principles, Need for Management principles- Early Management approaches - Scientific Management-Administrative Management-Human Relation Movement-Modern Management Approaches-Behavioral Approach-Quantitative Approach-System approach -Contingency approach

Thinking and Decision-making process

Human Information Processing -Approaches (Lens model, Cognitive approach, Process training approach)- Phases of decision making- Types of decision making- Decision cycle- Behavioral decision making- Decision rationality - Models of behavioral decision making-Use of heuristics- Thinking – process, images, language- Concepts- Problem solving- Creative thinking Perception Definition- Factors- Perceptual grouping and selectivity - Stimuli selection- Barriers - Honing perceptual skills Attitudes and values Definition, Characteristics, Functions and Formation of attitudes-Definition, types, formation of values-Values and behavior- Values and ethics- Values and attitudes Learning Definition – Components –Determinants- Theories (classical, operant, cognitive, social learning)- Principles of reinforcement- Punishment- Learning curves- Learning and behavior

General Management

Planning –Organization-Decision Making-Communication-Staffing-Directing-Motivation-Counseling -Mentoring –Leadership Organizational Behavior Personal Growth and Development **Definition**, characteristics, determinants, causes, Theories (Type, Trait, Intrapsychic, Social learning, Skimmer's)

Placement Semester	Semester IV
Name of the Program	M.Sc. in Bioinformatics
Program Code	MSC0223
Name of the Course	Dissertation and Viva
Course Code	MSC0223S407P
Course Type	Practical/Ability Enhancement
Credits	7
Hours per Semester	210

Major biological databases (e.g., NCBI, UniProt, PDB)

- Data formats (FASTA, GenBank, PDB) and their utilization
- Multiple sequence alignment techniques (e.g., ClustalW, MUSCLE)
- Database searching methods (e.g., BLAST, PSI-BLAST)
- Primary structure databases - PDB, NDB, MMDB.
- gene expression database - GEO, SAGE
- Microbial genome database-MBGD

Dissertation.

Pedagogy

Identifying several situations same and able to dissertation work, writing a proposal and making a presentation to the Dissertation faculty advisory committee. Reporting to the committee on the progress of research work periodically. Making use of a variety of research methods. Defending the inference before the Examining Committee.

Contents

Every student will do a detailed study on the topic selected for the dissertation, and is expected to prepare a two or three proposals which he intends to take up for the Dissertation. Faculty will examine this and decide on the topic of dissertation.

The Process involves:

1. Formulation of objectives and hypothesis
2. Review of literature
3. Designing the tool for data collection
4. Data collection
5. Coding, classifying and analysis of data
6. Inferences, conclusions and recommendations
7. Preparing a bibliography
8. Writing the dissertation and submission

MODEL PAPER

M. Sc. Bioinformatics Semester I

MSC02230S101 **FOB-I**

First Semester

M. Sc. in Bioinformatics

Examination (Month/ year)

Paper - I

Fundamental of Bioinformatics

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A Discuss about the Bioinformatics Approaches.

B Describe about Bioinformatics Resources.

C Describe benefits of Structure database.

2. Short Essay (Attempt any Two) **2X10 = 20**

A Write down Sequence alignment algorithms applications.

B What is Derived Databases? Explain about it.

C Describe Protein database with example.

3. Short notes (Any four) **4X5 = 20**

A NAR databases

B Structure visualization tools

C UCSC Genome Browser

D What gene expression database**?**

E What is EMBOSS?

MODEL PAPER

M. Sc. Bioinformatics Semester I

MSC0223S102 **RM&B-II**

First Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper II

Research Methodology & Biostatics

Time: Three Hours

Maximum Marks: 70

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. Long Answer (Attempt any two) **2X15 = 30**

A. Introduction to research methodology.

B. Discuss about the biostatistics

C. Describe Types of variables & scales of measurements.

Q. No. 2. Short Essay (Attempt any Two) **2X10 = 20**

A. Concept of probability distribution

B. Basics of Testing of Hypothesis

C. Describe Correlation & Regression

Q. No. 3 Short notes (Any four) **4X5 = 20**

A. Cluster randomization.

B. Sampling & Non sampling errors

C. Incidence & Prevalence

D. Random & non- random sampling

E. Methods of minimizing errors.

MODEL PAPER

M. Sc. Bioinformatics Semester I

MSC0223S103 **CS-III**

First Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper III

Clinical Sciences

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about classification and general characteristics of Bacteria.

B Discuss about Cell organization of prokaryotic.

C What do you understand about General Pharmacology?

2. Short Essay (Attempt any Two) **2X10 = 20**

A. Describe Microbial contamination control and Sterility testing

B . Explain structure of Cell wall and Nucleus?

