Doctor of Philosophy (Ph. D.)
Academic Curriculum

For

BIOTECHNOLOGY

Department of Biotechnology

Faculty of Sciences

D.D.U. Gorakhpur University, Gorakhpur
Uttar Pradesh, India

2024

Doctor of Philosophy (Ph. D.)
Academic Curriculum

Every student admitted in Biotechnology for the Ph. D. programme will be required to pass a course work of minimum 12 credits. The division of this 12 credits course work is as following:

Paper	Course Code	Course Name	Credit
I	RPE 700	Research and Publication Ethics (RPE)	**1+1**
II	BT 701	Research Methodology	**5**
III	Innovative Research Approaches in [Subject Area/ discipline] (Any one)		**5**
	BT 702	Omics for Crop improvement	
	BT 703	Advance Microbial Biotechnology	
	BT 704	Enzyme Engineering	
	BT 705	Structural Biology	
		Total	**12**

Detail Syllabus

Research and Publication Ethics

RPE 700 Research Methodology 2 (1+1)

Theory:-

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

2. Scientific conduct: Ethics with respect to science and research, Intellectual honesty and research integrity, scientific misconduct: Falsification, Fabrication and Plagiarism (FFP), Redundant publication: duplicate and overlapping publication, salami slicing, Selective reporting and misrepresentation of data.

3. Publication Ethics: definition, introduction and importance, best practices/ standard setting initiatives and guidelines: COPE, WAME, etc, conflict of interest, publication misconduct, definition concept, problems that lead to unethical behavior and vice-versa, types, Violation of publication Ethics, Authorship and contributor ship, identification of publication misconduct, complain and appeals, Predatory publisher and journals.

Practice:-

1. Open Access Publishing: open Access publication and initiatives, SHERPA/ RoMEO online resource to check publisher copyright and self-archiving policies, Software tool to identify predatory publication developed by SPPU, Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester,etc.

2. Publication Misconduct: Group Discussion regarding subject specific Ethical Issues, FFP, Authorship, conflict of Interest, complaints and appeals: example and fraud from India and abroad.

3. Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools

4. Databases and Research Metrics: Databases: Indexing databases, Citation database: web of Science, Scopus etc. Research Metrics: Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite, Metrics: h-index, g-index, i10 index, altmetrics.

Suggested Readings

(1) P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
(2) Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrived from http://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
(3) Indian National Science Academy (INSA), Ethics in Science Education, Reasearch and Governance(2019),ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf
(4) Bird, A. (2006)- Philosophy of Science.
(5) Maclntyre, Alasdair (1967)- A short History of Ethics.
(6) National Academy of Science, National Academy of Engineering and institute of Medicine (2009) On being a Scientist: A Guide of Responsible Conduct in Research.
(7) Beall, J. (2012) – Predatory publishers are corrupting open access. Nature, 489(7415).

BT 701 Research Methodology 5 (5+0)

Unit 1

Meanings, objective, motivation, Type of research, research approaches, the significance of the research, research methods and methodology, research process, criteria for good research, outcomes of research, selection of research problem, the necessity of defining the problem, techniques involved in defining a research problem, literature surveys, and different methods of data collections, methods of analysis and interpretation of findings, writing of references/bibliography, scientific writing, and effective presentations.

Unit 2 Good Lab Practices (GLPs), Biosafety norms, BSL1,2 3 and 4, biosafety levels, biohazards, patents in biotechnology, preparation of stock solutions, Ethical Committees related to biotechnological research.

Unit 3

Sampling and sampling methods, design, collection and classification of data, graphical representation of data, probability. Measure of central tendency, measures of dispersion. Test of significance, variations.

Unit 4

Biological databases (NCBI, EBI, JDBD), Sequence analysis (Multiple sequence analysis Local & Global). Algorithms fused for Nucleic acid and protein analysis.

