COURSES OF STUDIES

FOR Ph.D PROGRAM

Of Biotechnology

(Effective from January 2023-24)

GANGADHAR MEHER UNIVERSITY, SAMBALPUR, ODISHA

SEMESTER SYSTEM OF Ph.D.

Sl No.	Paper	Code	Credit	(Marks) Mid Term + Term End
1	Recent Trends in Biotechnology	BT-711	4	100 (20+80)
2	Research Methodology - I	BT-712	4	100 (20+80)
3	Research Methodology - II	BT-713	4	100 (20+80)
4	Dissertation or Review writing/presentation /viva-voce	BT-714	8	150+25+25=200
5			20	500

Structure of the Color indicates

Red: Employability **Green: Entrepreneurship** **Blue: Skill Development**

SEMESTER - I

BT-711: Recent Trends in Biotechnology

Unit 1: Biochemistry and metabolism

Classification, factors affecting rate of enzyme action- pH, temperature, concentration, oxidation, Coenzymes. Kinetics of single substrate reactions, MM equation and its modifications, LB plots and their significance, significance of Km and V max. Enzyme inhibition- competitive, non-competitive, uncompetitive and allosteric. Specificity and mechanism of enzyme action.
Structure and functional group properties; Peptides and covalent structure of proteins; Elucidation of primary and higher order structures; Evolution of protein structure; Structurefunction, relationships in model proteins like ribonuclease A, myoglobin, hemoglobin, chymotrypsin.
Bases, nucleosides, nucleotides, physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic methods, non – enzymatic transformation of nucleotides and nucleic acids, methylation, Sequencing, chemical synthesis of DNA. Three-dimensional structure of DNA. Different forms of DNA – circular DNA and Supercoiling.

Unit 2: Genetic engineering& Plant Biotechnology

Prokaryotic and Eukaryotic Transcription and post transcriptional modifications. Protein synthesis

and translational control. Control of gene expression in prokaryotes. Nucleic Acid Sequencing. Restriction enzymes, ligases, s1 nuclease, terminal deoxynucleotides, transferases, Poly A polymerases, Reverse Transcriptase, Alkaline phosphatase. Gene Cloning Vectors: Plasmids, phagemids, cosmids, Artificial chromosomes. cDNA Synthesis and cDNA library preparations. Cloning mRNA enrichment, reverse transcription, DNA primers, Linkers, adaptors, Library construction and screening. Genomic libraries (complete sequencing projects). Cloning interacting genes- Two-and three hybrid systems, cloning differentially expressed genes. Basis of tumor formation, Mechanism of DNA transfer, Features of Ti and Ri plasmids, role of virulence genes, use of Ti and Ri as vectors, binary vectors, markers, use of reporter genes, 35S and other promoters, use of scaffold attachment regions, multiple gene transfers, particle bombardment, electroporation, microinjection

Unit 3: Bioinformatics

Concepts of molecular modeling, physical and computer models, different representations of computer models, Generation of 3D coordinates–using X-ray crystallography. Concepts of Force Fields, Quantum and Molecular mechanical force fields Energy-Minimizing Procedure, Ab initio Methods, Semi-empirical Molecular Orbital Methods.
Steps involved in Homology Modeling. Fold Recognition and ab-initio methods, Derivation and significance of Ramachandran Plot, Root Mean Square Deviation (RMSD), Energy Plot based on Potential of mean force, Packaging Quality.
Concepts in 3D structure comparison, purpose of structure comparison, Algorithms for structure comparison (FSSP, VAST & DALI), Identifying Putative Drug Targets and Potential Drug Leads: Starting Points for Virtual Screening and Docking Receptor Flexibility for Large-Scale In-silico Ligand Screens: Chances and Challenges, Molecular Docking**.**

Unit 4: Advanced Microbial Biotechnology

Tools and techniques of microbial diversity, metagenomics.
A brief outline of processes for the production of some commercially important Organic acids (e.g., Citric acid, Lactic acid); Amino acids (Glutamic Acid, and Phenylalanine); and Alcohols (Ethanol, 2,3-butanediol) secondary metabolites: Antibiotics-beta-lactams (Penicillin), aminoglycosides (Streptomycin)

Fermentation Microbial Growth and Death Kinetics; Media for Industrial Fermentation; media optimization; Air and Media Sterilization; Types of fermentation processes - Analysis of batch, Fed-batch and continuous bioreactions, bioreactors, specialized bioreactors (pulsed, fluidized, photobioreactors etc. Concept of SSF, downstream processing, product recovery.

Primary and Secondary screening. Strain improvement by Physical, Chemical and Molecular techniques. Emerging techniques (genome shuffling etc), screening techniques.

Recommended Books

1. A.L. Lehninger, Principles of Biochemistry, 4th edition, W.H Freeman and Company,
2. L.Stryer, Biochemistry, 5th Edition
3. V.Voet and J.G.Voet, Biochemistry, 3rd edition, John Wiley, New York, 2004.

