# SIKSHA 'O'ANUSANDHAN
## (DEEMED TO BE UNIVERSITY)

## COURSES OF STUDIES

FOR

## M.Sc. BIOTECHNOLOGY

SEMESTER SYSTEM

**KHANDAGIRI SQUARE, PO- KHANDAGIRI**
**BHUBANESWAR – 751030**
**SIKSHA 'O'ANUSANDHAN DEEMED TO BE UNIVERSITY**
**M.Sc. BIOTECHNOLOGY**
**(With Effect from 2019-2020 Admission Batch)**

# FACULTY OF PHARMACEUTICAL SCIENCES SPS, SIKSHA 'O' ANUSANDHAN
**(DEEMED TO BE UNIVERSITY)**

## Program Educational Objectives (PEOs) of M.Sc. Biotechnology Programme

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|---|
| 1: The students will exhibit ability to pursue respectable careers in the industry, agriculture, and applied research where biological system is increasingly employed. |
| 2: Graduates will address the increasing need for skilled scientific manpower, contributing to application, advancement, and impartment of knowledge in interdisciplinary areas of biotechnology. |
| 3: Students will exhibit excellent professional skills, communication skills and ethical attributes as an effective team member. in a competitive global environment. |
| 4: Graduates will demonstrate right mixes of innovative ability, equipped with entrepreneurship skills, contributing to self and national development. |
| 5.The successful candidates will be cognizant and responsive to the societal needs and will possess the initiative and critical acumen required to continuously improve their knowledge through life long learning. |
| 6. To learn from every environment and become responsible, ethical and productive citizens. |

# Program Outcomes (POs) of M.Sc. Biotechnology Programme

| | |
|---|---|
| 1. **Biotechnology Knowledge and Problem analysis** | Ability to identify and justify medicinal values of natural resources and to analyze the disease process and develop ways of intervention using biotechnological approach. Able to address safety, efficacy, toxicity and environmental issues of drug candidates and drug products. |
| 2. **The Pharmacist and Society** | Ability to develop suitable drug product for better patient compliance. |
| 3. **Research and development** | Equips capacity to build a career in academics, biotech-based industries as scientists or technocrats in the division of production, research and development. |
| **4. Modern Tools** | Demonstrate the ideas and research approach for their higher studies in molecular biotechnology and develop their scientific endeavor. |
| 5. **Communication** | Develops expertise to analyse the justifications behind various regulatory/legal bodies governing the research and development of molecular biology associated research and development industry. |
| **6. Lifelong Learning** | Exhibit thorough application oriented knowledge to students in various emerging areas of molecular biology, so as to meet the global challenges of industry and academia. |
| **7. Environment and sustainability** | Aptitude to designs aids in developing solutions for complex problems giving due importance to the public health and safety, and the cultural, societal, and environmental considerations. |

# Progaramme Specific Outcomes (PSO)

| | |
|---|---|
| **1. Expertise in the field of Biotechnology** | Understand basic and advanced concepts and techniques of Biotechnology. Gain an appreciation and knowledge of how to deal with ethical issues relating to Biotechnology**.** |
| **2. Development of product oriented methodologies** | It will enable the students to explore the possibilities of variation in cellular and molecular organizations of cells and tissues for result interpretations. This will make students to know the method of somatic embryogenesis, protoplast culture and germplasm conservation. This will make students know about the production of plant secondary metabolites through tissue culture method. |
| **3. Invention and Entrepreneurship** | Molecular cloning and characterization of unknown genes; Gene Knock-out technologies; Gene therapy and its applications; Transposons and T-DNA tagging; Gene regulation and silencing which will equip the students fit for biotechnology research and industry. |
| **4. Pharmaceutical research and development** | Understanding of the concept of protein folding and different disease associated with misfolding of protein will be helpful in employability of students in different pharmaceutical companies and research and development organizations . Experience on microbiological technique will be helpful the student to secure job in clinical, food and pharmaceutical industries. They can build career in research and development organization to serve the society. |

