M.Phil / Ph.D– BIOINFORMATICS
(Effective from the academic year 2018 - 2019 and onwards)

PREAMBLE

- The degree of Master of Philosophy [M.Phil] /Doctor of Philosophy (Ph.D) is awarded to a candidate who has submitted a thesis on the basis of original and independent research in any biochemistry field of research.
- This makes a contribution to the advancement of knowledge, which can be useful to the society.
### DEPARTMENT OF BIOINFORMATICS  
#### FACULTY OF ARTS, SCIENCE AND HUMANITIES  
#### RESEARCH PROGRAM – M.Phil / PhD in Bioinformatics  
#### (2018–2019 and onwards)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Name of the course</th>
<th>Instruction hours / week</th>
<th>credits</th>
<th>Maximum Marks (100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18RBI101</td>
<td>Research Methodology and Pedagogy</td>
<td>4</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>18RBI201</td>
<td>Advanced Techniques in Bioinformatics</td>
<td>4</td>
<td>4</td>
<td>100</td>
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<tr>
<td>18RBI301A</td>
<td>Drug Discovery and Modeling</td>
<td></td>
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<tr>
<td>18RBI301B</td>
<td>Advanced Bioinformatics</td>
<td>4</td>
<td>4</td>
<td>100</td>
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<tr>
<td>18RBI301C</td>
<td>Biochematics</td>
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</table>

**Program Total**

|               |               | 12                        | 12      | 300                 |
UNIT I: Research Methodology
Introduction; Definition; Objectives of research; Types of research; Research approaches; Significance of research; Research methods; Research process; Criteria of good research; Problem encountered by researchers in India; Need for research design; Features of good design; Important concepts relating to design; Different research designs; Basic principles of experimental design. Writing a Research proposal for financial assistance from National and International funding agencies.

UNIT II: Computational Biology
Computer hardware – Hardware components – input and output devices. Secondary storage devices – Operating Systems: need and usage, Evolution of operating systems, functions. MS DOS, DOS, LINUX, Basic Internal and external commands for each OS. Networking – Advantages of network, types of networks, Data warehouses and Data marts Data mining. Biological Databases- Sequence databases-Nucleic acid and protein sequence databases, GenBank, DDBJ, EMBL, Swiss-Prot and PIR. Structural databases-PDB and MMDB. Motif database-PROSITE, CATH and SCOP. Genome and Proteome databases.

UNIT III: Algorithms and Protein Structure Analysis
Algorithms: Protein and Nucleic acid sequence Algorithms: Sequence Databases, Use of the algorithms BLAST, Multiple sequence alignments and Clustering algorithms. Phylogeny: Evolutionary trees; Biological networks: Pathway analysis.

Protein structure analysis: Protein structure databases; Protein structure comparison; Fold recognition; 3D-1D Profiles; Threading and Comparative structure modeling.

UNIT IV: Scientific writing

UNIT V: Pedagogical methods in higher education
Objectives and role of higher education- Important characteristics of an effective lecture- Quality teaching and learning- lecture preparation- characteristics of instructional design- Methods of teaching and learning: Large group- Technique – lecture, seminar, symposium, team teaching, project, small group technique- simulation, role playing demonstration, Brain storing, Case discussion, and assignment, methods of evaluation- self evaluation, student evaluation,
diagnostic testing and remedial teaching- question banking- electronic media in education:- ‘e’
learning researches- web based learning.

SUGGESTED READING

Publishers

Edition Paperback.

3. David W.Mount, (2003) Bioinformatics-Sequence and Genome Analysis, CBS,
Publishers.


and Sons Company, New Delhi.


International (P) Ltd. New Delhi

UNIT I: Elements of C Programming, Perl and Visual Basic

C Programming: Variables, Data types, Operators, Statements, Loops-Simple programs using Loops, Arrays-Integer arrays, Character arrays, Programs using arrays. Introduction to Functions - Programs using functions, Introduction to Pointers, Files: Defining & Opening a file, closing a file, Input/Output operations on files.
Perl: Introduction to Perl, I/O variables, Control Statement and Regression
Visual Basic: Introduction and Purpose of Database, Introduction to Visual Basic Function in VB, Controls, Data connectivity using DAO.