4. “Molecular Biology of the gene” by Waston et al 4th ed.
5. “Genes IX” by Benjamin Lewin.
6. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
7. DNA Cloning: a Practical Approach, .M. Glover and B.D. Hames, IRL Press, Oxford, 1995.
8. Molecular modeling basic principles and applications-Hans-Dieter Holtje and Folkers, Wiley 2003.
9. Molecular modeling of Proteins-edited by Andreas Kukol, Humana Press, Apr 2008 3
10. Introduction to Protein Architecture, Arthur M. Lesk,, Oxford University Press, 2001
11. Molecular Biotechnology: Principles and Application of Recombinant DNA3rd edition, B.R. Glick & J.A. Pasternak, 2005.
12. Microbial Biotechnology, Glazer AN, Nikaido H, WH Freeman and Company, (1995).
13. General Microbiology, Stainer RY, Ingraham JL, Wheelis ML. & Painter PR. The Macmillan Press Ltd., (2000).
14. Microbiology-Principles and exploration, Black JG, Prentice Hall, (1999).
15. Microbial Biotechnology, Glazer AN, Nikaido H, WH Freeman and Company, (1995).

BT-712: Research Methodology I

Unit 1: Scope of Researchand Ethics

Introduction and Scope, Research problem: Identification, Selection, Formulation of research objectives
Research design: Components, Types and Importance Research
ethics, Institutional ethics committee Plagiarism - Pitfall

Unit 2: Technical Writing

Types of technical documents: Full length research paper, Short/Brief communications, Letters to editor, Book chapter, Review, Conference report, Project proposalComponents of a full length research paper: Title/Topic statement, Abstract/key words, Aims and objectives, Hypothesis building, Rationale of the paper, Work plan, Materials and methodology, Results and discussion, Key issues and arguments, Acknowledgement, Conflict of interest statement, bibliography, Technical Resumes & Cover LettersComponents of a research proposal: Project summary, Key words, Origin of the proposal,Major Objectives, Methodology, Instrument facility available in the PI’s department, Overview of status of Research and Development in the subject, Importance of the proposed project in the context of current status, Bibliography

Unit 3: Scientometrics

How to cite and how to do referencing
Literature search technique: using SCOPUS, Google Scholar, PUBMED, Web of Science, Indian Citation Index, and RG
Styles of referencing: APA, MLA, Oxford, Harvard, Chicago
Annotated bibliography
Tools for citing and referencing: Grammarly, Endnote etc.

Unit IV: Presentation andCommunicationskills
Tables, Figures and Pictures using Excel PowerPoint slide preparation ofPosters
Electronic submission of manuscripts
Communication skills, oral and poster

BT-713: Research Methodology II

Unit I: IPR andCyberLaw

Patents
Patent laws, process of patenting a research finding Intellectual property (IP), Intellectual property right (IPR) Copyright, Trademarks, GI
Cyber laws COPE

Unit II: QuantitativeDataAnalysis
Types of data, Data collection - Methods and Tools
Hypothesis testing
Normal and Binomial distributions and their property Tests of significance: Student *t*-test, *F*-test, *Chi-square* test Correlation andRegression, ANOVA – One-way and Two-way, Multiple-range test

Unit III: ComputerFundamentals
Introduction to MS-Office software: MS-Word (Track change) MS-Excel
MS-Power Point MS-Access
Features for Statistical data analysis using computers and software, Microsoft Excel Data

Analysis ToolPak, SPSS

Unit IV: Advanced Tools &TechniquesinBiotechnology

Microscopic techniques – Compound Microscopy, Fluorescence and electron microscope

UV and visible spectroscopy

Principle, protocol and application of Chromatography – GLC & HPLC

Electrophoresis and its application.

PCR, Real time PCR

DNA microarray, DNA sequencing

Recommended Books

1. Mastering Internets - Coleman P and DysonP
2. How the Internet Works - GrallaP
3. Inside Microsoft Office Professional - Cassel P *etal.*
4. Microsoft Office 2003 All in One, Microsoft Office 2010 In Depth - HabrakenJ
5. Microsoft 2007: Introductory Concepts and Techniques - Shelly GB, Vermaat ME, CashmanTJ
6. Statistical Methods - Snedecor GW & Cochran WG
7. Computers: Concepts & Uses - SumnerM
8. How Computers Work - WhiteR
9. Cyber Law Simplified - SoodV
10. Cyber Law - Kumar AnupaP
11. Plagiarism: Why it happens, How to prevent it? - GilmoreB
12. Perspectives on Plagiarism and Intellectual Property in a Post-Modern World- Buranen Land RoyAM
13. Biostatistical Analysis - ZarJH
14. Research Methodology – RPanneerselvam
15. Research Methodology: Methods & techniques, 2008 – CRKothari
16. Analytical chemistry – AIVogel
17. Instrumental methods of analysis – BKSharma
18. Instrumentation - Chatwal andChatwal
19. Instrumentation - Upadhyaya andUpadhya