

**M. PHIL.COURSE CURRICULUM**  
**(ONE YEAR COURSE: SEMESTER PATTERN)**

**BIOTECHNOLOGY**  
**(2021-22)**



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

**SYLLABUS FOR M. PHIL (BIOTECHNOLOGY) COURSE**

**SEMESTER I**

| <b>PAPER CODE</b> | <b>SUBJECTS</b>                                | <b>CREDITS</b>         | <b>MARKS</b>               |
|-------------------|--|------------------------|----------------------------|
| <b>BT-601</b>     | <b>ADVANCES IN BIOTECHNOLOGY</b>               | <b>05</b>              | <b>50</b>                  |
| <b>BT-603</b>     | <b>RESEARCH METHODOLOGIES</b>                  | <b>05</b>              | <b>50</b>                  |
| <b>BT-605</b>     | <b>SEMINARS,REVIEW WRITING,<br/>PRACTICALS</b> | <b>10<br/>(2 +3+5)</b> | <b>100<br/>(20 +30+50)</b> |
| <b>TOTAL</b>      |  | <b>20</b>              | <b>200</b>                 |

**SEMESTER II**

| <b>PAPER CODE</b> | <b>SUBJECTS</b>     | <b>CREDITS</b> | <b>MARKS</b> |
|-------------------|---------------------|----------------|--------------|
| <b>BT-602</b>     | <b>ELECTIVE I</b>   | <b>05</b>      | <b>50</b>    |
| <b>BT-604</b>     | <b>ELECTIVE II</b>  | <b>05</b>      | <b>50</b>    |
| <b>BT-606</b>     | <b>DISSERTATION</b> | <b>10</b>      | <b>100</b>   |
| <b>TOTAL</b>      |                     | <b>20</b>      | <b>200</b>   |

**ELECTIVE COURSES**

(\* : A candidate shall have to select an elective from A or B from each elective for paper BT-602 and BT-604)

**BT-602:ELECTIVE I:**

**A. PLANT BIOTECHNOLOGY;**

**B. ANIMAL BIOTECHNOLOGY**

**BT-604: ELECTIVE II:**

**A. ENVIRNOMENTAL BIOTECHNOLOGY; B. INDUSTRIAL BIOTECHNOLOGY**

### **\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.

## **SEMESTER I**

### **BT 601 (ADVANCES IN BIOTECHNOLOGY)**

**Full Marks-50**  
**Credits-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 safety measures and ethical aspects in Biological research, (5) To enhance the technical skill of M.Phil. students from Biotechnology to increase their employability in research laboratories and industries

#### **UNIT I: GENETIC ENGINEERING**

Introduction of mutation in genes, PCR and microarray methods, Assays of gene expression (reporter assays), Gene therapy and targeted drug delivery, Methods of protein-interaction (yeast two hybrid and three hybrid system). Principles of molecular genetics-based therapies and treatment with recombinant proteins or genetically engineered vaccines, Technology of classical gene therapy, drug design and targeting, CRISPR-CAS system and its role in genetic medicine

#### **UNIT II: MICROBIOLOGY**

Microbial nutrition: nutritional types of microorganisms: Mechanism of nutrient uptake by bacteria, Microbial Physiology: Transformation, Transduction and Conjugation in bacteria; Microbial Pathogenicity - toxins, mode of action. Important Bacterial and Viral pathogens, Microbial fermentation: production of alcohol by yeast, production of antibiotics by microbes, Biofertilizers, Biopesticides, Biopolymer and Bio-film. Microbial drug resistance

#### **UNIT III: IMMUNOLOGY**

Antigens and Antibodies: antigen, antigenicity and immunogens, Haptens and Superantigens. Structure and functions of Antibody; Antigen and Antibody interaction: Complement fixation, structure and classes of antibodies, genetic basis of antibody diversity. MHC I and II: structure and antigen presentation. T and B lymphocytes activation and role in humoral and cell mediated immunity. Vaccines live and attenuated, killed, multi-subunit and

DNA vaccines. Hypersensitivity, auto immune diseases. ELISA, RIA, Hybridoma Technology. Immunotherapy and it's medicinal implications