## Mapping of Program Educational Objectives (PEOs) Vs. Program Outcomes (POs)

| | $PO_A$ | $PO_B$ | $PO_C$ | $PO_D$ | $PO_E$ | $PO_F$ | $PO_G$ | $PO_H$ | $PO_I$ | $PO_J$ | $PO_K$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **PEO1** | √ | √ | √ | √ | √ | √ | √ | | | | |
| **PEO2** | | | | | | | √ | | √ | | √ |
| **PEO3** | | | | | | | √ | √ | √ | √ | √ |
| **PEO4** | √ | √ | √ | √ | √ | √ | √ | √ | | | |
| **PEO5** | | | √ | | | √ | √ | √ | √ | √ | |
| **PO6** | | | | | | | | √ | √ | √ | √ |

## SEMESTER SYSTEM

The course comprises four semesters. One Semester = 15 weeks. Theory 1 Credit = 1hr/week. Practical 2 credit = 3hrs/week. Theory paper carries 100 marks and practical paper carries 100 marks each (Students seminar 100 marks and Project work of 100 marks will be evaluated in IV Semester). Total Credit is 90 (Ninety).

## COURSE STRUCTURE

**Semester –I**

| | |
|---|---|
| BT 1.1-Cell Biology and Genetics | (40 Lectures / 4 Credits) |
| BT 1.2-Biomolecules & Enzymology | (40 Lectures / 4 Credits) |
| BT 1.3-Molecular Biology | (40 Lectures / 4 Credits) |
| BT 1.4-Bioinstrumentation | (40 Lectures / 4 Credits) |
| BT 1.5-Practicals | (50 Classes/ 8Credits) |

**Semester –II**

| | |
|---|---|
| BT 2.1-Plant and Animal Biotechnology | (40 Lectures / 4 Credits) |
| BT 2.2-Genomics and Proteomics | (40 Lectures / 4 Credits) |
| BT 2.3-Microbial Technology | (40 Lectures / 4 Credits) |
| BT 2.4-Environmental Biotechnology | (40 Lectures / 4 Credits) |
| BT 2.5-Practicals | (50 Classes / 8 Credits) |

**Semester-III**

| | |
|---|---|
| BT 3.1-Genetic Engineering | (40 Lectures / 4 Credits) |
| BT 3.2-Industrial Microbiology | (40 Lectures / 4 Credits) |
| BT 3.3-Pharmaceutical Biotechnology | (40 Lectures / 4 Credits) |
| BT 3.4-Biostatistics & Bioinformatics | (40 Lectures / 4 Credits) |
| BT 3.5-Practicals | (50 Classes / 8 Credits) |

**Semester-IV**

| | |
|---|---|
| BT 4.1-Seminar Presentation | (2 Credits) |
| BT 4.2-Project | (16 Credits) |

## SEMESTER-I

## COURSE STRUCTURE

### BT 1.1: CELL BIOLOGY AND GENETICS 4 credits

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT 1.1 CELL BIOLOGY AND GENETICS** | CO1 | Identify and present relevant information from research publications dealing with issues of cell biology and genetics. | 1,2/2 | 1,2 |
| | CO2 | The students will be able to assess and relate the information to the context of cell biology, plan and carry out simple experiments on the basis of cell. | 1,2/2,3 | 1,2, |
| | CO3 | The course enables students to analyse hereditary data and apply fundamental coupling analyses and genetic calculations. | 1,2/2,3 | 1,2, 3 |

**Objectives:**

- The course gives the life activities at cellular and molecular level and basic functions of the various cellular compartments and organelles.
- It also gives the structural- functional and biochemical details of all cellular activities.
- This explains the basic principles of Mendelian, population genetics and heredity and gives an overview on the classical genetics- Linkage & Crossing over.

### BT 1.2: BIOMOLECULES AND ENZYMOLOGY 4 credits

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| BT1.2: Biomolecules And Enzymology | CO1 | Students will be able to understand the structure and functions of biomolecules like carbohydrates, amino acids, proteins, lipids and nucleic acids. | 1,2/2/ | 1,2 |
| | CO2 | It will enable the students to explore the role of kinetics and inhibition of enzymes in metabolic pathways. | 1,2/2,3 | 1,2, 3 |

**Learning Objectives:**

- To make the students familiarize with the chemistry of biomolecules like carbohydrates, amino acids, proteins, lipids and nucleic acids.

