FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
Department of Biochemistry
Course Curriculum

PART- A: Introduction				
Program: Bachelor in Science *(Honors / Honors with Research)*		**Semester - VIII**	Session: **2024-2025**	
1	**Course Code**	**BCSE - 10 T**		
2	**Course Title**	**Industrial Biochemistry**		
3	**Course Type**	**Discipline Specific Elective (Theory)**		
4	**Pre-requisite (if, any)**	As per the Program		
5	**Course Learning. Outcomes (CLO)**	*On successful completion of the course, the student shall be able to:* ➢ Understand Industrial production of Bio substance ➢ Analyze the basic concepts of industrial operations of bioreactors. ➢ Demonstrate the Various control points of industrial operations. ➢ Apply control mechanism of bioreactor in an industry.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Bioreactors and its Operations:** Bioreactor design. Concept of bioreactor. Type of bioreactors. Working scales. Elements of a bioreactor. Requirements of industrial bioreactors. Auxiliary facilities. Operation of a bioreactor. Aseptic operations. Aseptic inoculation and sampling. Seals and valves. Measurement and control of fermentation conditions: temperature, pH, dissolved oxygen concentration (DO), foaming, consumption and formation of gases and products.	12
II	**Sterilization, Aeration and Agitation in Bioreactor:** Sterilization of the bioreactor and culture media. General considerations. Sterilization of the culture medium. Methods of sterilization. Heat sterilization. Theory of heat sterilization. Calculation of the duration of media sterilization. Continuous sterilization. Sterilization by filtration. Air sterilization. Aeration of the bioreactor. General considerations. Transfer of gas-liquid matter. Specific rate of oxygen uptake. Critical oxygen concentration (C). Stirring of the bioreactor. Geometry and types of agitators. Required power for stirring: power number and Reynolds number.	11
III	**Down Stream Processing-** Separation of cells and other insoluble from fermented broth. Filtration and microfiltration, centrifugation (batch, continuous, basket). Cell disruption: Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), Chemical methods (alkali, detergents), Enzymatic methods Products isolation: Extraction and adsorption method, precipitation (ammonium sulphate. Organic solvents, high molecular weight polymers), column chromatography; ultra filtration, Products polishing: Crystallization and drying.	11
IV	**Bioreactor Products:** Production of enzymes on an industrial scale. Production of ethanol, acetone-butanol. Production of antibiotics. Production of food and fermented beverages. Authorized microorganisms (GRAS). Biochemistry of the production of alcoholic beverages. Biochemistry of the production of lactic and meat products. Biochemistry of bread fermentation. Biochemistry of food additives. Quality assurance.	11
Keywords	Cell product, production, harvesting, bioreactor	

Name and Signature of Convener & Members of CBoS:

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
- Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
- Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002.
- Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
- Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment (CIA): **30 Marks**

End Semester Exam (ESE): **70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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PART- A: Introduction				
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1	**Course Code**	**BCSE - 10 P**		
2	**Course Title**	**Industrial Biochemistry**		
3	**Course Type**	**Discipline Specific Elective (Practical)**		
4	**Pre-requisite** (if, any)	As per Program		
5	**Course Learning. Outcomes (CLO)**	*On successful completion of the course, the student shall be able to:* ➢ Demonstrate production of bioactive compounds in an industry. ➢ Demonstrate the key features of Bioreactors. ➢ Produce novel mechanism for production. ➢ Apply knowledge of bioreactors in industry.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ To prepare broth media for microbial growth. ➢ To culture the microbial organisms in a shake flask using orbital shaker incubator. ➢ To estimate the Microbial biomass produced through shake flask culturing. ➢ To plot Microbial growth curve for shake flask culturing using turbidity method. ➢ To get familiarized with the lab scale fermenter (bench top fermenter) ➢ Heat balance across a batch sterilization process. ➢ Production of Ethanol in lab. ➢ Production of organic acid in lab.	**30**
Keywords	Fermentation, Sterilization, Media, Broth	

Name and Signature of Convener & Members of CBoS:

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
- Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.
- Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo, 1973.
- Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Young M.M., Reed Elsevier India Private Ltd, India, 2004.
- Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK, 2007.

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **50 Marks**

Continuous Internal Assessment (CIA): **15 Marks**

End Semester Exam (ESE): **35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS: