

# CENTRE FOR BIOINFORMATICS

## M. D. UNIVERSITY, ROHTAK

(JAN,2017 to DEC, 2017)

### PH.D. COURSE WORK SCHEME OF EXAMINATION

S.No.	Paper Code	Paper title	Credits	Internal Evaluation	External evaluation	Total
1	17BINPC1	Computational and Systems Biology	4	20	80	100
2	17BINPC2	Structural Bioinformatics	4	20	80	100
3	17BINPC3	Research methodology	4	20	80	100
4	17BINPC4	Review Writing and Presentation	3	-	75	75
5	17BINPC5	Seminar	1	25	-	25
Total						400

## **Syllabus for Ph.D. Course work (Bioinformatics)**

**Course Title: Computational & Systems biology**

**Course Code: 17BINPC1**

**Credit: 4 0 0**  
**MM. Th 80+ IA 20**  
**Time: 3 Hours**

**Note for Examiner: Examiner should set 2 questions from each unit. Each question shall carry 16 marks. Students will have to attempt atleast one question from each unit.**

### **Unit-1**

#### **Biological data**

Types of biological data (various omics)

Biological Databases Nucleic acid and protein sequence and protein structure databases

Overview of available Bioinformatics resources on the web

### **Unit-2**

#### **DNA sequence analysis**

Sequence annotation and sequence analysis-Phylogeny of gene (blast, fasta, HMMer) and residue conservation. Primer design and T<sub>m</sub> Calculation, DNA Restriction pattern analysis. Condon bias and its effect on the protein expression with reference to various expression system.

### **Unit-3**

#### **Bioinfo tools 2 Protein sequence and structure insights (PSSI)**

X-ray, NMR, Comparative modeling, ab initio, threading methods.

Structure refining techniques Energy minimization approaches (Steepest descent, Conjugate gradient etc), Basis of Molecular dynamics simulations and its application.

### **Unit-4**

#### **Introduction to Systems Biology-I (SB)**

Principles of Networks – Graph Theory and information theory of molecular systems

Types of biological networks.

### **Unit-5**

#### **Basics of Systems Biology-II (SB)**

Biological Network Databases Genomic networks (Gene regulation)

Protein-protein interaction networks; Biochemical flux networks

**Students are advised to consult relevant journal articles and reviews to gather the recent information on the above mentioned topics**

## **Course Title: Structural Bioinformatics**

**Course Code: 17BINPC2**

**Credit: 4 0 0**  
**MM. Th 80+ IA 20**  
**Time: 3 Hours**

**Note for Examiner: Examiner should set 2 questions from each unit. Each question shall carry 16 marks. Students will have to attempt atleast one question from each unit.**

### **Unit-1**

**Protein Structure Prediction** Introduction, Protein Stability and Folding, Application of Hydrophobicity, Superposition of Structures, DALI methods, Evolution of Protein Structures, CASP, Secondary Structure Prediction, Homology Modelling, Fold Recognition, ROSETTA, LINUS.

### **Unit-2**

#### **Molecular Modeling and Dynamics**

Introduction, Molecular Dynamics using simple molecules, Signification of Times steps & Temperature Conformational energy calculations and molecular dynamics, Docking by Energy minimization, Ramachandran Plot.

### **Unit-3**

#### **Drug Discovery and Development**

Drug Discovery Cycle, The Lead compound, Pharmacophore, Bioinformatics in drug discovery and development, chemical databases, ADME and Toxicity, Virtual Screening, Molecular Docking, Structure and Ligand Based Drug Designing, Case studies.

### **Unit-4**

#### **Structural Bioinformatics Tools**

Tools for Molecular Visualization and Analysis: RASMOL, PYMOL, VMD, SWISS-PDB Viewer. Molecular Modeling and Docking: Swiss-Model, Arguslab, Hex, DOCK and Autodock. Online Tools: Biology Workbench, Marvin Sketch, Chemskech, pubchem.

### **Unit-5**

#### **Quantitative tools**

Introduction to QSAR methodologies, Types of QSAR methods – 2D, 3D, 4D, 5D and 6D- QSAR methodologies, Descriptors classification, Application of QSAR in molecular design.

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## **Course Title: Research Methodology**

**Course Code: 17BINPC3**

**Credit: 4 0 0**

**MM. Th 80+ IA 20**

**Time: 3 Hours**

**Note for Examiner: Examiner should set 2 questions from each unit. Each question shall carry 16 marks. Students will have to attempt atleast one question from each unit.**

### **Unit-1**

Colloidal solutions of biopolymers and their electrochemical properties, Hydrodynamic properties;

Viscosity, diffusion etc of biopolymers; Molecular weight determination, osmotic pressure, reverse osmosis and Donnan effect, Structure of biomembranes and heir electrochemical properties, membrane potential, action potential and propagation of impulses; PPI

### **Unit-2**

Electrophoresis; different methods of electrophoresis for protein, nucleic acids, small molecular weight compounds and immune precipitates (Immuno electrophoresis). Peptide mapping and combination of electrofocussing and SDS-PAGE. Blotting techniques (Northern, Southern and western blotting); RT-PCR

### **Unit-3**

Theory of centrifugation and application to biological systems. Rotors angle/vertical/zonal/continous flow centrifuge, differential centrifugation density gradient centrifugation. Ultra centrifugation principle and application. Chromatography – adsorption, affinity, partition, Ion-exchange, gelpermeation, GLC, TLC, RPC, HPLC etc.

### **Unit -4**

Introduction to principles and applications of (a)Spectroscopic methods (UV, Vis, IR, Fluorescence, ORD, CD, & PAS) (b)NMR, ESR & Mass spectrometry, Use of radioactive and stable isotopes and their detection in biological systems.

### **Unit-5**

Automatic analyzer for amino acids, protein sequencer, peptide synthesizer & nucleic acid synthesizer. Cell sorters and their applications. Theory of lyophilization and its applications to biological systems. Introduction to principles and working of light and electron microscope.

**Students are advised to consult relevant journal articles and reviews to gather the recent information on the above mentioned topics**