MAHARSHI DAYANAND UNIVERSITY ROHTAK

Centre for Biotechnology

Ph.D. Course Work

Program Specific Outcomes

PSO1 Ph. D. Course Work programme is designed in a way to teach the students with theoretical full knowledge of Trends in Biotechnology, Research Methodology, Computational and System Biology which, in turn, allow the students to become efficient researchers to start their carrier in research through Ph.D. & other R & D programmes.

POS2 Students would gain mastery in advance research methodology and usage of computerized statistical packages.

POS3 Students develop understanding about the various tasks required to carry out a good research.

POS4 Students would get theoretical knowledge about review writing.

POS5 Find the resources needed to perform the research process and documentation of its findings.

S. No.	Paper Code	Paper title	Internal Assessment	Written theoretical evaluation	Seminar	Total
1	17CBTPC1	Computational and Systems Biology	20	80	0	100
2	17CBTPC2	Trends in Biotechnology	20	80	0	100
3	17CBTPC3	Research methodology	20	80	0	100
4	17CBTPC4	Review Writing and Presentation	0	50	50	100
Total						**400**

***Internal assessment:** Two assignments of 10 Marks each.

****Seminar : 50**

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w.e.f. session 2018-19

PH.D. COURSE WORK SCHEME AND SYLLABUS

Course Code: 17CBTPC1 **MM: 80**
Course Title: Computational and Systems Biology **Time: 3Hr**

COURSE OUTCOMES

- **CO1** Students would gain knowledge about the concepts underlying systems biology.
- **CO2** Students would be able to develop and confirm the research ideas and apply the knowledge of research designs in planning and analysing research.
- **CO3** Exhibit strong skills in critical analysis and synthesis of scientific information using different computational tools.
- **CO4** Students would gain knowledge about office applications of computer in research.

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

Unit I

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 II

Bioinfotools 1: DNA sequence analysis (DSA**)** Sequence annotations and sequence analysis - Phylogeny of gene (blast, fasta, HMMer) and residue conservation. Primer design and Tm 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 III

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 IV

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 peptidomemetics folding for binding or binding for folding.

Unit V

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

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Course Code: 17CBTPC2 **MM: 80**

Course Title: Trends in Biotechnology **Time: 3Hr**

COURSE OUTCOMES

- **CO1** The students will gain knowledge regarding various techniques of nuclear and chloroplast transformation, role of antisense and RNAi in crop improvement, effect of climate change on crop production and the applications of metabolic engineering.
- **CO2** The students will understand the principle & basic assembly of biosensors and their applications.
- **CO3** The students will learn the molecular tools in parasitology and molecular biology and targeted transformation of insect genome and general characteristics of antimicrobial drugs and routes of drug administration.

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

Unit I

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 ad RNAi in crop improvement. Impact of global climate change on agricultural production, effect of CO_2 and high O_2 on crop productivity and target for crop biotechnology, applications of metabolic engineering – in pharmaceuticals (edible vaccines, plantibodies etc), food technology; functional foods and nutriceuticals, agriculture, Bioenergy generation, bioethanol and biohydrogen.

Unit II

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 III

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 IV

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 typhii, Clostridium tetani, Bascillus anthracis, Vibrio cholerae*. Advances in antibiotic development Penecillin, Streptomycin, Tetracyclines, Rifampicin. Advances of Vaccinology: Recombinant vaccines, naked DNA vaccines, subunit peptide and edible vaccines

Unit V

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

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

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Ph.D. Course Work

w.e.f. session 2018-19

Course Code : 17CBTPC3 **MM: 80**

Course Title: Research Methodology **Time: 3Hr**

COURSE OUTCOMES

- **CO1** The students will gain knowledge about the colloidal solutions of biopolymers and their electrochemical properties and bio-membranes
- **CO2** The students will be able to apply the gained knowledge on various types of centrifugation, chromatography, electrophoresis techniques and spectroscopy
- **CO3** The students will understand the working mechanism of electron microscope, lyophilization and protein sequencer

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

Unit I

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 II

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 SDSPAGE. Blotting techniques (Northern, Southern and western blotting); RT-PCR

Unit III

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. Chromatographs- adsorption, affinity, partition, Ion-exchange, gel permeation, GLC, TLC, RPC, HPLC etc.

Unit IV

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

Unit V

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