

REVISED SYLLABUS

(Approved vide emergent BPGS meeting held on 16-08-2018, Effective from Session 2017- 2018)

Doctor of Philosophy

in

BIOTECHNOLOGY

**BABASAHEB
BHIMRAO
AMBEDKAR
UNIVERSITY**



• LUCKNOW •
प्रज्ञा शील करुणा
ESTABLISHED 1996

**Babasaheb Bhimrao Ambedkar University
(A Central University)
Vidya vihar , Raebareli Road
Lucknow -226025**

COURSE STRUCTURE FOR Ph. D. BIOTECHNOLOGY

Course Code	Course title	Credit	Max Marks
DPHBT-101	RESEARCH METHODOLOGY	04	100
DPHBT -102A	ADVANCES IN MICROBIAL TECHNOLOGY	04	100
DPHBT -102B	PLANT BIOTECHNOLOGY	04	100
DPHBT -102C	IMMUNOLOGY & ANIMAL BIOTECHNOLOGY	04	100
DPHBT -102D	NEUROBIOLOGY	04	100
DPHBT -102E	ADVANCES IN ENZYME TECHNOLOGY	04	100
DPHBT -102F	ADVANCES IN STRUCTURAL BIOLOGY	04	100
DPHBT -103	REVIEW OF LITERATURE	04	100
DPHBT -102F	PREPARATION AND PRESENTATION OF SYNOPSIS BEFORE DRC FOR EVALUATION	04	100

**Syllabus for Ph. D Course Work
DPHBT-101
(Research Methodology) for Ph.D. in Biotechnology**

**Prof. D. R. Modi, Prof. Sangeeta Saxena,
Dr. G. Sunil Babu, Dr. Anand Prakash,
Dr. Monica Sharma & Dr. Yusuf Akhter
Credit=4
Max Marks: 100
Sessional: 30
End Semester Exam: 70**

Unit 1. General Research approach

Definition- defining research problem, Basic and applied research, Approaches and Methodology, Research/ experimental design, Literature collection and documentation. Research report- Writing of research proposal, report and Research paper: Data presentation, Analysis and Interpretation. Documentation: Footnotes and Bibliography. Ethical, legal, social and scientific issues in biological research. Role of Intellectual Property Rights (IPR) in Research and development. A brief idea of funding agencies - DST, DBT, ICMR, CSIR and UGC.

Unit 2: Biophysical methods

Analysis of biomolecules using spectrometric analysis(UV-Vis, IR& FTIR, and Mass spectrometry). Structural determination- NMR& ESR and X-diffraction. Affinity analysis- Equilibrium dialysis, Surface Plasmon Resonance. Radiolabelling- use of radioisotopes used biology, molecular imaging of radioactive materials.

Unit 3: Microscopy and Immunotechniques

Analysis of Biological samples using microscopic techniques. Visualization of cells and subcellular components – Light , Fluorescent and Electron microscopy. Living cells- Phase contrast and confocal microscopy. FISH & GISH.

Principles involved in antigen and antibody reactions (Precipitin & Agglutination). Antibody generation, RIA, ELISA, Western blot and Immunoprecipitation (Chip) and Flow cytometry

Unit 4: Molecular Biology Techniques

Nucleic acid purification - isolation of DNA and plasmids (Plant & animal cells). Amplification of DNA by PCR (simple, nested, Multiplex). Gene expression studies- RT –PCR, Micro array. Cloning – types (Ta cloning), Blue –white screening. Role of RFLP, AFLP and RAPD in Biology.

Unit 5: Bioinformatics and Statistics

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

Statistics: Level of significance, Simple Correlation, correlation coefficient, simple linear regression. Student's t' test, Chi square test, Fisher test and Z- test. Analysis of variance: One way & two ways ANOVA.