**BT 1.3: MOLECULAR BIOLOGY** **4 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| BT1.3: Molecular Biology | CO1 | Describe the connection between DNA, RNA and proteins. | 1,2,3/2, 3 | 1,2 |
| | CO2 | Explain why a change to a DNA sequence will alter ALL subsequent proteins produced from that template, while altering an RNA sequence in the same way will only alter one or a few proteins produced from that template. | 2,3,4/1, 2,3 | 1,2, 3 |
| | CO3 | Name the enzymes, organelles and molecules involved in Transcription and describe the role of each. | 2,3,4/1, 2,3 | 1,2, 3 |
| | CO4 | Predict how an addition or deletion mutation in the promoter sequence of a gene would impact future transcription of that gene. | 2,3,4/1, 2,3 | 2,3, 4 |
| | CO5 | Name the enzymes, organelles and molecules involved in Translation and describe the role of each. | 2,3,4/1, 2,3 | 2,3 |
| | CO6 | Describe the role of each different type of RNA molecule. | 2,3,4/1, 2,3 | 2,3, 4 |

**Learning Objectives:**

- Understand current experimentation in the field of molecular biology.
- Learn how to read and understand primary publications in molecular biology.
- Learn how to present molecular biology research data to an audience.
- Understand basic and advanced molecular biology concepts and techniques.
- Gain an appreciation and knowledge of how to deal with ethical issues relating to science**.**

**BT 1.4: BIOINSTRUMENTATION** **4 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| BT1.4: Bioinstrumentation | CO1 | Study the role of different components and their function in biophysical techniques | 3,4,5/2, 3 | 2,3, 4 |
| | CO2 | Understand the basic working principle of instruments for cell analysis | 2,3,4/2, 3 | 3,4 |
| | CO3 | Utilize the bioseparation principle in life science study for it commercial application | 3,4,5/3, 4 | 3,4 |

Learning Objective:

To understand the basic principles behind the working of most common instruments used in biological sciences and the functionality of the key components used in them.

**BT 1.5: PRACTICAL** **8 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| BT1.5: PRACTCALS | CO1 | Students will be able to understand the cellular integrity and biomolecular composition of cells and tissues at intervals of time using appropriate techniques. | 2,3,4/3, 4 | 1,2 3,4 |
| | CO2 | It will enable the students to explore the possibilities of variation in cellular and molecular organizations of cells and tissues for result interpretations. | 2,3,4/3, 4 | 1,2 3,4 |

**Learning Objectives:**

- To make the students familiarize with the techniques relating to the study of cells, preparation of buffer, isolation, separation and quantification of biomolecules from cells and tissues.

## SEMESTER-II

### BT 2.1: PLANT AND ANIMAL BIOTECHNOLOGY 4 credits

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT 2.1: PLANT AND ANIMAL BIOTECHNOLOGY** | CO1 | This will make students to know the techniques of plant tissue culture used in plant breeding, agriculture and industry. | 2,3,4/3, 4 | 2,3 |
| | CO2 | This will make students to know the method of somatic embryogenesis, protoplast culture and germplasm conservation. | 2,3,4/3, 4 | 2,3 |
| | CO3 | This will make students know about the production of plant secondary metabolites through tissue culture method. | 2,3,4/3, 4 | 2,4 |

**Course Objective:** This course will provide knowledge in applications of biotechnology in plant and animal sciences.

### BT 2.2: GENOMICS AND PROTEOMICS 4 credits

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT2.2: GENOMICS AND PROTEOMICS** | CO1 | To understand the principles of linkage, recombination and chromosome mapping to establish the physical and genetic connection between two neighbouring genes; hybridization techniques for genome analysis. | 3,4/3,4 | 3,4 |
| | CO2 | Learning different types of molecular markers and their applications in genome analysis; Construction of Genomic libraries. | 3,4/3,4 | 3,4 |
| | CO3 | To extrapolate various Genome sequencing strategies | 3,4/3,4 | 3,4 |
| | CO4 | Students will gain in depth knowledge on proteins targeting to different organelles along with post translation modification of protein. | 3,4/3,4 | 3,4 |

## Learning Objectives:

The course of Genomics involves understanding the study of entire genomes, including the complete set of gene. This course also includes concepts of mapping of genome, hybridization techniques, molecular markers in genome analysis and genome sequencing strategies.

**BT 2.3: MICROBIAL TECHNOLOGY** **4 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT2.3: MICROBIAL TECHNOLOGY** | CO1 | Understand the morphological, microscopic, biochemical and molecular technique for identification and diversity study of microbes | 2,3,4/3, 4 | 3,4 |
| | CO2 | Understand the basic principles of different types of microorganism for their application in different industries | 2,3,4/3, 4 | 3,4 |
| | CO3 | Study of the infectious microbes and their disease prevention and control | 2,3,4/3 4 | |

**Learning objective:** To understand the basic structures, principles and function of diverse microbial cell types to employ them in food, pharma and health industry.

