

Pre-Ph.D. COURSE CURRICULUM

BIOTECHNOLOGY (2021 - 22)



**MSCB UNIVRSITY, SRIRAM CHANDRA VIHAR,
TAKATPUR, BARIPADA – 757003
ODISHA**

SYLLABUS FOR PRE-PhD.in BIOTECHNOLOGY COURSE

Paper	Subjects	Credits	Marks
BT-801	Current and Applied Aspects of Biotechnology	05	50
BT-802	Research Methodologies	05	50
BT-803	Review writing and seminars presentation (To be evaluated by external examiner)	10	100
Total		20	200

BT 801: CURRENT AND APPLIED ASPECTS OF BIOTECHNOLOGY

BASICS OF GENETIC ENGINEERING
BASIC MICROBIOLOGY AND IMMUNOLOGY
PLANT AND ANIMAL BIOTECHNOLOGY
INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY
ETHICS AND BIOSAFETY

BT 802: RESEARCH METHODOLOGIES

DEFINITION AND SCOPE OF RESEARCH
RESEARCH DESIGN
RESOURCES AND APPROACHES IN RESEARCH
SAMPLING AND COLLECTION PROCESSING, ANALYSIS AND INTERPRETATION OF DATA IN RESEARCH
REPORT WRITING/THESIS

BT 803: REVIEW WRITING AND SEMINARS

PROGRAMME OUTCOMES (POs)

- PO 1: The programme has been aligned with the National Biotechnology Development Strategy (2015-2020) aligned by DBT, Govt. of India, aiming at development of human resources in the field of biotechnology and promote human capital for education, advanced strategic research and entrepreneurship.
- PO 2: The students in this program will acquire knowledge, skills and expertise in conducting cutting edge research, for higher studies/R&D activity.
- PO 3: Acquire conceptual knowledge and comprehensive understanding of the fundamental principles in respective discipline.
- PO 4: Apply knowledge, understand and critically evaluate the concepts and scientific developments to take up any challenge towards teaching and research, and cater to the industrial need.
- PO 5: Visualize and gain practical knowledge on multidisciplinary aspects related to current research in the fields of biotechnology.
- PO 6: Acquire various skills so as to get motivated to innovate, design methods and techniques to carry out research, in the field of plant animal on microbiology.
- PO 7: Aims to train students in Biotechnology wherein through engineering use of principles to develop technologies, devices and systems that require substantive expertise in Biology, Agriculture, Pharmaceutical, Industrial, as well as Clinical Research components
- PO 8: Promoting academic & research collaboration with institutes & industries at national & international level.
- PO 9: Envisioning value based education for strengthening their professional carrier.
- PO10: Students will develop research skills to make them competent for various opportunities in India & abroad.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- PSO 1: Will acquire adequate knowledge to compete national level examinations like NET, GATE, IOCL, DRDO, etc.
- PSO2: Will have a strong foundation in interdisciplinary sciences such as computer sciences and biological sciences, to develop accelerated and precise technologies for industrial problems, and prepare them for productive careers in fields of biotechnology, pharmaceutical, bioinformatics, research, and healthcare industries
- PSO 3: Will be able to demonstrate and apply their knowledge of cell biology, biochemistry, microbiology and molecular biology to solve the problems related to the field of biotechnology.
- PSO4: Will be able to gain fundamental knowledge in animal and plant biotechnology and their applications. Students will be equipped to understand three fundamental aspects in biological phenomenon: a) what to seek; b) how to seek; c) why to seek?
- PSO5: Will be able to (a) To elaborate concepts of biochemistry with easy to run experiments; (b) To familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in biochemistry.
- PSO6: Will be able to understand various facets of molecular procedures and basics of genomics, proteomics that could be employed in early diagnosis and prognosis of human diseases.
- PSO7: Will be able to gain hands on experience in gene cloning, protein expression and purification. This experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.
- PSO 8: Will evolve with recent innovations and scientific updates in the technological era in accordance with best scientific temperament, professional and research ethics throughout life.
- PSO 9: Will have potential to test hypothesis, design of experiments, and interpret data analysis to solve the scientific problems in the field of
- PSO10: Will help to apply computational modeling, proteins dry design & simulation to test the module and solve scientific problems.