Books suggested:

1. Biophysical chemistry: Applications to Biochemistry and molecular biology by David Frifelder
W H Freeman and company Publishers.
2. Principles and Techniques of practical Biochemistry by K Wilson and K Walker ,Cambridge
3. Molecular Cloning : A laboratory manual J Sambrook & EF Fritsch Cold Spring Harbor Laboratory
press
4. Principles of Gene Manipulation by RW Old & SB Prime rose; Blackwell Science Publishers
5. Biochemical calculations by Irwin H Segel, John Wiley & Sons Publishers
6. Biostatistics ,B R Bhatt , New Age Publishers
7. Bioinformatics Sequence and Genome Analysis by David W Mount
8. Essential Bioinformatics by Jin Xiong; Cambridge Publishers

DPHBT-102A
ADVANCES IN MICROBIAL TECHNOLOGY

Prof. D. R. Modi
Credit=4
Max Marks: 100
Sessional: 30
End Semester Exam: 70

Unit1: Review of Literature of relevant topic of research area. National and international status.

Unit2: Systematics of microbial taxonomy: Systematics and Taxonomy; Modern approaches to bacterial taxonomy, polyphasic classification; Ribosomal DNA sequencing, General characteristics of primary domains and of taxonomic groups belonging to Bacteria, Archea and Eukarya. Nomenclature and outline of bacterial classification as per Bergey's manual. Bacterial genetic system: Transformation, conjugation, Transduction.

Unit 3: Techniques in Microbiology: Theory and practice of sterilization, pure culture techniques; culture collection, preservation and maintenance of microbial cultures.

Unit 4: Industrial Microbiology: Microbial products- Industrial production of chemicals: alcohol (ethanol), acids (citric, acetic), solvents (glycerol, acetone), antibiotics (penicillin, streptomycin), amino acids (lysine, glutamic acid).

Unit 5: Applied Microbiology: Industrial production of glucose from starch and cellulose. Production of glucose-fructose syrup from sucrose. Use of lactase in dairy industry. Use of proteases in food, detergent and leather industries, Sterilization and pasteurization of food products. Technology of typical food /food products (bread, cheese) Food preservation. Current status of genetically modified microorganism in industries.

DPHBT-102 B
PLANT BIOTECHNOLOGY

Prof. Sangeeta Saxena
Credit=4
Max Marks: 100
Sessional: 30
End Semester Exam: 70

Unit I: Review of Literature : Review of literature related to research area including research papers relevant to the topic of research, current International and national status of the topic of research.

Unit II: Plant Genome : An introduction to genome size and organisation. Gene structure and expression of plant genes, examples of promoter elements used to derive transgene expression, protein targeting. Molecular dissection of genome , Molecular markers for genome analysis - kinds of molecular markers DNA markers Application of molecular markers in characterisation, DNA Fingerprinting, Application of molecular markers in other fields of molecular biology e.g. transgenic crops, Fingerprinting of cultivars, fungi, plants.

Unit III: Plant Biotechnology and Genetic Engineering: Plant Tissue culture, Culture types, Plant regeneration, Plant transformation techniques. Current state of transgenic crops, role of genetic engineering in stress management. Manipulation of plant development, Genetic Engineering of metabolic pathway in medicinal plants.

Unit IV: Biotechnological approaches to Disease Resistance: Plant pathogen interactions, Plant virology/mycology etc. Diagnostic development, Natural disease resistance pathways. The transgenic approach - PDR, RNAi, siRNA, miRNA. Engineering resistance / tolerance, Improvement of crop yield and quality. Viral disease resistance genes - coat protein genes, movement protein genes, ribozymes, defective genomes, antisense RNA technology etc.

Unit V: Bioinformatics in disease management and IPR issues:- Major bioinformatics resources, Sequence and structure databases; Sequence analysis (sequence alignment, phylogeny); Genomics and Proteomics sequence and data bases, sequence analysis, scoring matrices, sequence- bases database searches, Pair wise sequence alignments and multiple sequence alignments, designing of degenerate primers and siRNA based on multiple sequence alignment data, taxonomy and phylogeny, sequence pattern and profile , Intellectual property rights - Patent laws at national and international level, Ethical issues, Public awareness and perception of biotechnology.