C. Define Pharmacokinetics.

3. Short notes (Any four) **4X5 = 20**

A. Animal and bacterial viruses.

B lytic cycle & lysogeny

C Opioids

D. Application of sterilization

E repetitive DNA sequence.

MODEL PAPER

M. Sc. Bioinformatics Semester I

MSC02S104 **MT-IV**

First Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper-IV

Medical Terminology

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about Origin of medical terms.

B Discuss about historical perspective of diagnostic and therapeutic tests.

C What do you understand about ICD.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. Common sign and symptoms of disease conditions.

B . What are the therapeutic tests, and procedures related to digestive system.

C. Issues associated With ICD Development.

, Short notes (Any four) **4X5 = 20**

A. Development Of Medical Terminology.

B What Is Reproductive System.

C Definition & Types Of Suffixes.

D. Division Of The Body Into Body Cavities And Planes.

E Write Down Common Medical Terms And Meaning Of Those Terms.

MODEL PAPER

M.Sc. Bioinformatics Semester I

MSC02S105 **CA-V**

First Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper-V

Computer Applications

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about Memory

B . Discuss about input / Output Devices:.

C What do you understand about Magnetic ink character recognition (MICR):.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. Optical mark recognition (OMR).

B . Bar code reader.

C. Computer software

3. Short notes (Any four) **4X5 = 20**

A. Monitor..

B Word processing software.

C. Definition of Machine language.

D. Compiler & Interpreter

E Interpreter.

MODEL PAPER

M. Sc. Bioinformatics Semester I

MSC02S106 **IM-VI**

First Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper-VI

Introductory Mathematics

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

a) What do you understand about Probability theory and probability distributions?

b) Define Maxima and Minima of a function?

c) Describe probability mass function and probability distribution function, cumulative distribution function

2. Short Essay (Attempt any Two) **2X10 = 20**

a) What is central tendency?

b) What is Measures of dispersion?

c) What is skewness and kurtosis?

3. Short notes (Any four) **4X5 = 20**

a) Describe Correlation and regression analysis.?

b) Describe Bivariate data?

c) What is Hyperbola?

d) What is range, mean deviation?

e) What is Conditional probability?

MODEL PAPER

M. Sc. Bioinformatics Semester II

MSC0223S201 GE - I

Second Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper I

Genetic Engineering

Time: Three Hours

Maximum Marks: 70

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 Long Answer (Attempt any two) 2X15 = 30

A. Discuss about Basic concepts of DNA structure

B. Define enzymes

C. What Radioactive and non-radioactive probes?

Q. No. 2 Short Essay (Attempt any Two) 2X10 = 20

A. What is Isolation of total RNA and mRNA?

B. Write down about Bacteriophages

C. What is Plasmids?

Q. No. 3 Short notes (Any four) 4X5 = 20

A. cDNA

B. Introduction of DNA into mammalian cells

C. Real time PCR

D. Types of PCRmultiplex and Describe each.

E. Differential gene expression methods.

MODEL PAPER

M. Sc. Bioinformatics Semester II

MSC0223S202 PWPT II

Second Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper II

Programming with Perl Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) 2X15 = 30

A. Discuss Perl Data types.

B. Discuss Bioperl and its installation.

C. Discuss common gateway interface module.

2. Short Essay (Attempt any Two) 2X10 = 20

A. What is CGI program?

B. What is exploring data?

C. Discuss about Databases.

3. Short notes (Any four) 4X5 = 20

A. Creating and storing R workspaces

B. Perl regular expression

C. Use of R Language?

D. Subroutines and its advantage

E.Fidelity of thermostable enzymes

MODEL PAPER

M. Sc. Bioinformatics Semester II

MSC0223S203 MB - III

Second Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper III

Molecular Biology

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A Discuss about Genome Organization of bacterial genome?

B Describe about DNA methylation & Imprinting?

C Describe DNA reassociation kinetics

2. Short Essay (Attempt any Two) **2X10 = 20**

A Write down about DNA Replication?

B What are the Role of nuclear matrix in chromosome?

C. Describe Prokaryotic & Eukaryotic?

3. Short notes (Any four) **4X5 = 20**

A What is gene targeting

B What is DNA repair?

C What is mismatch correction?

D What is matrix binding proteins**?**

E Intragenic and intergenic suppression

MODEL PAPER

M. Sc. Bioinformatics Semester II

MSC02S204 DMS - IV

Second Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper IV

Database Management System

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A Discuss about DBMS

B Discuss Entity Relationship Model

C Discuss Data Base design

2. Short Essay (Attempt any Two) **2X10 = 20**

A What is BCNF?

B Comparison between traditional file system and DBMS?

C Discuss Integrity and security of Databases

3 Short notes (Any four) **4X5 = 20**

A SwissProt and PDB.

B Consistency and Concurrency control

C Functional Dependency and its types

D Temporal database

E SQL queries.