UNIT II: High throughput Technology

High throughput genome and Protein sequencing, Genome and Proteome assembly; DNA and Protein micro arrays, Gene and Protein expression data sets. Micro array techniques- Types of micorarrays-Designing a microarray experiment-Microarray Technology in Treating Disease

UNIT III: Proteomics

Introduction to Proteomics – The Proteome – Mining proteomes- Bridging Genomics and Proteomics- Proteomics and the new biology, Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications – Proteomics in drug Discovery in human - phage antibodies as tools- Glycobiology and Proteomics- In plant genetics and breeding

UNIT IV: Genomics


UNIT V: Applications of Bioinformatics

Agriculture, Molecular biology, Environment, Biotechnology, Neurobiology, Drug Designing, Biomedical genome medicines.

SUGGESTED READING


UNIT I: Introduction to drugs

UNIT II: Drug design
   Homology modeling –Molecular modeling using computers-CADD, protein-ligand docking in drug design –vaccine development through bioinformatics.

UNIT III: Target of drug
   Target discovery-Target validation-Assay development-High through screening-Lead optimization-Drug substrate manufacture-Development of new drugs.

UNIT IV: Clinical trial
   Candidate drug nomination-clinical trial-Investigational new drug application-FDA, patenting and formulations-Marketing.

UNIT-V: Tools used for drug docking
   Determination of active site and hot spots, Receptor-Ligand interactions, Pharmacophore Identification (Catalyst, DISCO, GASP), Denovo drug designing (Group Build, Gen Star). Tools used for docking (DOCK, FLEX, GLIDE, SLIDE, GOLD, SURFLEX).

SUGGESTED READING


WEB SOURCES
2. www.sdsc.edu/~wilfred/genome/lectures/lab_6.html
4. www.sanger.ac.uk/projects/microbes
UNIT I: Structural Bioinformatics

UNIT II: Structural Bioinformatics Approaches

UNIT III: Pharmocogenomics and Toxicogenomics
Definition of pharmacogenomics and toxicogenomics – case study in cancer – safety metabolisms pharmacology – exploitary toxicology, pre clinical toxicology, pharmacokinetics and metabolism.

UNIT IV: Nutrigenomics
Nutritional genetics – Nutritional genomics – Genetic nutrition – gene director nutrition with reference to diabetes cardiovascular disease and obesity and neurogenomics – short notes on herbal informatics (Medicinal Foods)

UNIT V: Chemogenomics and Metagenomics
Definition – Effects of Chemical on genes – delayed mutation – Interaction of molecules (Small & Big) with DNA intercalation. Application of Metagenomics to cultured and uncultured microorganisms.

SUGGESTED READING


WEB LINKS
UNIT I: Isolation and Purification of Protein & Bio-active compounds- Techniques
Extraction (soxhlet and cold percolation), Isolation of Alkaloids, Flavonoids and Terpenoids Protein extraction from Plants, Animals and Microorganism. Purification: Native gel, Chromatographic methods (Column, Preparative TLC, HPLC, HPTLC, Ion exchange, Gas Chromatography, Gel filtration, Affinity).

UNIT II: Structure elucidation of Protein and Bioactive compounds

UNIT III: Macromolecular Modelling
Software tools for modeling bio-molecules. Molecular electrostatic potentials, charge analyses. Protein conformations, folding and mutation through modeling-design of ligands for known macro molecular target sites. Computer representations of molecules, chemical databases and 2D substructure searching, 3D database searching, deriving and using Three-dimensional pharmacophores, sources of data from 3D database.

UNIT IV: Advances in drug design methodologies
Biomolecular structure, Lipinski’s rule, Structure activity relationship (SAR), Pharmacokinetics, Pharmacophoric pattern, ADME Properties, quantitative structure activity relationship. Use of genetic algorithms and principle component analysis in the QSAR equations.

UNIT V: Docking
Docking-Rigid and Flexible Structure-based drug design and induced fit for all classes of targets- Theories of enzyme inhibition - Enzyme Inhibition strategies.- Enzyme inhibition as a tool for drug development –Examples. Finding new drug targets to treat disease- strategies for target identification and lead design Screening technology and Informatics for natural products drug discovery. The drug development process, the practice and limitations of Computer assisted drug discovery process.
SUGGESTED READING