Books suggested:

1. Molecular Biology of the Cell.

By: Bruce Alberts, Bray D, Lewis J, Raff M, Roberts K and Watson J D. Garland Publishing Inc. New York.

2. Molecular Cloning: a Laboratory Manual.

By: Sambrook J, Fritsch E F and Maniatis T. Cold Spring Harbor laboratory Press. New York.

3.Plant Biotechnology.

By: Adrian S, Nigel S and Mark F. Oxford University Press.

4.Biotechnology in crop Improvement.

By: Chawla H S. International Book Distributing Company

5.Practical Application of Plant molecular Biology.

By:Henry R J. Chapman and Hall

Websites provided:

www.ncbi.nlm.nih.gov.in, www.qiagen.com, www.nature.com, www.arabidopsis.com,
www.tigr.org, www.bioresearch.ac.uk, www.royalsoc.ac.uk, www.plantprotection.org, www.geopie.edu/traits/herbes.html,
www.pioneer.com, www.dupont.com, www.bio.org/foodag,
www.ers.usda.gov, www.monsanto.com, www.ejb.org, www.florigene.com, www.bio.org,
www.cals.cornell.edu,www.newscientist.com

DPHBT-102C
Immunology and Animal Biotechnology

Dr. G. Sunil Babu
Credit=4
Max Marks: 100
Sessional: 30
End Semester Exam: 70

Review of literature relevant to the Research topics.

1. Immune system in Health and Disease: overview of the immune system, Humoral and cellular responses and their role in controlling the infectious diseases. Immune response alleviation and immunological disorders. Genetic predisposition of diseases. Role of MHC in disease susceptibility and resistance. Polymorphisms- SNPs, Role of SNPs in Human diseases.

2. Cancer biology: Mechanism of Carcinogenesis, Proto oncogenes and Oncogenes. Sarcoma and Carcinoma, Tests related to malignancy. Cancer therapy- Chemo and radiation therapies. Immune surveillance in Cancer. Mutations: Types and their role in Cancer. Detection of mutations.

3. Animal cell culture: Primary and established cell cultures. Role of serum in culture. Development of serum free media. Maintaining of cell lines and cryopreservation. Continuous cell lines used in the production of Vaccines and mAbs (CHO, Vero and Sp2/0). Cell synchronization and cell cloning. Transformation and differentiation. Stem cell culture, Nuclear Transfer experiments (Roslin & Honolulu techniques).

4. RNAi - regulation of genome by double stranded RNA. si RNA and miRNA. miRNA biogenesis and maturation. mirTRons, miRNA and mRNA interactions, Orthologous/homologous/paralogous nature of miRNAs. Role of miRNA in prognosis and pathogenesis of diseases. Bioinformatic tools used in the Identification and prediction of miRNAs.

5. Immunoinformatics- introduction, immunology databases, IMGT databases, (IMGT/LIGM_DB; IMGT/3D structure-DB; IMGT/MHC_DB; IMGT/PRIMER-DB, IMGT-GENE-DB). IMGT Web resources. Immunoinformatics in transplantation. Human immune disease- gene identification, RIKEN database, FANTOM3 .

Books suggested:

1. Molecular Cloning : A laboratory manual J Sambrook & EF Fritsch Cold Spring Harbor Laboratory press
2. Culture of Animal cells 4th Edi by Freshney, R.I.
3. Kuby's Immunology. 6th Edition Richard A Goldsby, Thomas J Kindt, Barbara S Osborne ;W.H.Freeman & Coy publishers
4. Animal cell culture- practical approach by Edi. Jhon R.W. Masters ; Oxford
5. Bioinformatics Sequence and Genome Analysis by David W Mount, CSHL press
6. Essential Bioinformatics by Jin Xiong; Cambridge
7. RNAi – a guide to gene silencing by Gregory J . Hannon; CSHL Press
8. Immunoinformatics: bioinformatics strategies for better understanding of immune function, Novartis Foundation, ISBN 0-470-85356-5

DPHBT-102D Neurobiology

Dr. Anand Prakash

Max Marks: 100

Sessional: 30

End Semester Exam: 70

Introduction to Neurons and The Brain: Introduction to neurons; The Neuron Doctrine; Components of neurons; Classification of neurons; The Nissl and Golgi stains; Types of neurons; Cytology of neurons; Dendrites structure and function; Axons structure and functional aspects; Ultrastructure; Myelination and synapses. Organization of the nervous system mice, rat and human; Subdivisions of the nervous system; The scalp, skull and meninges; Cerebrospinal fluid.