MODEL PAPER

M. Sc. Bioinformatics Semester II

MSC02S205 DAV-V

Second Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper V

Data Analytics & Visualization

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) 2X15 = 30

A. Discuss about Data Analytics.

B. Discuss Dynamic Data analytics programming approach.

C. Discuss about Introduction to different types of data (structured, unstructured, big data).

2. Short Essay (Attempt any Two) 2X10 = 20

A. What are Data cleaning and preprocessing techniques?

B. What are Data visualization techniques?

C. Discuss about Introduction to data clustering.

3 Short notes (Any four) 4X5 = 20

A. Hierarchical clustering

B. Data transformation

C. Bar charts

D. Decision trees

E. **B**ox plots

MODEL PAPER

M. Sc. Bioinformatics Semester II

MSC02S206 IT - VI

Second Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper VI

Internet Technology

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about Internet Technologgy application in health crae sector.

B. Discuss healthcare Information Technology.

C. Discuss Issues in Internet Technology.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. What are Internet tools?

B. What are Internet networks?

C. Discuss access to Internet in hospital.

, Short notes (Any four) **4X5 = 20**

A. Informatics officer roles and responsibilities

B. IT and Computer

C. Communication

D. Models of health care delivery

E.Information Technology and Systems.

MODEL PAPER

M. Sc. Bioinformatics Semester III

MSC0223S303 BMCDD -I

Third Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper I

Biomolecular Modeling and Computational Drug Design

Time: Three Hours

Maximum Marks: 70

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

Long Answer (Attempt any two) **2X15 = 30**

Q 1. Discuss about Basic Thermodynamics.

Q 2. Discuss The Laws of Thermodynamics

Q 3 Discuss Homology modeling

Short Essay (Attempt any Two) **2X10 = 20**

Q 1 What is QSPR and QSAR

Q 2 Introduction to Molecular mechanics.

Q3 Discuss Computational Drug design.

Short notes (Any four) **4X5 = 20**

Q 1. How Molecular descriptors used in QSAR studies.

Q 2. Describe Principle component and partial least squares analysis.

Q 3. Discuss about Statistical methods for QSAR modeling.

Q 4. What is Hamiltonian Formulation and Canonical Transformations

Q 5. Ergodic Hypothesis

MODEL PAPER

M. Sc. Bioinformatics Semester III

MSC0223S302 GAP- II

Third Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper II

Genomics and Proteomics

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Introduction to genome and genomics.

B. Introduction to proteome and proteomics.

C Discuss about Next Generation sequencing & assembly.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. What is Protein-protein interactions.

B Neural network

C. Discuss Binary Alignment/Map

3. Short notes (Any four) **4X5 = 20**

A Proteomics

B MALDI

C STRINGS

D What are the tools for analysis of protein-protein interactions.

E What is NGS Platforms based on pyrosequencing?

MODEL PAPER

M. Sc. Bioinformatics Semester III

MSC0223S303 SAP- III

Third Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper III

Sequence analysis and Phylogenetics

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about Sequence Analysis.

B. Discuss ABOUT algorithm of BLAST.

C Discuss paralogues and xenologues.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. Theory and application of various approaches for MSA.

B Discuss about Molecular Clock.

C. Discuss Maximum likelihood.

3. Short notes (Any four) **4X5 = 20**

A. Gap penalties

B Multiple sequence alignments

C. Phylogenetic Tree Construction

D UPGMA

E. What are the statistical assessments of phylogenetic methods?

MODEL PAPER

M. Sc. Bioinformatics Semester III

MSC0223S304 HGAD-IV

Third Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper IV

HUMAN GENETICS AND DISEASES

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. What are the important reasons to study human chromosome structure?

B. Discuss about banding techniques.

C Describe Dystrophy.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. What is Klinefelter syndrome?

B Discuss Huntington disease.

C. Benefits of informed consent and right of choice?

3. Short notes (Any four) **4X5 = 20**

A What is schizophrenia?

B Diabetes

C Ethical issues in medical genetics?

D. Thalassemia syndromes.

E Multifactorial disorders.

MODEL PAPER

M. Sc. Bioinformatics Semester III

MSC0223S305 HOMT - V

Third Semester

M. Sc.in Bioinformatics

Examination (Month/year)

Paper V

Hospital Organization and Management Theory

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about **Management**.

B. Evolution of management thought.

C Nature of Management process.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. What is accounting information?

B . What is Third Party Administrator?

C. Discuss access and quality of care issues.

, Short notes (Any four) **4X5 = 20**

A Decision Making

B Stepsinplanning.

C Delegation of Authority Staffing.

D. Models of health care delivery.

E Information Technology and Systems.

MODEL PAPER

M. Sc. Bioinformatics Semester III

MSC0223S306 LMIH - VI

Third Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper VI

Legal & Medical Issues in Hospitals

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about Sophisticated drug and Technology.

