w.e.f. 2020-2021

Ph.D. Course Work (2020-21)

Program Specific Outcomes:

PSO1 Ph. D. Course work is designed in a way to teach the research students with theoretical knowledge of Research Methodology, Research and Publication Ethics, Trends in Biotechnology and Computational and System Biology which, in turn, allow the research students to become efficient researchers.

PSO2 The research scholars will get exposure of research ethics, research processes, tools and techniques. The research students would also gain mastery in advance research methodology and usage of computerized statistical packages.

PSO3 The research scholars can also achieve appropriate knowledge of research work & thesis/research writing. The research students will develop understanding about the various tasks required to carry out good research.

PSO4 Explore the resources needed to perform the research process and perform proper documentation of their findings.

PSO5 Present and report their research in acceptable manner for the Life Sciences research community.

Duration: One Semester (Six months) **Total Credit requirement:** 14 credits

Program Structure: Ph.D. in Biotechnology

SEMESTER 1						
Course Code	**Nomenclature of Course**	**Theory marks (end semester examination)**	**Internal Assessment marks**	**Maximum marks**	**Hours /Week**	**Credits**
20CBTPH11C1 (Compulsory for all Ph.D. Course work)	Research Methodology	80	20*	100	4	4
20MPCC1[#] (Compulsory for all Ph.D. Course work)	Research and Publication Ethics	40	10**	50	2	2
20CBTPH11C3	Trends in Biotechnology	80	20*	100	4	4
20CBTPH11C4	Computational and Systems Biology	80	20*	100	4	4
Total marks/Credits				**350**		**14**

Note: [#]The compulsory course on 'Research and Publication Ethics' shall be offered by Ch. Ranbir Singh Institute of Social and Economic Change for all UTDs/Centres/Institutes passed vide Resolution No. 27 of the 271st meeting of EC held on 29.7.2020.

*Internal assessment will comprise of 2 written assignments and 2 presentations of 05 marks each.
**Internal assessment will comprise of 1 written assignment and 1 presentation of 05 marks each.

Ph.D. Course Work Syllabus

Research Methodology

Name of the Program	Ph.D. Course work in Biotechnology	**Program Code**	CBT
Name of the Course	Research Methodology	**Course Code**	20CBTPH11C1
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To understand some basic concepts of research and its methodologies & identify appropriate research topics
2. To understand the research methodologies in terms of instrumentation, their principal and SOPs
3. To write a research report and thesis and/or research proposal for funding from government agencies
4. Select and define appropriate research problem and parameters
5. Students should understand the link between quantitative research questions and data collection and how research questions are operationalized in educational practice

Course Outcomes:

1. Define and develop a possible HIED research interest area using specific research designs
2. Demonstrate knowledge of research processes (reading, evaluating, and developing)
3. Understanding of the state of the art research instruments for high throughput analysis
4. Understand research problems
5. Identify, explain, compare, and prepare the key elements of a research

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 SDS- PAGE. 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. Chromatography – adsorption, affinity, partition, Ion-exchange, gel permeation, GLC, TLC, RPC, HPLC etc, 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 – IV
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.
References: **1.** Sharma AK (2012) Research Methodology and Techniques in Biotechnology. ISBN-10 : 8126161957 **2.** Arumugam N (2016) Research Methodology for Life Sciences. ISBN : 9789384826796 **3.** Salar RK et al. (2013) Biotechnology: Prospects and Applications. ISBN 978-81-322-1683-4 **4.** Oliver U (2012) How to Commercialise Research in Biotechnology? Effectiveness of the Innovation Process and of Technology Transfer in the Biotechnology Sector. ISBN 978-3-8349-4134-3 **5.** Walker JM (2018) Methods in Molecular Biology. ISSN: 1064-3745 https://www.springer.com/series/7651 **6.** Amid A et al. (2018) Multifaceted Protocol in Biotechnology. ISBN 978-981-13-2257-0

Research and Publication Ethics

Name of the Program	Ph.D. Course work in Biotechnology	**Program Code**	PH
Name of the Course	Research and Publication ethics	**Course Code**	20MPCC1
Hours/Week	2	**Credits**	2
Max. Marks.	40	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsoryquestion consisting of short answer from all units. The candidate has to attempt one question each
from each unit along the compulsory question (5 x 8 = 40 marks)

Course Objectives:

1. To study the philosophy of ethics
2. To study the scientific conduct of research
3. To study the publication ethics
4. To know about various journal citation databases
5. To know the importance of quality publications

Course Outcomes:

By completion of course the student is able to

1. Ethics in conduct of scientific research
2. Know the scientific misconducts
3. How to avoid plagiarism and what are the penalties of plagiarism
4. Know the quality of research publications
5. Write research and review articles.