1. Synaptic Transmission: Electrical and chemical synapses; Structure and their properties; Transmission; Synaptic vesicles; Vesicle release mechanism; EPSP and IPSP; Temporal and spatial summation; Presynaptic modulation; Drug effects on synapse, Classification of neurotransmitters and neurotransmitter receptors; Receptor binding assays; Determination of affinity and binding capacity of receptor; Scatchard plot; Receptor agonists and antagonists. The Reward Circuitry; Reinforcement System; Brain Aversion Systems.

2. The Methods of Cognitive Neuroscience: Brief History of Cognitive Neuroscience; Experimental Techniques Used with Animals; Single-cell recording; Lesions; Genetic manipulations; Neurology; Structural imaging of neurological damage Causes of neurological disorders; Converging Methods; Virtual lesions: Transcranial magnetic stimulation Functional imaging. Methods of tissue processing for microtomy, cryotomy and vibratome; Golgi and other impregnation method; Principles and application of transmitted light and fluorescence microscopy: Confocal microscopy and immunocytochemistry; Basic concepts of stereology and image analysis; Diagnostic tools in clinical neuroscience.

3. Tools in behavioral studies of the brain in animals: Animal activity monitoring; Different types of mazes and their application in studies on behaviour, learning and memory and cognitive aspects of animals; Rotarod; Grip strength meter; Pain sensitivity testing with the help of tail-flick instrument and paw test.

4. Neuroinformatics: Elements of Neural network and computation, complexity and learning. Non-linear elements and networks, linear and polynomial threshold elements, network capacity, learning theory, the sample complexity of learning, perception training, learning complexity, the intractability of learning, model selection. Brain as electrical machine.

Texts/ References

- Siegel et al., Basic Neurochemistry, Lippincott -Williams-Wilkins.
- Kandel et al., Principles of Neural science, McGraw-Hill Medical.
- Zegmond, Fundamentals of Neuroscience, 1st Edition, Academic Press.
- Neuroscience: Exploring the Brain, 2nd edition, Lippincott Williams & Wilkins, 2001.

DPHBT-102E

ADVANCES IN ENZYME TECHNOLOGY

Dr. Monica Sharma

Max Marks: 100

Sessional: 30

End Semester Exam: 70

UNIT –I

Advances in Microbial Technology-Microbial growth: Continuum and Stochastic models, mathematical expression of growth, growth curve, measurement of growth and growth yields; synchronous growth; continuous culture, fed batch cultures, microbial bioenergetics, design, analysis and stability of bioreactors.

1. UNIT II

Metagenomics-Introduction, scope of metagenomics, bioinformatics tools, data analysis, next generation sequencing methods, insilico analysis of enzymes, protein ligand interaction, molecular docking and related software tools.

2. UNIT III

Enzymes kinetics- Modes and types of enzyme catalysis, Steady state and equilibrium hypotheses of enzyme catalysis, Michaelis-Menten and Briggs' Haldane equations, determination of K_m & V_{max} , meaning and significance of k_{cat}/K_m .

3. UNIT IV

Enzyme inhibition kinetics and enzyme regulation, principles of enzyme assays. Medium Engineering-enzyme kinetics in biphasic reactions; stabilization of biphasic aqueous- organic systems, equilibria in biphasic aqueous- organic systems. Enzyme engineering by directed evolution and rational approach, immobilization kinetics of enzymes and their application, Synzymes/Artificial enzymes.