#### **UNIT IV: BIOTECHNIQUES**

Recent advances in imaging techniques, Electron (transmission and scanning) microscope, Principle, Instrumentation of UV-Visible, Fluorescence, FTIR, LC-MS and GC-MS spectroscopy. Centrifugation (principle and basic instrumentation), Ultra Centrifuge, Chromatography, Gas and High Performance Liquid Chromatography, Affinity chromatography, Electrophoresis & Immunochemical Techniques: Principles of Electrophoresis, PAGE, (Native and SDS-PAGE) Blotting (Southern, Northern and Western) techniques, ELISA, Radioimmunoassay.

#### **UNIT V: BIOETHICS, BIOSAFTY AND IPR**

Introduction to bioethics: Social and ethical issues in biotechnology. Biosafety guidelines in India, Ethical conflicts in biotechnology, Biosafety in laboratory institution: laboratory associated infection and other hazards, assessment of biological hazards and level of biosafety, Intellectual Ethical issues in human gene therapy and human cloning, property Rights : Types of IP (Trademarks, Copyright, design, Traditional knowledge, Geographical indications), Patenting and fundamental research,. Patenting definition of patent. Product and process patents, Patenting multicellular organisms, Plagiarism of intellectual property

#### **COURSE OUTCOMES**

- ✓ 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 learn the usage of instruments in experiments for future research.
- ✓ To update current knowledge regarding biomedical engineering involving new methods and the instrumentation
- ✓ 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

## **BT 603 (RESEARCH METHODOLOGIES)**

**Full Marks-50**

**Credits-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, (4) To inculcate bio-safety and bio-ethics among students to prepare them for future research activities

### **UNIT I**

#### **SCOPE OF RESEARCH:**

Definition of Research, Objectives and Significance of Research, Motivation in Research, Criteria of Good Research, Research and its types, Research process and steps in it, Various Steps in Research process, Research Methods versus Methodology, Resources in research: Books, Journals, International Abstract, International Conference Proceedings, etc

### **UNIT II**

#### **RESEARCH DESIGN:**

Objectives & strategies of research, Research topic and its selection, 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: Research Aims, Objectives, and strategies of research Purposes, Work Plan, Ethics in research, Writing a research proposal for funding

### **UNIT III**

#### **DATA COLLECTION AND SAMPLING METHODS:**

Types of data collection and classification, designing questionnaires and schedules, Probability sampling, random sampling, systematic sampling, stratified sampling, cluster sampling and multistage sampling. Non-probability sampling: convenience sampling, judgement sampling, quota sampling, Using online data collection methods

### **UNIT IV**

#### **ANALYSIS OF DATA:**

Sampling Methods of Data collection, Processing, Analysis and Interpretation of data, Statistical measures and their significance: Central tendencies, variation, skewness, Kurtosis, time series analysis, correlation and regression, Testing of Hypotheses: Parametric (t-test, z-test and F-test) Chi Square, ANOVA, Multiple Regression, Factor Analysis, Discriminant Analysis, Cluster Analysis, multidimensional scaling, Analysis of enzyme data, sequence analysis and modelling of protein structure, Docking studies

## **UNIT V**

### **THESIS WRITING:**

Structure and Components of Research Report, Pre writing considerations, Thesis writing, Format of report writing, Format of publications in research journals. Plagiarism check and its importance in scientific writing

### **COURSE OUTCOMES**

- ✓ To understand some basic concepts of research and its methodologies
- ✓ To identify the overall process of designing a research study from its inception to its report.
- ✓ To identify appropriate research topics
- ✓ To select and define appropriate research problem and parameters
- ✓ To prepare a proposed thesis problem project proposal (to undertake a project)
- ✓ To organize and conduct research (advanced project) in a more appropriate manner and be familiar with the steps involved in identifying and selecting a good instrument to use for research.
- ✓ To write a research report and thesis