B. Discuss Informed Consent.

Cprofessional conduct of healthcare and health information professional

2. Short Essay (Attempt any Two) **2X10 = 20**

A. What is Quality of life.

B What is Health Insurance &Third-Party Administrator.

C. Discuss access and quality of care issues.

, Short notes (Any four) **4X5 = 20**

A. Malpractice & negligence

B. Female feticide & Infanticide.

C. Billing assessment of population health .

D Models of health care delivery.

E. Law in Health care.

MODEL PAPER

M. Sc. Bioinformatics Semester IV

MSC0223401 ACB – I

Fourth Semester

M. Sc. in Bioinformatics

Main Examination (Month/year)

Paper I

Algorithms in Computational Biology

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about Algorithms and Data structures in Bioinformatics.

B. Discuss Dynamic programming.

C. Introduction to optimization problem and methods of optimization.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. What is Random sampling?

B. What is Newton methods?

C. Introduction to data clustering.

3 Short notes (Any four) **4X5 = 20**

A.Big-O Notation

B.Swarm algorithm and Ant Project Mangement.

C. Monte Carlo

D.Euclidean

E. Center-based Clustering Algorithms

MODEL PAPER

M. Sc. Bioinformatics Semester IV

MSC0223402 SB- II

Fourth Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper II

STRUCTURAL BIOLOGY

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about Protein

B Discuss Hierarchical organization of protein structures

C Comparison and classification of proteins

2. Short Essay (Attempt any Two) **2X10 = 20**

A. What is DSSP and STRIDE methods

B Discuss Three-dimensional structure of DSSP

C What is Ligand interactions?

3 Short notes (Any four) **4X5 = 20**

A. Macromolecular interactions

B Calculation and analysis of electron density map

C. Various types of weak interactions and their roles in stabilizing

D Base pairing in nucleic acids

E. Structural properties of A, B, & Z DNA

MODEL PAPER

M. Sc. Bioinformatics Semester IV

MSC0223403 BT - III

Fourth Semester

M. Sc. in Bioinformatics

Examination (Month/year)

Paper III

Bioinformatics Tool

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A Discuss about the BioinformaticsTools.

B Describe about Bioinformatics Databases.

C Describe benefits of Structural databases.

2. Short Essay (Attempt any Two) **2X10 = 20**

A Write down Sequence similarity applications.

B What are genomics databases? Explain about it.

C Describe Protein database with example.

3. Short notes (Any four) **4X5 = 20**

A CATH

B Structure visualization tools

C BLAST

D What gene expression database**?**

E PDB

MODEL PAPER

M. Sc. Bioinformatics Semester IV

MSC0223404 AI&ML - IV

Fourth Semester

M. Sc. in Bioinformatics

Examination (Month/ year)

Paper IV

Artificial Intelligence and Machine Learning

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Introduction to Artificial Neural Networks

B Describe Models of a Neuron.

C Discuss Computer vision .

2. Short Essay (Attempt any Two) **2X10 = 20**

A. Describe Machine Learning .

B Recurrent Networks

C What is Boltzman, Supervised and unsupervised learning?

3 Short notes (Any four) **4X5 = 20**

A. Network architectures

B Boltzmann machine

C What is Temporal processing?

D Recurrent neural networks.

E.Deep Learning

MODEL PAPER

M. Sc. Bioinformatics Semester IV

MSC0223405 HT - V

Fourth Semester

M. Sc. in Bioinformatics

Examination (Month/ year)

Paper V

Healthcare Technology

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Emerging technology issues in healthcare.

B concepts and operation of the main components of word processor.

C electronic spreadsheet

2. Short Essay (Attempt any Two) **2X10 = 20**

A. conceptual and relational data modeling.

B . data integrity.

C relational normalization theory

, Short notes (Any four) **4X5 = 20**

A. database systems

B Health Statistics

C. Billing softwares .

D Models of health care delivery.

E. presentation software programs.

MODEL PAPER

M. Sc. Bioinformatics Semester IV

MSC0223406 OB - VI

Fourth Semester

M. Sc. in Bioinformatics

Examination (Month/ year)

Paper VI

Organizational Behaviour

Time: Three Hours

Maximum Marks: 70

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

1. Long Answer (Attempt any two) **2X15 = 30**

A. Discuss about organizational Behaviour

B Discuss about Organizational policies.

C Utilization management.

2. Short Essay (Attempt any Two) **2X10 = 20**

A. Professionalism .

B International Standards Organization.

C Hospital organizations

Short notes (Any four) **4X5 = 20**

A. Types of hospitals.

B Health Statistics

C. Billing assessment of population health.

D Healthcare Industry.

E. Information Technology in quality.