4. UNIT V

Recombinant expression, vector engineering, types of vector, codon usage, Transcriptome analysis, enzymes in genetic engineering, Construction of cDNA, cloning: mRNA enrichment, reverse transcriptase, DNA primers, linkers, adaptors and their chemical synthesis; genomic libraries and screening of libraries for selection of desired clones using nucleic acid hybridization techniques.

Suggested Books:

1. Bioprocess Engineering Principles by Pauline M. Doran
2. Metagenomics for Microbiology- Jacques Izard Maria Rivera. eBook
ISBN: 9780124105089 Paperback ISBN: 9780124104723. Academic Press.
3. Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems by Irwin H. Segel. I SBN-13: 978-0471303091. ISBN-10: 0471303097.
4. Fundamentals of Enzyme Engineering. Yoo, Y.J., Feng, Y., Kim, Y.-H., Yagonia, C.
ISBN 978-94-024-1026-6.
5. Molecular Cloning : A laboratory manual J Sambrook & EF Fritsch Cold Spring Harbor
Laboratory press
6. Recombinant Protein Production with Prokaryotic and Eukaryotic Cells. ... A Comparative
View on Host Physiology:Selected articles from the Meeting of the EFB
Section on Microbial Physiology, Semmering,Austria, 5th–8th October 2000.

DPHBT-102F
ADVANCES STRUCTURAL BIOLOGY

Dr. Yusuf Akhter
Credit=4
Max Marks: 100
Sessional: 30
End Semester Exam: 70

Course Contents:

UNIT -I:INTRODUCTION

Overview of Structural Biology:Basic structural principles, conformational principles, Ramachandran diagram, forces involved in macromolecular interaction, building blocks of proteins, Proteins-Primary Structure, Chemistry And Covalent Modifications, motifs of protein structures:Protein Secondary and Supersecondary Structure , alpha domain structures, alpha/beta structures, Macromolecular crystallography-concepts.

UNIT -II:

Structural Classification of Proteins, Profiles and Protein Families, DNA structures, DNA recognition in prokaryotes and eukaryotes, specific transcription factors, enzyme catalysis and structure. Membrane proteins, signal transduction, proteins of the immune system. Structure of Spherical viruses, DNA – Protein Interactions,RNA – Protein Interactions.

UNIT -III:

Protein Folding and flexibility, Protein Misfolding, Disease, in vivo Folding and Degradation, Prediction, Engineering and design of protein structures. Methods to identify secondary structural elements, Macromolecular Machines in Protein Folding and Unfolding.

UNIT-IV

Determination of protein structures by X-ray and NMR methods. Prediction of secondary structure- PHD and PSI-PRED methods. Tertiary Structure : homology and comparative modelling, fold recognition and ab-initio approaches. Structures of oligomeric proteins and study of interaction interfaces.

UNIT- V

Introduction to Molecular Graphics, *In silico* study of biological structures. Structural genomics- concepts and significance, Structural databases, Protein Quaternary Structure and Cooperativity, Metalloenzymes – Structure & Mechanism, Carbohydrate Binding Proteins: Structure and Function.

Prescribed Text Books:

1. Introduction to Protein Structure by Carl-Ivar Branden, John Tooze
2. Proteins: Structures and molecular properties. Freeman, New York. Second edition by Creighton, T. E.
3. Introduction to Protein Architecture Arthur M. Lesk (2001) Oxford University Press

Additional Reading:

1. Voet & Voet. (2011). Biochemistry, (4th edition), Wiley
2. Nelson & Cox, Lehninger. (2008). Principles of Biochemistry 4th edition, W. H. Freeman Publications.
3. Foundations of Structural Biology by Leonard J. Banaszak

DPHBT-103
REVIEW OF LITERATURE

Credit=4
Max Marks: 100
Sessional: 30
End Semester Exam: 70

In addition to the above two Papers, every student shall be required to submit a review of literature based on a theme/topic of his/her choice. This course may have a component on reviewing of published research work in the relevant field/ a publishable review articles.

DPHBT-104

PREPARATION AND PRESENTATION OF SYNOPSIS BEFORE DRC FOR EVALUATION

Credit=4
Max Marks: 100
Sessional: 30
End Semester Exam: 70