**Module 1:** Introduction to Microbiology, History and scope of Microbiology, Microbial

**BT 2.4: ENVIRONMENTAL BIOTECHNOLOGY** **4 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT 2.4: ENVIRONMENTAL BIOTECHNOLOGY** | CO1 | Students will be able to understand the concepts and problems relating to environment. | 2,3,4/3, 4 | 3,4, 5 |
| | CO2 | It will enable the students to explore the possibilities of remediation of environmental problems. | 2,3,4/3, 4 | 3,4, 5 |

**Learning Objectives:**

- To make the students familiarize with the environmental concepts and remediation of environmental problems.

**BT 2.5: PRACTICALS** **8 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT 2.5 PRACTICALS** | CO1 | Knowledge on tissue culture will be useful to secure employment in tissue culture related industries. | 2,3,4/3, 4 | 2,3, 4,5 |
| | CO2 | Experience on microbiological technique will be helpful the student to secure job in clinical, food and pharmaceutical industries. | 3,4/3,4 | 2,3, 4,5 |

**Learning objective**

To give a hands-on training in various technique used in plant tissue culture and molecular markers used in plant biotechnology. Hands on training will be given on isolation, identification and characterization of bacteria by biochemical and molecular methods. To perform physiochemical parameter analysis of water samples collected from different source.

## SEMESTER III

**BT 3.1: GENETIC ENGINEERING** **4 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| BT3.1: GENETIC ENGINEERING | CO1 | A comprehensive idea about Genetic Engineering; versatile tools and techniques employed in genetic Engineering; Recombinant DNA technology; Transformation methods, genomic DNA isolation, Plasmid DNA isolation, restriction digestion of Plasmid and genomic DNA, elution of DNA by low melting gel agarose, Ligation, insert analysis, isolation of RNA and PCR. | 3,4,5/3, 4 | 4,5 |
| | CO2 | Synthesis of cDNA, Understanding Reverse Transcription method, Construction of libraries. | 3,4,5/3, 4 | 4,5 |
| | CO3 | Methods of production of transgenic cells and their application in various areas of biotechnology will be discussed in details. | 3,4,5/3, 4 | 4,5 |
| | CO4 | Molecular cloning and characterization of unknown genes; Gene Knock-out technologies; Gene therapy and its applications; Transposons and T-DNA tagging; Gene regulation and silencing which will equip the students fit for biotechnology research and industry. | 3,4,5/3, 4 | 4,5 |

**Learning Objectives:**

To provide fundamental insights of the principles, practice and key concepts relevant to genetic engineering and appraise them about applications of genetic engineering. This

;**BT 3.2: INDUSTRIAL MICROBIOLOGY** **4 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT 3.2: INDUSTRIAL MICROBIOLOY** | CO1 | Students will gain knowledge about fermentation and design of various types of bioreactors. | 3,4/3,4 | 4,5 |
| | CO2 | Studying bioreactors and large scale production are helpful for skill development of students. | 4,5/3,4 | 4,5 |
| | CO3 | This course builds employability skill within our students. | 4,5/3,4 | 4,5 |
| | CO4 | Knowledge on large scale production helps in entrepreneurship. | 4,5/3,4 | 4,5 |

**Learning Objectives:** This course deals with applied part of microbiology. It covers details about fermentation process and various types of bioreactors. It also deals with large scale production of various microbial products. Concept of enzyme immobilization technique is also included.

**BT 3.3: PHARMACEUTICAL BIOTECHNOLOGY 4 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| BT 3.3: PHARMACEUTICAL BIOTECHNOLOGY | CO1 | Students get familiarized with different immunological responses and the molecules responsible for immunomodulation. | 3,4,5/3, 4 | 4,5 |
| | CO2 | They learned the process of different diagnosis tools using antibody and antigen for different diseases. | 3,4,5/3, 4 | 4,5 |
| | CO3 | Different disorders and their probable drug molecule and mode of action. | 3,4,5/3, 4 | 4,5 |
| | CO4 | Steroids used in different diseases and their microbial production. Protein miss-folding and role on diseases. | 3,4,5/3, 4 | 4,5 |

**Learning Objective**: To provide an understanding about the basic concept of immunological response, different disorders and drug discovery & designing, mechanism of action of different drugs, microbial use of steroid transformation and protein engineering for drug development.