Unit 5

Intellectual Property Rights (IPR): an introduction; IP as a global indicator of innovations, Role of IPR in economic and cultural developments, Types of IPR, Patents, Copyrights, Trademarks, Geographical Indications, Trade Secrets, Semiconductor Integrated Circuits and Layout Designs, Protection of Plant Varieties and Farmers' Rights (PPV& RF), Industrial Designs. Scope of Patents in Biotechnology.

Suggested Readings

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International, 418p.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
3. Day, R.A., 1992. How to write and publish a Scientific paper, Cambridge University Press.
4. Fink, A.,2009. Conducting Research Literature Reviews: From the internet to paper. Sage Publications.
5. Satarkar, S.V.,2000. Intellectual property rights and copyright. EssEss Publications.
6. Saxena, V.P.,2013. Lecture Notes on Research Methodology. Indra Publishing House.

BT 702 Omics for crop improvement 5 (5+0)

Unit 1
Omics: Types and its relevance and scope in agriculture. Genomics, Proteomics, and Metabolomics approaches for crop improvements. Plant genome sequencing strategies and analysis of some important crop's whole genome sequences.

Unit 2
Molecular markers in plant genome mapping. Tagging of agronomically important traits. Gene pyramiding, Molecular markers in crop improvement. Molecular breeding approaches and Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants.

Unit 3
Genomics-assisted crop breeding approaches, Transgenic plants (Biotech Crops): present status; methods of production of transgenic crops, Some important commercialized transgenic plants. Limitations and challenges for production of transgenic plants. Molecular farming and its importance,

Unit 4
Allele mining by TILLING and EcoTILING methods; Genome editing technologies: Types and approaches for crop improvement., CRISPR/CAS system. Plant transcription factors and their role in developing stress tolerance crops.

Unit 5
Bioinformatics tools for sequence analysis, plant genome databases; plant transcription factor databases; genome-wide identification and *in-silico* characterization of a few selected plant transcription factors.

Suggested Readings

- Genomes by T.A. Brown, John Wiley & Sons Ltd, New York
- Genome analysis (Volume I, II, III and IV) a Laboratory Manual by Bruce Birren,Eric D. Green, Sue Klapholz, Richard M. Myers and Jane Roskams, Cold SpringHarbor Laboratory Press.
- Discovery Genomics, Proteomics and Bioinformatics, Campbell AM &Heyer L, 2004,

.

BT 703 Advance Microbial Biotechnology 5 (5+0)

Unit 1

Isolation and selection of industrially important microorganisms, Molecular tools for identification of microbial strains, methods for the preservation and maintenance of microbial cultures, metagenomics approach in search of novel microbial strains for enzymes and metabolites.

Unit 2

The microbial fermentation process, substrates, and media formulation, Solid State fermentation (SSF), and Submerged Fermentation (SmF). Factors influencing the SSF and SmF process. Approaches for microbial strain improvement.

Unit 3

Microbial enzymes for the food, detergent, and pharma industry, Strategies for the overproduction of microbial enzymes with suitable examples. Microbial inoculants for the formulation of biopesticides and biofertilizers and production strategies.

Unit 4

Microbial genome sequencing: strategies and applications, microbial genome databases and its uses, Bioinformatics intervention in microbial genome sequences.

Unit 5

Gut microbiome, Prebiotic, and Probiotics: Development of Prebiotics and Probiotics for animal and human use, functional foods.

Suggested Readings

- Pelczar MJ Jr., Chan ECS and Kreig NR., Microbiology, 5th Edition, Tata McGraw Hill, 1993.
- Maloy SR, Cronan JE Jr., and Freifelder D, Microbial Genetics, Jones Bartlett Publishers, Sudbury, Massachusetts, 2006.
- Crueger and A Crueger, (English Ed., TDW Brock); Biotechnology: A textbook of Industrial Microbiology, Sinaeur Associates, 1990.

