

Examination Scheme for the Ph.d. Course 2015-2016

Serial Number	Paper code	Subject	Internal assessment	Written theoretical evaluation	Seminars (if any)	Maximum Marks
1	PP-101	Computational and systems biology	20	80	0	100
2	PP-102	Trends in biotechnology	20	80	0	100
3	PP-103	Research Methodology	20	80	0	100
4	PP-104	Review writing and Seminar	0	50	50	100
Grand Total 400						

Internal assessment will be based on assignment, test and attendance in the class Review should be submitted within month after the final examination is over Qualification marks will be 50% in aggregate

Computational and systems biology

Theory Marks: 80

Internal assessment: 20

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 (BD)

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 Bioinfo tools

1 DNA sequence analysis (DSA)

Sequence annotations and sequence analysis - Phylogeny of gene (blast, fasta, HMMer) and residue conservation.

Primer design and T_m Calculation, DNA Restriction pattern analysis.

Codon bias and its effect on the protein expression with reference to various expression system *E coli* (BL21D3; XL-11 Blue; pLys, Rossetta), yeast (*Pischia pastoris*) and insect cell lines (SF-20).

Unit-3

Bioinfo tools 2 Protein sequence and structure insights (PSSI)

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

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

Protein functional site identification for site directed mutagenesis / protein activity modulation, Protein-protein interaction prediction.

Unit-4

Molecular recognition (MR)

Basis of molecular recognition, Prediction of intrinsically disordered proteins and their interaction functions, Stereochemical aspects of drug action, Pharmacophore identification and receptor mapping, 3D- QSAR, transition from agonist to antagonist activity, Design and mechanism of peptidomimetics Folding for binding or binding for folding.

Unit-5

Introduction to Systems Biology (SB)

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

Types of biological networks

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

Research Methodology

Theory Marks: 80

Internal assessment: 20

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 their 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 immuno 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/continuous flow centrifuge, differential centrifugation density gradient centrifugation. Ultra centrifugation principle and application. Chromatography – adsorption, affinity, partition, Ion-exchange, gel permeation, 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.

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Trends in Biotechnology

Theory Marks: 80

Internal assessment: 20

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

Genetic manipulation of Plants

Techniques of nuclear and Chloroplast transformation; advantages, vector and success; Marker-free methodologies; Gene stability and gene silencing, gene stacking, Role of antisense and RNAi in crop improvement. Impact of global climate change on agricultural production, effect of CO₂ and high O₂ on crop productivity and target for crop biotechnology, applications of metabolic engineering – in pharmaceuticals (edible vaccines, plantibodies etc), food technology; functional foods and nutraceuticals, agriculture, Bioenergy generation, bioethanol and biohydrogen.

Unit 2

Biosensors

Principle & basic assembly of biosensors, fabrication of biosensors, electrochemical biosensors, SPR Biosensors, Enzyme Biosensors, DNA sensor, Immunasensors, Microbial Biosensors, Applications of Biosensors in food industry, Clinical Diagnostics, Environmental Monitoring, Future Prospects of Biosensors, Quantum dots.

Unit 3

Parasitology

Molecular tools in parasitology, Molecular biology, immunology and structural studies of malaria parasite proteins, Therapeutics and diagnostics approaches for malarial parasite, Chromatin remodeling process, proteins involved and their biochemical characterization, Targeted transformation of insect genome, GFP as marker for transgenic insect, Application of transgenic insect technology in the sterile insect technique.

Unit 4

Microbiology

Viral Cell Interaction, Virus Replication, Respiratory viruses, Virus encephalitis, Viral hepatitis, Enteric viruses, Arboviruses, HIV, HTLV, Swine Flu, Molecular and Immunological techniques for viral detection,

Virulence factors at the molecular levels associated with pathogens such as *Mycobacterium tuberculosis*, *Salmonella typhi*, *Clostridium tetani*, *Bacillus anthracis*, *Vibrio cholerae*.

Advances in antibiotic development Penicillin, Streptomycin, Tetracyclines, Rifampicin.

Advances of Vaccinology: Recombinant vaccines, naked DNA vaccines, subunit peptide and edible vaccines

Unit 5

Chemotherapy

General characteristics of antimicrobial drugs and routes of drug administration, PKS & types of PKS in antibiotic production, Quorum sensing, determination of the level of antimicrobial activity – disc assay, microbroth dilution and spore germination inhibition, Toxicological study – Hemolytic, MTT assay

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