BT-801

CURRENT AND APPLIED ASPECTS OF BIOTECHNOLOGY

Full Marks-50
Credit-5

OBJECTIVES

(1) To learn the recent developments in Biotechnology, (2) To study the most applied areas in Biotechnology, (3) To revive and update knowledge of students on various areas of Biotechnology, (4) To learn the biosafety measures and ethical aspects in Biological research, (5) To enhance technical skills in biotechnology and train the students for PhD programme in Biotechnology

UNIT I: BASICS AND ADVANCES OF GENETIC ENGINEERING

Methods of gene cloning, Creation and maintenance of transgenic and knockout animals and plants, recombinant gene expression and protein purification techniques, Induction of mutation in genes, PCR ,REAL TIME PCR and microarray methods, DNA sequencing methods (Sanger's chain termination method, and automated DNA sequencing); Next generation sequencing (NGS). Assays of gene expression (reporter assays), Gene therapy and targeted drug delivery. CRISPR/Cas9 and Targeted Genome Editing, Transient Gene silencing and knockout approaches (siRNA, shRNA, microRNA).Methods of protein-interaction (yeast two hybrid and three hybrid system). Electrophoretic mobility shift assays, DNA footprinting by DNase I and dimethyl sulphate, ChIP- chips. Co-immunoprecipitations and pull-downs. Use of fluorescent tags for protein localization stud, Phage display. 3D BIO PRINTING,Biomarkers, lab on a CD, microfluidic for understanding biology , organ on a chip ,Bioimimicry , nano biomimicry,nano artificial cell

UNIT II : BASIC MICROBIOLOGY AND IMMUNOLOGY

Evolution of microbes, Important microbes, Transformation, Transduction and Conjugation in bacteria, Growth and culture of bacteria, Microbial growth and kinetics (synchronous culture, continuous and batch and fed-batch cultures, chemostat and turbidostat); Methods for identifying microbes (polyphasic approach) Microbial fermentation: production of alcohol by yeast, production of antibiotics by microbes, Bio-film, Organisation and structure of lymphoid organs of the immune system. Innate and acquired immunity. Cells and molecules involved in innate and aquaired immunity, Antigens and Antibodies: antigen, antigenicity and immunogens, Haptens and Superantigens. Structure and functions of Antibody; Antigen and Antibody interaction, Complement System, Major Histocompatibility Complex, Hypersensitivity. Flow cytometry ,hypersensitivity ,autoimmunity , transplantation grafts vs host reaction,NAPPA application to study immunological response, human pathology atlas

UNIT III: PLANT AND ANIMAL BIOTECHNOLOGY

Plant tissue culture: Basic techniques,culture media,callus culture,Somatic embryogenesis,Haploid culture,Proplast isolation,culture and fusion. Recombinant DNA

technology of plants: Indirect Gene transfer Methods: *Agrobacterium* and T_i plasmid, Direct gene transfer methods: Physical, Chemical and electrical methods. Totipotency of plant cells, Organogenesis, Somatic embryogenesis, artificial seedproduction, Micropropagation, Somaclonal variation, Androgenesis and its applications ingenetics and plant breeding.

Culture of animal cells: Primary culture: Isolation of mouse and chick embryos, human biopsies, methods for primary culture, nomenclature of cell lines, sub culture and propagation and routine maintenance. Cell characterization: cytotoxicity assays, cell quantitation, cell culture contamination: monitoring and eradication, cryopreservation, Stem cell culture and its applications. Cell and Tissue engineering, Cloning of Animals: Methods and uses. Introduction, nuclear transfer for cloning, cloning from embryonic cells, adult and fetal cells, Handling and maintenance of animals, Ventilated cages, Different routes of injections and collection of various biological components, Formulation of feed and design of experiment

UNIT IV: INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

Scope of Environmental biotechnology, Environmental pollution: Types (Air, Water and Soil pollution, radioactive pollution and noise pollution), Ecosystem management: Renewable resources; solid waste management, Sustainable development through Biotechnology: Biofertilizers, Vermiculture, Organic farming, Bio-mineralization, Biofuels (Bioethanol and biohydrogen), Bioremediation of contaminated soil and water, Phytoremediation of heavy metals. Industrially important microorganisms, growth conditions (media and parameters) and their optimization, growth curve of microbes, Bio-reactors: design of bioreactors, Fed-batch and continuous culture, Production of industrially important chemicals: Alcohol (ethanol), Acids (citric, gluconic), Solvents (acetone, butanol), Antibiotics (penicillin, tetracycline), Amino acids (lysine, glutamic acid), Single cell protein production. Biopolymer production, biodegradable plastic.