## **BT- 605 (SEMINARS, REVIEW WRITING, PRACTICALS)**

**Full Marks-100**

**Credits-10**

### **OBJECTIVE**

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

1. Isolation and purification of genomic DNA
2. Determination of  $T_m$  value of nucleic acids
3. Blotting techniques
4. Electrophoresis (agarose, native and SDS-PAGE)
5. Detection of enzyme activity (amylase, lipase, protease, DNase and RNase)
6. Effect of pH and temperature on enzyme activity
7. Determination of  $K_m$  and  $V_{max}$  of enzymes
8. Zymographic determination of enzyme activity
9. Blood film preparation and identification of cells/blood cell counting
10. Lymphoid organs and their microscopic organization
11. Immunization and collection of serum
12. Antigen-antibody reaction
13. ELISA
14. Measurement of central tendency, determination of SD, ANOVA
15. Docking analysis



## 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

## SEMESTER II

### BT 602 (ELECTIVE I)

#### (A. PLANT BIOTECHNOLOGY or B. ANIMAL BIOTECHNOLOGY)

Full Marks-50

Credits- 5

## OBJECTIVES

### (A) Plant Biotechnology

(1) To learn about various biotechnological tools and techniques to be applied in the field of crop improvement, plant breeding, micropropagation and tissue culture, (2) To apply the principle of recombinant DNA technology in production of genetically modified improved quality of plants, (3) Enhance the skills of M.Sc. students from Biotechnology with skills of plant tissue culture

### (B) Animal Biotechnology

(1) To develop biotechnological skills on handling and culture of animal cells in the laboratory, (2) To learn the skills on establishment of primary and secondary cell cultures, (3) To develop theoretical knowledge on production of valuable animal products such as monoclonal antibodies, enzymes and proteins

## A. PLANT BIOTECHNOLOGY

Organization of plant genome - Nuclear, chloroplast and mitochondrial genome, callus culture, Somatic embryogenesis, Haploid culture, Proplast isolation, culture and fusion. Recombinant DNA technology of plants: Indirect Gene transfer Methods: *Agrobacterium* and T<sub>i</sub> plasmid, Direct gene transfer – particle bombardment, PEG-mediated, electroporation, microinjection and alternative methods. Molecular characterization of transformants, Transgenic crops for herbicide, pest, biotic and abiotic stress resistance, Terminator gene technology. Antisense and RNAi strategies for metabolic engineering, Development of

drought resistant and saline resistant plants, ethical and social aspects of genetically modified crops

### **(B) ANIMAL BIOTECHNOLOGY**

Culture of animal cells: Different cell culture techniques; Primary culture, sub- culture and propagation and routine maintenance, Development of cell lines; Characterization and maintenance of cell lines; cryopreservation, Cell cloning and selection, Stem cell culture and its applications. Tissue engineering, Cloning of Animals: Application of animal cell culture for *in vitro* testing of drugs; Applications of cell culture technology in production of human and animal vaccines. Transgenic animal models: gene knock-outs, Ethical aspects of animal cloning

## **COURSE OUTCOMES**

### **(A) PLANT BIOTECHNOLOGY**

- ✓ 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 production of artificial seeds, transgenic and disease resistant varieties
- ✓ To have knowledge on the molecular mechanisms of gene transfer methods in plant
- ✓ To understand the methods of bioenergy production from plant materials and terminator technology to restrict the use of transgenic crop production.
- ✓ To have adequate skill to establish tissue culture from the explants of different medicinal and aromatic plants

### **(B) ANIMAL BIOTECHNOLOGY**

- ✓ To comprehend the basic concepts, techniques, procedure, growth and establishment of different types of animal cell cultures
- ✓ To understand cloning and its importance, transgenic animals, their application in industry;.
- ✓ To pursue research related to animal cell/tissue culture at national & international level.
- ✓ To develop skill on engineering the animals to improve sustainability, productivity and suitability for pharmaceutical, agricultural and industrial applications.
- ✓ To acquire practical skill to establish various cell lines from different animals for research