**Module 1:** Innate immunity and adaptive/acquired immunity; Lymphocytes; immune

**BT 3.4: BIOSTATISTICS AND BIOINFORMATICS 4 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT 3.4 BIOSTATISTICS AND BIOINFORMATIS** | CO1 | Students will be able to understand the concepts and techniques of computations relating to biological sciences. | 4,5,6/3, 4 | 4,5 |
| | CO2 | It will enable the students to explore the possibilities of interpretation of biological data. | 4,5,6/3, 4 | 4,5 |

**Learning Objectives:**

- To make the students familiarize with the computation and interpretation of data relating to biological sciences.

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**BT 3.5 PRACTICAL** **8 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| **BT 3.5 PRACTICAL** | CO1 | Understand the method to isolate, digest and ligate bacterial gene. | 4,5,6,/3 ,4 | 4,5, 6 |
| | CO2 | Understand the principles and techniques for bacterial transformation. | 4,5,6,/3 ,4 | 4,5, 6 |
| | CO3 | Perform RNA isolation and analysis. | 4,5,6,/3 ,4 | 4,5, 6 |
| | CO4 | Learn to isolate industrially important microorganism and produce alcohol, antibiotics, lipase, cellulase, baker's yeast and lactic acid etc. | 4,5,6,/3 ,4 | 4,5, 6 |
| | CO5 | Understand the principle and perform different immunological assays. | 4,5,6,/3 ,4 | 4,5, 6 |

**Major practicals will be conducted with the following broad topics**
**Learning Objectives:**

To provide fundamental insights of the principles, practice and key concepts relevant to Statistical analysis, genetic engineering, immunological techniques as well as bioprocess engineering.

## SEMESTER-IV

**BT 4.1: SEMINAR PRESENTATION 2 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| | CO1 | Explore an appreciation of the self in relation to its larger diverse social and academic contexts. | 5,6,7/3, 4 | 4,5 |
| | CO2 | Through independent learning and collaborative study, attain, use, and develop knowledge. | 5,6,7/3, 4 | 4,5 |
| | CO3 | Acquire, articulate, create and convey intended meaning using verbal and non-verbal method of communication that demonstrates respect and understanding in a complex society. | 5,6,7/3, 4 | 4,5 |

**Objectives:**

1. Identify, understand and discuss current, real-world issues.

2. Distinguish and integrate differing forms of knowledge and academic disciplinary approaches (e.g., humanities and sciences) with that of the student's own academic discipline (e.g., in agriculture, architecture, art, business, economics, education, engineering, natural resources, etc.). And apply a multidisciplinary strategy to address current, real-world issues.

3. Improve oral and written communication skills.

**BT 4.2: PROJECT WORK 16 credits**

| COURSE | CO | Course Outcome's | PO/ PSO | BTL |
|---|---|---|---|---|
| BT 4.2: PROJECT WORK | CO1 | Provide (where appropriate) an analysis (for example using statistics) to define the degree of or uncertainty in the results and their possible implications. | 5,6,7/3, 4 | 3,4, 5 |
| | CO2 | Effectively communicate the results and conclusions of the research both orally and in writing. Use a scientific writing style with clear referencing and documentation of results. | 5,6,7/3, 4 | 4,5 |
| | CO3 | Critically evaluate the quality of the project (for example strengths and weaknesses of the study), discuss findings in the context of previous literature and make suggestions for future follow-on research | 5,6,7/3, 4 | 4,5 |
| | CO4 | Produce overall conclusions that are supported by the data and summarise the project in an abstract. | 5,6,7/3, 4 | 4,5 |

**Objectives:**

- Critically appraise existing literature on dissertation subject, explain concepts where relevant and synthesise information from a range of sources in order to define a research question and/or scientific hypotheses that can be tested.
- Design an appropriate methodology (such as an experiment or simulation) that will answer the research question. Provide justification for the approach adopted considering possible sources of bias or error in the methods used.
- Define aims and objectives. Partition the project into a manageable sequence of tasks with clearly defined deliverables and milestones that can be achieved in realistic timescales.