

POST-GRADUATE DEPARTMENT OF Biosciences & Biotechnology

Syllabus for Ph. D. Course Work in Biotechnology & Zoology

(With Effect From the session 2021)

Duration: One Semester (Six Months)
Total Credit Hours: 24
Maximum Marks: 400
Evaluation Pattern: Continuous

STRUCTURE

Paper No.	Code	Paper Title	Type	Full Marks (Internal + End Term)	Credit	Venue
Paper – I	BSBT-PhD-I	Research Methodology and Computer Applications	Theory	100 (40 + 60)	6	University P. G. Department (FMU)
Paper – II	BSBT-PhD-II	Recent Advances in Biotechniques	Theory	100 (40 + 60)	6	University P. G. Department (FMU)
Paper – III	BSBT-PhD-III	Literature Review (Including Book Review related to the proposed topic)	Project	100 (30 + 70)	6	Department of the Proposed Supervisor
Paper – IV	BSBT-PhD-IV	Preparation of Research Proposal/ Synopsis	Project	100 (30 + 70)	6	Department of the Proposed Supervisor
Total				400	24	

Organization of Papers:

PAPER-I: Shall be organized by the respective Head of the Department in the University

PAPER-II: Shall be organized by the respective Head of the Department in the University

PAPER-III: Shall be organized by the proposed teacher guide(s) who have offered to supervise Ph.D. work in a specialized area.

PAPER-IV: Shall be organized by the proposed teacher guide(s) who have offered to supervise Ph.D. work in a specialized area.

Marking Pattern:

Paper Type	Internal Evaluation			End Term Examination			Total
	Home Assignment	Seminar Presentation	Written (Internal)	Written (End Term)	Report	Viva-Voce	
Theory	10	10	20	60	NA	NA	100
Project	NA	30	NA	NA	50	20	100

Board of Examiners:

Sl. No.	Section	Examiner(s)
01	Home Assignment	Internal Course Teacher/ Instructor from the University P. G. Department
02	Seminar Presentation (Paper I & II)	Faculty Members of the University P. G. Department, as nominated by the Head of the Department
03	Seminar Presentation (Paper III & IV)	Faculty Members of the University P. G. Department, as nominated by the Head of the Department including the RAC. The proposed Supervisor, if from outside the University Campus, may be coopted as a member examiner.
04	Written (Internal)	Internal Course Teacher/ Instructor from the University P. G. Department
05	Report	Department Research Committee (DRC) and Research Advisory Committee (RAC)
06	Viva-Voce	Department Research Committee (DRC) and Research Advisory Committee (RAC)
07	Written (End Term)	Examiner as appointed by the Board of Studies

Notes:

- 1) Besides incorporating 'Objectives', 'Prerequisites', 'Teaching schemes', 'Learning outcomes', 'Suggested Readings' etc. in the syllabi of both the theory papers, a concept note including 'Background', 'Framework', 'Content' and 'Outcome' must also be prepared and approved by the Board of Studies for the two project papers (III – Review and IV – Synopsis).
- 2) The first paper, on Research Methodology, should have a unit devoted to Computer Applications and should also include Research Ethics, as per the UGC mandate.
- 3) The proposal for constitution of Research Advisory Committees (RAC) for the students registered for Ph. D. Course Work should also be given by the Department Research Committee.

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Paper – I : BSBT-PhD-I: Research Methodology and Computer Applications

Unit I: INTRODUCTION TO RESEARCH METHODOLOGY

Research: Definition, Importance of research, Characteristics of research, Types of research (basic, applied, qualitative, quantitative, analytical, etc); Features of translational research – Concept of laboratory to market (bench to public) – Industrial R&D. Research process – Observation – Axiom – Theory – Experimentation; Selection and formulation of research problem, Research questions, Research design – Formulation of Hypothesis, Review of Literature; Framing research objective and literature survey: Web browsing for information search and search engines; Sources of Scientific Information [Academic search Engines: PubMed, Science Direct, Google Scholar, E-journal and E-Library – Public Library of Science (PLOS), CiteSeer, Directory of Open Access Journals, INFLIBNET, High Wire Press]

Unit II: STATISTICAL TOOLS

Tabulation of data, Data analysis, Error, Accuracy, Precision, Bias; Mean, Standard deviation, Relative standard deviation. Coefficient of variation, Confidence limits of a measurement, Standard Error, Propagation of errors; Two-sided vs. one-sided test, F-test for precision, t-Tests for bias, Chi-squared test, Linear correlation and regression, Analysis of variance (ANOVA); Use of Microsoft Excel, SPSS package for statistical analysis.

Unit III: SCIENTIFIC COMMUNICATION

Types of research report: Dissertation and Thesis, editorial, research paper, review article, short communication, conference presentation etc.; Scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts.

Presentation skills - formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions; Internet as a medium of interaction between scientists.

Publishing scientific papers - Assessment of Quality of Journals, peer review process and problems, recent developments such as open access and non- blind review. SCI & SCI-E, UGC-Care list of journals; Publishing Houses: Elsevier, Wiley & Springer Nature.

