**INDUSTRIAL BIOTECHNOLOGY**

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| **Course code** | **Course name** | **Course Category** | **L-T-P** | **Credits** |
| 22BEXY03 | Industrial Biotechnology | Open free elective | 3-0-0 | 3 |

**Course Learning Objectives:**

1. The course aims to provide fundamental insights to exploit enzymes and microbes for the manufacturing of products which have a huge industrial significance. It uniquely blends the science and engineering with various biochemical processes to obtain products of diverse fields such as chemicals, food, bioenergy etc.

2. The course introduces bioreactors, its types, operation methods and provides an experimental demonstration of the same. Strategies to obtain higher yields, design of the reactors and production of biofuels from microbes are thoroughly explained.

3. Students of various disciplines such as biotechnology, chemical engineering, food engineering, and pharmaceutical industries can be benefitted from the course as it discusses the existing bioprocess applications such as wine and cheese making, antibiotics and vaccines etc.

4. The course majorly focuses on the applications and allows students to gain practical knowledge rather than mere theory especially enzyme. Major bottlenecks for the operation of biochemical industries will be discussed.

5. To make better understanding of biotransformation of drug designing.

6. Industrial knowledge for production of biofuels and other product.

**Course Content:**

**UNIT-I: Bioprocess Technology (7 hours)**

1. Introduction to industrial biotechnology
2. Basic principles of bioprocess engineering and fermentation technology
3. Isolation, preservation and maintenance of industrial microorganisms

4. Screening of microorganisms for new products

**UNIT-II: Fermentation Technology and Fermenters (Bioreactors) (6 hours)**

1. Component parts of fermentation process and basic functions of fomenters
2. Fermenters design
3. Types of Fermenters

**UNIT-III: Downstream Processing (9 hours)**

1. Removal and recovery of cell mass
2. Cell disruption methods
3. Extraction (e.g. Liquid-liquid extraction) and concentration of products
4. Purification of products
5. Precipitation and separation of proteins from recombinant strains

**UNIT-IV: Enzyme Biotechnology (7 hours)**

1. Industrial use of enzymes
2. Bio reactors for enzyme production
3. Methods of enzyme immobilization
4. Biosensors

**UNIT-V: Biotransformation (4 hours)**

1. Biotransformation
2. Steroid biotransformation and applications
3. Recent advances in biotransformation

**UNIT-VI: Biofuels Production and Industrial Production of Chemicals and Biomolecules (12 hours)**

1. Biomass as fuel
2. Design of biogas plant
3. Hydrogen- biohydrogen
4. Ethanol
5. Bio diesel and algae as a source of energy
6. Microbial fuel cell technology
7. Production of Acetone
8. Production of organic acid-citric acid, gluconic acid; amino acids –glutamic acid, lysine
9. Production of Antibiotic
10. Production of Fermented Foods
11. Production of Vitamins, steroids, biopolymers, etc

**Learning Resources:**

**Text Book:**

1. RGUKT prepared modules for all units.
2. Stanbury, Vitaker and Hall, ‘*Principles of Fermentation Technology’*, Butterworth Heinemann, 2nd Ed., 1999.
3. Pauline M. Doran, ‘*Bioprocess Engineering Principles’*, Academic Press, 2nd Ed., 2012.
4. El-Mansi, “*Fermentation* *Microbiology and Biotechnology*”, CRC Press, 3rd Ed., 2011.

**Reference Books:**

1. T. Devasena, ‘*Enzymology*’, Oxford University Press, 2012.
2. G.N. Stephanopoulos, ‘*Metabolic Engineering: Principles and Methodologies’*. Academic Press / Elsevier, 1998.
3. P. Fellows, ‘*Food Processing Technology: Principles and practice’,* Woodhead Publishing Ltd., Cambridge, 2nd Ed., 2005.
4. Paul A. Belter, ‘*Bioseparations: Downstream processing for Biotechnology*,’ Wiley Interscience, 1st Ed., 1988.

**Course Outcomes:** At the end of the course, the student will be able to

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| CO 1 | Well understanding of fermentation and their type of fermentation |
| CO 2 | What are the regulating factors for fermentation and bio-processing |
| CO 3 | Downstream processing steps and controlling factors |
| CO 4 | Understood the environmental sustainability by use of biotechnology |
| CO 5 | Well understanding of industrial production of biofuel and enzyme with different products |
| CO 6 | How to produce chemical and bimolecular on industrial scale and what are the factor responsible for it. Well understanding of the application of biotechnology production in industrial scale |

**For Theory Courses Only:**

**Assessment Method**

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| **Assessment Tool** | **Monthly tests** | **End Semester Test** | **Total** |
| Weightage (%) | 40% | 60% | 100% |