BT 704 Enzyme Engineering 5 (5+0)

Unit 1
Enzymology: an Introduction: Enzymes as biocatalysts, Theories & Mechanism of enzyme action, specificity of enzyme action (lock and key and induced fit model of enzyme activity), mechanisms of enzyme catalysis, units of enzyme activity, turnover number, allosteric enzymes, isozymes; Multi-substrate enzymes; Coenzymes and their role in enzyme action Classification and nomenclature of enzymes

UNIT 2
Experimental Measures of Enzyme Activity Enzyme induction, active site determination; Initial velocity measurements, factors affecting the velocity of enzymatic reactions, reporting enzyme activity data, enzyme stability, various strategies for enzyme purification , molecular weight determination

Unit 3
Enzyme Kinetics and Inhibition Michaelis- Menton kinetics (Pre-steady state, Steady state, Derivation of M-M equation) Determination and significance of Vmax and Km; Linear plots for enzyme kinetic studies Enzyme inhibition: Competitive inhibition. Uncompetitive inhibition. Noncompetitive inhibition, kinetics of these types of inhibitions; Importance of studying enzyme inhibition, Enzymes as therapeutic molecules , Biotransformation of drugs

Unit 4
Immobilization of enzymes Immobilization techniques, kinetics of immobilized enzymes, immobilization of amylase, cellulase, protease and lipase, Use of isozymes as markers in cancer and other diseases. Enzymes used in detergents, in food, leather and wool industries;

Unit 5
Biocatalyst stabilization: medium engineering, enzyme reactions in water restricted media and super critical fluids. Biosensors. Enzyme Engineering and site directed mutagenesis, Designer enzymes. The design and construction of novel enzymes, Lead Compound, Structure based drug design, combinatorial chemistry, High-throughput screening, Case study of DHFR etc

.Suggested Readings

- Biocatalysts for industry, J.S. Dordick, Plenum Press, New York, London.
- Enzyme Technology, M.F. Chaplin & C. Bucke.
- Enzymes in Industry, Production & Applications W. Gerhartz.
- Enzymes Technology, P. Gacesa and J. Hubble, Open University Press, England, UK. ϖ Biochemical Engineering, J.M. Lee, Prentice Hall INC, New Jersey

BT 705 Structural Biology 5 (5+0)

Unit 1
Defining the terms for nucleic acids: nomenclature and symbols, atomic numbering scheme, torsion angles and their ranges, definitions of torsional angles in nucleic acids, sugar pucker modes, pseudo rotation cycle syn/anti orientation about N-Glycosidic bond, orientation about the C9-C51 bond, helical parameters, hydrogen bonding between bases.

Unit 2
Structure and conformational properties of bases, furanose sugars and phosphate groups, geometry of bases, preferred sugar puckering modes, bond distances and angles in furanoses, syn/anti conformation and other conformation aspects of nucleotides.

Unit 3
RNA Structure: RNA double helices, RNA triple helices, Watson-Crick and Hoogsteen base pairing, mini double helices formed by ApU and GpU, turns and bands in UpAH. DNA structure: A-DNA, B-DNA, C-DNA conformation, DNA-RNA hybrids, Z-DNA formation.

Unit 4
Basic structural principles of proteins: Building blocks of proteins, Peptide bond, Ramachandran plot, Protein folding, Motifs of protein structure, Alpha domain structures, alpha and beta structures, anti parallel beta structures.

Unit 5
Interaction of biomolecules: Protein-protein, Protein-DNA and Protein-ligand, drug-DNA interactions. Databases of sequences and structure for protein and DNA

Suggested Readings

- Petsko and Ringe, Protein Structure and Function, New Science Press, 2004
- V.Voet and J.G.Voet, Biochemistry, 3rd edition, John Wiley, New York, 2004.
- A.L. Lehninger, Principles of Biochemistry, 4th edition, W.H Freeman and Company, 2004.
- Stryer, Biochemistry, 5th edition, W.H. Freeman and Company, 2002