Unit IV: COMPUTER APPLICATION & BIOINFORMATICS

MS-Office and its application, File handling in window, various versions of MS- Office, Research publishing tool- MS-Word, Adobe Acrobat, Graphics tool- MS- Excel, MS-Power Point: Creating presentations and adding effects; software for plagiarism; Reference Management Software like Zotero/Mendeley/ Endnote. Introduction to Bio-informatics and different tools, World Wide Web, Introduction to data structures and database concepts, NCBI, PubMed, Entrez databases, UniProt, SwissProt, database sequence searching from Nucleotide and protein databases-Blast and different types of blast, submitting DNA sequences to databases, Fasta format for sequence alignment, Sequence analysis, pairwise alignment, Multiple sequence alignment, use of Sequence Alignment tools, application of Bioinformatics in phylogenetic relationships, protein structure prediction & engineering, Homology modelling and docking, Protein structure prediction, protein expression analysis and mapping, Data mining.

Unit V: RESEARCH ETHICS

Introduction to ethics and research ethics. Overview of theories and methods in ethics and research ethics. Good research practice, Criteria and principles for good research practice; research integrity and meaning of scientific misconduct and fraud. Cases and procedures for establishing misconduct, preventions and sanctions. How to handle data. The meaning of secrecy and confidentiality. Responsibility for the results of research. Responsibility for research and the results and consequences of research. The limits of responsibility. Risks and the precautionary principle. Ethical vetting of research. Different kinds of vetting of research, procedures and ethical principles guiding research on human beings and animals.

Paper – II: BSBT-PhD-II: Recent Advances in Biotechniques

Unit I: NUCLEIC ACID

De novo: oligonucleotide synthesis, DNA extraction (Genomic DNA & Plasmid DNA); Quantification (UV spectroscopy, real-time polymerase chain reaction: quantitative PCR, DNA microarray); Polymerase chain reaction (PCR); Electrophoresis: Agarose electrophoresis, DGGE, Southern Blot; X-ray Crystallography for DNA structure prediction; DNA Hybridization; DNA Sequencing, FISH, DNA Microarray

Optimizing RNA Preparation and Analysis (Sample Collection and Protection, RNA Extraction methods, Quantitation of Isolated RNA); RNA Structural studies by NMR and X-ray crystallography, RNA Expression studies: Northern Blot, RT-PCR, Transcriptomics & Microarray, RNA Seq; protein–RNA interactions: EMSA, RNA pull-down assays, RNA immunoprecipitation; RNAi & Gene Silencing by Antisense RNA.

Unit II: PROTEIN & ENZYMES

Protein extraction and solubilization, Concentrating protein solutions, Spectrophotometric method for Estimation of Total protein, Chromatographic method (HPLC and LC-MS), Electrophoretic methods (SDS-PAGE, NATIVE PAGE, 2D-Electrophoresis), Antibody based methods(ELISA, Protein immunoprecipitation, Immunoelectrophoresis, Western blot, Protein immunostaining); Protein structure determination (X-ray crystallography, Protein NMR, Circular Dichroism); Protein–protein interactions(Yeast two-hybrid system,Co-immunoprecipitation, Affinity purification); Protein sequencing; Peptide mass fingerprinting; Protein microarray; Protein engineering. Enzymes Extraction, Purification and Activity assay; enzyme inactivation methods; Enzyme immobilization, Enzyme Engineering.

Unit III: CARBOHYDRATES & LIPIDS

Chromatographic and Electrophoretic methods to analyse the type and concentration of monosaccharides and oligosaccharides; chemical methods for quantifying carbohydrates (titration, gravimetric and colorimetric); physical methods to determine the carbohydrate concentration (polarimetry, refractive index, IR, and density); Analytical methods for estimation of Polysaccharides and Fibers; Conformational Analysis via Nuclear Magnetic Resonance Spectroscopy; Mass Spectrometry of Carbohydrates; Development and characterization of antibodies to carbohydrate antigens.

Lipid Extraction & Purification Methods; lipid quantification (gravimetric and chromatographic approaches, Raman, nuclear magnetic resonance, and fluorescence spectroscopic analysis); Lipid Staining Methods; Lipid Profile Test; Lipidomics: Techniques, Applications.

Unit IV: GENETIC ENGINEERING

Genomics; Genome Mapping; Cloning of gene; DNA transformation and transfection methods; Screening of recombinant clones; Expression of Recombinant Gene; Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins; Targeted gene replacement & Knockout Analysis, Gene editing by CRISPER-CAS. Designing of RNAi experiment. Metabolic Engineering of Microbes for production of Biofuels; Metabolic engineering of Plant Secondary metabolites pathway (phenylpropanoid pathway, shikimate pathway); Metabolic engineering of Animal cells for production of antibodies. Application of Molecular Markers in crop improvement.

Unit V: MICROBIOLOGY

Microscopy: Confocal, SEM,TEM; Biochemical tests for identification of bacteria, Culture dependent and independent methods of bacterial identification; Media designing for culture of novel bacteria; Effect of Environmental factors on microbial growth; Strain improvement; Mutagenesis : Induction and isolation of drug resistant mutants of bacteria; Bioreactors and Optimization of Bioprocess parameters, Screening of industrially important microbes; Techniques of Downstream processing; Methods for Enzyme and Whole cell immobilization, Development of Antimicrobial peptides.

Paper – III: BSBT-PhD-III: Literature Review

Literature Review (Including Book Review related to the proposed topic)

Paper – IV: BSBT-PhD-III: Preparation of Research Proposal/ Synopsis