## **BT 604 (ELECTIVE II)**

### **(A. ENVIRONMENTAL BIOTECHNOLOGY OR B. INDUSTRIAL BIOTECHNOLOGY)**

**Full Marks-50  
Credits-5**

#### **OBJECTIVE**

##### **(A) Environmental Biotechnology**

(1) To understand the effect of various environmental pollutants and ecological damages, (2) To apply various biotechnological methods for bioremediation of key environmental pollutants, (3) To explore sustainable, renewable and green energy resources and (4) To apply microbial, plant and green technologies for conservation of ecosystem

##### **(B) Industrial Biotechnology**

To learn skills of industrial scale bacterial growth using bioreactors, (2) To develop various skills on downstream processing used in product development and purification, (3) To learn the basic skills of producing alcohols, acids, antibiotics etc., (4) To develop skills on industrial biotechnology for value added products such as mushroom culture and milk products, (5) To enhance employability of M.Sc. biotechnology students in biotech industries

#### **A. ENVIRONMENTAL BIOTECHNOLOGY**

Scope of environmental biotechnology, Treatment of industrial effluents- solid waste management- Management of nuclear waste, Sustainable development through Biotechnology: Biofertilizers, Vermiculture, Organic farming, Bio-mineralization, Biofuels (Bioethanol and biohydrogen), Bioremediation- *in situ* and *ex situ* bioremediation, Phytoremediation of heavy metals Biodegradation of xenobiotics. Biomonitoring, Biodiversity conservation, conservation of ecosystem, pesticide pollution and its remediation using bacteria, Heavy metal (Hg, Pb and As) pollutants and their health hazards. Bio-plastics and biopolymers

#### **B. INDUSTRIAL BIOTECHNOLOGY**

Microorganisms of industrial importance, growth conditions of microbes and their optimization, Bio-reactors: design of bioreactors, Fed-batch and continuous culture, Downstream processing, Solid state fermentation, production, harvest, recovery, and uses - enzymes, antibiotics, vitamins, organic acids (acetic acid, lactic acid, citric acid), alcohol (ethanol), organic solvents (acetone-butanol), amino acids, microbial supplements (Lactic acid bacteria) as biopolymer, biofertilizers, Single cell protein production, Industrial production of enzymes and antibodies

## **COURSE OUTCOMES**

### **(A) ENVIRONMENTAL BIOTECHNOLOGY**

- ✓ To provide knowledge of current perspectives in ecological issues to address environmental problems.
- ✓ To address certain difficult environmental problems such as gene-environment interaction, detection of pollutants and elimination and treatment of toxic wastes.
- ✓ To apply biotechnology in environmental management, concepts and strategies of Metagenomics and Biofuel production with an emphasis to cleaner and sustainable environment.
- ✓ To employ and ensure the quality (good or bad) of the environmental samples for the betterment of society.
- ✓ To understand the relevance of basic analysis performed in environmental quality assessment.

### **(B) INDUSTRIAL BIOTECHNOLOGY**

- ✓ To provide fundamental insights to exploit microbes for manufacturing of products which have huge industrial significance.
- ✓ To isolate, screen and identify various microbes of industrial importance
- ✓ To work on lab bench fermenter, UP stream and Downstream processing methods
- ✓ To acquire the skill involved in the production of bioproducts and methods to improve modern biotechnology and can apply basic biotechnological principles, methods and models to solve industrial tasks.
- ✓ To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology and design and deliver useful modern biotechnology products to the Society.

## **.BT 606**

## **DISSERTATION**

**Full Marks-100**

**Credits-10**

### **OBJECTIVES**

(1) To train the students with basic laboratory techniques, (2) To enhance the thought-inducing ability among the students for development of scientific ideas, their execution and interpretation of results, (3) Data analysis methods and presentation skills of research data to enhance the research skills among the young students, (4) To prepare the young minds for building a career in research, industry or start-up initiatives

### **COURSE OUTCOMES:**

- To train students organize ideas, material and objectives for their dissertation and to begin development of communication skills.

## M. Phil course Work

- To facilitate the students to present their topic of research and explain its importance.
- To formulate a scientific question and present scientific approach to solve the problem.
- To interpret, discuss and communicate scientific results in written form.
- To gain experience in writing a scientific proposal and learn how to present and explain their research findings to the audience effectively.