Ph. D. Course Work Course Structure
(With effect from the 2020 – 2021 batch admitted in 2021)

COURSE STRUCTURE

Sl. No.	Paper Code	Title	Paper Type	Credit Hours	Marks [Internal + End Term]
1	BSBT-PhD-I	Research Methodology and Computer Applications	Theory	6	100 [40+60]
2	BSBT-PhD-II	Advances in Biotechniques (Subject Specific Paper)	Theory	6	100 [40+60]
3	BSBT-PhD-III	Research and Publication Ethics	Theory and Practical	2	50 [20+30]
4	BSBT-PhD-IV	Literature Review	Project	6	100
5	BSBT-PhD-V	Preparation of Research Proposal/ Synopsis	Project	4	50
	Total			**24**	**400**

MARKING PATTERN

Paper Sl. No.	Internal Evaluation				End Term Examination				Total
	Home Assignment	Presentation	Quiz	Written	Written*	Presentation	Report	Viva-Voce	
1	10	NA	10	20	60	NA	NA	NA	**100**
2	10	NA	10	20	60	NA	NA	NA	**100**
3	10	05 (GD)	05	NA	30	NA	NA	NA	**50**
4	NA	NA	NA	NA	NA	20	60	20	**100**
5	NA	NA	NA	NA	NA	10	30	10	**50**

**** Includes experiments in case of practical papers***

Scheme of Internal Evaluation (Theory):

Each theory paper consists of five units and irrespective of the credit hours assigned, will be of 100 marks, out of which, 40 will be internal marks (continuous evaluation) and 60 will be end term examination marks. There will be three components of internal evaluation – Quiz, Mid Term Written Test and Home Assignment as per the details below.

Component	Unit(s)	Marks	Remarks
Quiz – I	I	10	Best of the two quizzes will be considered
Quiz – II	III	10	
Mid Term (Written)	I & II	20	There will be no internal evaluation for the last unit (V)
Home Assignment	IV	10	
Total	**I – IV**	**40**	**Q – 10 + HA – 10 + W – 20**

BOARD OF EXAMINERS

Sl. No.	Section	Examiner(s)
01	Home Assignment and Quiz	Internal Course Teacher/ Instructor from the University P. G. Department
02	Seminar Presentation	A board of examiners consisting of faculty members of the University P. G. Department, who are members of the SRC in the subject. The proposed Supervisor, if from outside the University Campus, may be coopted as a member examiner.
03	Written (Mid Term)	Internal Course Teacher/ Instructor from the University P. G. Department
04	Report	A board of examiners consisting of faculty members of the University P. G. Department, who are members of the SRC in the subject. The proposed Supervisor, if from outside the University Campus, may be coopted as a member examiner.
05	Viva-Voce	A board of examiners consisting of faculty members of the University P. G. Department, who are members of the SRC in the subject. The proposed Supervisor, if from outside the University Campus, may be coopted as a member examiner.
06	Written (End Term)	Examiner as appointed by the Board of Studies

PASSING PERCENTAGE & DURATION

Passing Marks in Individual Paper: 50% (End Term and Internal Marks taken together) in each Theory/ Practical/ Project paper

Passing Marks in Aggregate: 55%

Division: No Division; Only Pass or Fail

Duration: One semester

Back/ Improvement: There is no provision for back/ improvement in the Ph. D. Course Work.

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 handing 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: IPR

Intellectual Property Rights: Introduction and the need for intellectual property right (IPR); IPR in India – Genesis and Development; IPR in other countries; Types of IP – Patents, Trademarks, Copyright & Related Rights; Types of IP – Industrial Design, Traditional Knowledge and Geographical Indications; Importance of IPR – patentable and non patentables; patenting life; Legal protection of Biotechnological inventions; Agreements and Treaties – History of GATT & TRIPS Agreement; IPR and WTO regime – Consumer protection and plant genetic resources. PATENTS: Patent and kind of inventions protected by a patent; Indian Patent Act 1970 and Recent amendments; Filing of a patent application-

precautions before patenting-disclosure/non-disclosure; Patent application- forms and guidelines, fee structure, time frames; Ownership of patent, Rights of patent holder and co-owner; Transfer of patent Rights- Limitations of patent Rights; The different layers of the international patent system (national, regional and international options); Plant variety protection and Farmer's Right Act; Biopiracy; Commercializing Biotechnology inventions. Case studies on Basmati rice, Turmeric, and Neem patents.

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 ENGINERING

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.

BSBT-PhD-III: Research and Publication Ethics

Unit I: PHILOSOPHY AND ETHICS

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

Unit II: SCIENTIFIC CONDUCT

Ethics with respect to science and research
intellectual honesty and research integrity
Scientific misconduct: falsification, fabrication and Plagiarism (FFP)
Redundant publications: duplicate and overlapping publications, salami slicing
Selective reporting and misrepresentation of data

Unit III: PUBLICATION ETHICS

Publication ethics: definition, introduction and importance
Subject specific ethical issue
Best practices/standard setting initiatives and guidelines: COPE, WAME etc
Conflicts of interest
Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
Violation of publication ethics, authorship and contributorship
Identification of publication misconduct, complaints and appeals
Predatory publishers and journals
Complaints and appeals: examples and frauds from India and abroad

Unit IV: OPEN ACCESS PUBLISHING

Open access publication and initiatives
SHERPA/RoMEO online resources to check publisher copyright and self-archiving policies
Software tools to identify predatory publications developed by SPPU
Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggestor, etc.

Unit V: DATABASE AND RESEARCH METRICS

Indexing database
Citation databse: Web of Science, Scopus, etc
Impact factor of journal as per JCR, SNIP, SJR, IPP, Cite Score
Metrics: h-index, g-index,i10 index, altmetrics

BSBT-PhD-IV: Literature Review

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

BSBT-PhD-V: Preparation of Research Proposal/ Synopsis