UNIT V: ETHICS AND BIOSAFETY

Intellectual property Rights: Types of IP (Trademarks, Copyright, design, Traditional knowledge, Geographical indications,). Basics of patents (Types of patent application and Specifications), concept of Prior Art and patent filing procedures. Guidelines for Biosafety and Bioethics; Institutional Biosafety Committee – Handling of GMO, Institutional Human and Animal Ethics Committee - compliance, concerns and approval; Safety practices and disposal of Bio-waste in the laboratory; Radioactivity and safety precautions; Handling and disposal of flammable and hazardous chemicals. Agreements and Treaties, Biosafety, Possible dangers of GMO, Protection of GMOs, Biosafety guidelines, Legislations of IPR in India, Patenting of biotechnological products.

COURSE OUTCOMES

After completion of the course, students will develop skills

- ✓ To understand the basic tools of recombinant DNA technology, restriction enzymes, vectors, DNA manipulating enzymes , Expression Systems and Molecular Markers, and methods of genome sequencing
- ✓ To learn the important and diversified groups of microorganism in nature and molecular techniques for characterization of microorganisms
- ✓ To have adequate knowledge on the immune system including organs, cells and receptors, molecular basis of antigen recognition, cellular and molecular basis of immune responsiveness
- ✓ To have in-depth knowledge of plant biotechnology starting from plant tissue culture to crop-improvement by basic and applied aspects of recombinant DNA technology.
- ✓ To develop skill on engineering the animals to improve sustainability, productivity and suitability for pharmaceutical, agricultural and industrial applications.
- ✓ To provide fundamental insights to exploit microbes for manufacturing of products which have huge industrial significance
- ✓ To employ and ensure the quality (good or bad) of the environmental samples for the betterment of society
- ✓ To understand basic concepts of ethics and safety that are essential for different disciplines of science and to interpret basics of biosafety and bioethics and its impact on all the biological sciences and the quality of human life

REFERENCES

- 1) Kuby Immunology, Judy Owen , Jenni Punt , Sharon Stranford., 7th edition (2012), Freeman and Co., NY
- 2) Cellular and Molecular Immunology, Abul Abbas, Andrew H. Lichtman, Shiv Pillai 9 th Edition 2017 Elsevier.
- 3) Janeway's Immunobiology, Kenneth M. Murphy, Casey Weaver 8th Edition 2011 W. W. Norton & Company
- 4) Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth Roittand Mosby, USA. Roitt's Essential Immunology (2011), 12th edition, Wiley and Black Well
- 5) Gene Cloning and DNA analysis: an introduction, Brown, T. A. Blackwell Science, 6th edition 2010
- 6) Genomes, Brown, T. A. Bios, 3rd edition, 2006
- 7) Gene Cloning and Manipulation, Howe, C. J., CUP, 2nd edition, 2007
- 8) Genes XIII, Lewin, B. Pearson Higher Education, 2003
- 9) Molecular Biology of the Gene, Watson, J. D. et al. 7th edition 2013
- 10) The Cell Cycle, Morgan, David O. OUP 2006
- 11) Immunotechnology: Principles, Concepts and Applications by Anthony Moran
- 12) Culture of Cells for Tissue Engineering by G. Vunjak-Novakovic, & R. Ian Freshney
- 13) DNA Transfer to Cultured Cells by Katya Ravid & R. Ian Freshney:
- 14) Animal Cell and Tissue Culture by Mathur Shivangi
- 15) Animal Cell Culture and Technology by Michael Butler
- 16) Culture of Animal Cells: A Manual of Basic Technique by R. Ian Freshney