Unit – I

PHILOSOPHY AND ETHICS

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

SCIENTIFIC CONDUCT

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

Unit - II

PUBLICATION ETHICS

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and viceversa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

Unit – III

DATABASES AND RESEARCH METRICS

(A) Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

(B) Research Metrics

1. Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics

Unit - IV

Practice

OPEN ACCESS PUBLISHING

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

PUBLICATION MISCONDUCT

(A) Group Discussions

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

(B) Software tools (2 hrs.) :Use of plagiarism software like Tumitin, Urkund and other open source software tools

References:

1. Bird, A. (2006). Philosophy of Science, Routledge
2. P. Chaddah (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarised.
3. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019).
4. Beall, J (2012), Predatory publishers are corrupting open access. Nature, 489(7415), 179.
5. National Academy of Sciences, National Academy of Engineering and Institute of Medicine (2009). On being a Scientist: A guide to Responsible Conduct in Research, Third Edition, national Academic press.

Trends in Biotechnology

Name of the Program	Ph.D. Course work in Biotechnology	**Program Code**	CBT
Name of the Course	Trends in Biotechnology	**Course Code**	20CBTPH11C3
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. Students would gain train in the research areas selected from different fields of biotechnology like animal biotechnology, microbiology, genetic engineering, plant biotechnology, parasitology and in-silico identification and validation of novel proteins
2. Students can develop understanding of applied research in the field of biotechnology
3. Students would gain knowledge of various techniques in biotechnology
4. To understand the genome of organisms
5. Students can develop understanding of applied part of biotechnology from industrial and pharmaceutical point of view

Course Outcomes:

1. Knowledge about various approaches to research
2. Knowledge of various techniques used in recombinant DNA technology
3. Understand the industrial components of Biotechnology
4. Understand the molecular tools for engineering the genome of the organisms
5. Learn the application of biotechnology in all facets of life

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 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 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, Quorum sensing, determination of the level of antimicrobial activity – disc assay, microbroth dilution and spore germination inhibition, Toxicological study – Hemolytic, MTT assay

References:

1. Bergey's Manual of Systematic Bacteriology (2nd Ed.), Volumes1 to 4 Springer
2. The Search for Bioactive Compounds from Microorganisms by S. Omura
3. Continuous Culture (Vol. 8) by A. C. R. Dean, D. C. Ellwood and C. G. T. Evans
4. Annual Reviews in Microbiology Volumes 46 & 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
5. Biotechnology: Current Progress Volume 1 by P. N. Cheremisinoff and L. M. Ferrante. Technomic Publishing Co. Inc
6. Advances in Applied Microbiology volumes 6, 10, 17 by D. Perlman and Umbreit (eds). Academic Press.
7. The Physiology and Biochemistry of Procaryotes by D. White. Oxford University Press
8. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.
9. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
10. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida 1995

Computational and Systems Biology

Name of the Program	Ph.D. Course work in Biotechnology	**Program Code**	CBT
Name of the Course	Computational and Systems Biology	**Course Code**	20CBTPH11C4
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each
from each unit along the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. Learn about the methods to characterise and manage the different types of Biological data.
2. To get introduced to the basic concepts of Bioinformatics and its significance in Biological dataanalysis
3. To understand Overview about biological macromolecular structures and structure predictionmethods
4. To use the experimental methods to solve the biological problem using computational algorithmsincluding database design and implementation
5. To implement the computational methods to analyse large collections of complex biological data tomake new predictions or discover new concepts of biology

Course Outcomes:

1. Capable of using critical thinking and research methods to be applied on computational biologyproblems
2. Gain knowledge to participate in cutting edge research by the assignment of research project
3. Gain knowledge about various Biological databases that provide information about nucleic acids andprotein
4. Understand the structural organisation, structural properties and various techniques employed inthe structure determination of Biological macromolecules – DNA, RNA, Protein
5. Gain knowledge about various bioinformatics analysis tools

Unit - I

Types of biological data: Biological Databases Nucleic acid and protein sequence and protein structure databases Overview of available Bioinformatics resources on the web, 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 - II

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-proteininteraction prediction.

Unit – III

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 – IV

Introduction to Systems Biology (SB): Principles of Networks – Graph Theory and information theory ofmolecular systems Types of biological networks Biological Network Databases Genomic networks
(Gene regulation) Protein-protein interaction networks; Biochemical flux networks

References:

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press,New York. 2004
2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and FrancisOuellellette, B.F., Wiley India Pvt Ltd. 2009
3. Introduction to Bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999
4. Introduction to Algorithms, 2nd Edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, PHIPvt.Ltd./ Pearson Education. 2001
5. Cell and Molecular Biology – Concepts and Experiments by Gerald Karp. Wiley International StudentVersion. 2008
6. Cell and Molecular Biology by De Robertis and De Robertis. Saunders College, Philadelphia, USA.2002
7. Molecular Biology of the cell (4th Ed.) by Bruce Alberts. Garland publishing Inc. 2002