BT-802

RESEARCH METHODOLOGIES

Full Marks-50
Credit-5

OBJECTIVES

(1) To learn fundamental methods of sampling, data collection, analysis and interpretation of results, (2) To learn basic statistical methods applied in data analysis, (3) To learn about various resources and their application in research To write a research proposal for funding

UNIT I

DEFINITION AND SCOPE OF RESEARCH

Definition of Research, Objectives and Significance of Research, Motivation in Research, Criteria of Good Research, Types of research, Various Steps in Research process, Research Methods versus Methodology,

UNIT II

RESEARCH DESIGN:

What is a Research Problem and Selection of Topic, Area of Research, Necessity of Defining the Problem, Hypothesis, Selecting the Problem Rationale for the Project, Technique Involved in Defining a Problem, Design of Experiments: Aims, Objectives, and strategies of research,

UNIT III

RESOURCES AND APPROACHES IN RESEARCH:

Resources in research: Books, Journals, International Abstract, International Conference Proceedings, etc. Audio-visual resources, Interviewing, Field Studies, Web resources

Approaches: Developing a research question, Choice of a problem Literature review, Surveying, synthesizing, critical analysis, Tools and techniques to execute experiments; Means to validate and analyze data; Use of statistical tools for analyzing the significance and interpretation of the data reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research, Work Plan, Chapter Division.

UNIT IV

SAMPLING AND COLLECTION PROCESSING, ANALYSIS AND INTERPRETATION OF DATA IN RESEARCH:

Sampling Fundamentals: Fundamental Definitions, Important Sampling Distributions, Central Limit Theorem, Sampling Theory, Sandler's A-test, Concept of Standard Error

Methods of Data collection: Methods of data collection, scope of Quantitative and Qualitative Data collection methods, Observation Method, Types of data (Primary and secondary data)

Processing, Analysis and Interpretation of data: Processing Operations, Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Problems in Processing, Statistics in Research, Elements/Types of Analysis

Analysis of Data: Methods of recording observations and documentation. Statistical measures and their significance: correlation and regression, Multiple Regression, Error Analysis, Testing of Hypotheses: Parametric (t, z and F) Chi Square, ANOVA

UNIT V

REPORT WRITING/THESIS:

Structure and Components of Research Report, Significance of Report Writing, Pre writing considerations, Different Steps in Writing Report, Layout of the Research Report Precautions for Writing Research Reports, Thesis writing, Format of report writing, Format of publications in research journals. Use of electronic tools for bibliographic formatting and checking Plagiarism; Oral presentation skills

COURSE OUTCOMES

- After completion of the pre-PhD course work the students will be able to
- Understand the basic concepts of research methodologies
- Identify the overall process of designing a research study from its inception to its report.
- Identify a research proposal and the appropriate methods to approach it scientifically
- Select and define appropriate research problem and parameters
- Prepare a proposed thesis problem project proposal (to undertake a project)
- Write a research report and thesis

REFERENCES

- 1) Bioethics and Biosafety, by Sateesh, M.K., IK International Publishers (India)
- 2) Patent law and Entrepreneurship by Singh I. and Kaur, B, Kalyani Publishers (India).
- 3) Law of Patents, by Srinivasan, K. and Awasthi, H. K. Jain Book Agency (India)
- 4) Patent Law by Narayan, P, Eastern Law House ().

- 5) Anthology of Biosafety (Vols. 1-4), by Jonathan, Y.R., American Biological Safety Association.
- 6) Handbook on intellectual property rights in India. by Adukia, R.S. (India).

BT-803

REVIEW WRITING AND SEMINARS

Full Marks-100
Credit-10

OBJECTIVE

(1) To develop skills on literature search, analyze published data and write a review and (2) To present a finding scientifically, (3) To enhance the presentation skill of the students

COURSE OUTCOME

After completion of this course, the pre-PhD scholars will be able to

1. Develop the skills to search literature, analyze them and write a review on a scientific idea
2. Incubate an idea and present it scientifically in context of the current knowledge on it
3. Present a research topic and review of literature
4. Develop expertise on a specific research area
5. Incubate a novel idea to develop a novel proposal