Name of Faculty	:	Faculty of Science
Name of Program	:	Master of Science
Course Code	:	2MSB04
Course	:	Bioprocess and Biochemical engineering
Type of Course	:	Professional Core
Year of Introduction	:	2023-24

Prerequisite	:	Helps to develop the skills in bioengineering processes
Course Objective	:	Optimizing the system using biological materials to manufacture variety of biological products Learning the fundamentals of bioreactor design and engineering with a solid understanding regarding the deisgn and operation fermentation processes. Develop skills in bioengineering to create and purify biochemical products using integrated biochemical processes.
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	Able to acquire a sound knowledge in mathematics and natural science and apply engineering principles in determining and solving contemporary and complex problems related to bioprocessing.
	CO2	Able to communicate creative idea and works effectively within professional community and larger society.
	CO3	Able to conduct practice-based tasks related to bioprocessing in a responsible, safe, voluntary, self-motivated and ethical manner.
	CO4	Able to demonstrate an ability to work in multidisciplinary and multicultural teams in developing innovative engineering solutions using complex problem-solving skills.
	CO5	Able to design biological reaction and reactors including its materials, instrumentation, control, and modeling.
	CO6	Application of principles and techniques to the study and utilization of microorganisms and their products.

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				
				Theory Marks		Practical Marks		Total marks
L	**T**	**P**	**C**	**SEE**	**CIA**	**SEE**	**CIA**	
4	0	0	4	70	30	0	0	100

Legends: ***L****-Lecture;* ***T****–Tutorial/Teacher Guided Theory Practice;* ***P*** *– Practical,* ***C*** *– Credit,* ***SEE*** *– Semester End Examination,* ***CIA*** *- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.*

Course Content

Unit No.	Topics	Teaching Hours	Weightage	Mapping with COs
1	Introduction to bioprocess technology. Isolation methods (mutants) Preservation (cryopreservation, lyophilization) Improvement of industrially important organisms - Strain Improvement, software that are used.	15	25%	CO3
2	Bioreactor design: Laboratory, pilot and large scale reactors. Plug flow reactors, enzyme reactors. Sterilization of media and air. Scaleup and Scaledown. Mass transfer of oxygen : Agitation and aeration, Determination of KLa, factors affecting KLa, fluid rheology. Inoculum development, aseptic inoculation and sampling	15	25%	CO1
3	Bioprocess kinetics: Kinetics of growth and substrate utilization in batch, fed batch and continuous systems. Control of process parameters: Instrumentation for monitoring bioreactor and fermentation processes, Sensors, Controllers, fermentation control systems and architecture, Incubation and sequence control, advanced control. Dynamic modeling of fermentation processes.	15	25%	CO5 CO6
4	Downstream processing: Methods of Cell separation, Disruption and product purification. Fermentation Economics, pollutants: Petroleum hydrocarbons and pesticides. Microbes and mineral recovery: Bioleaching of copper, gold and uranium.	15	25%	CO2, CO3

Suggested Distribution of Theory Marks Using Bloom's Taxonomy						
Level	Remembrance	Understanding	Application	Analyse	Evaluate	Create
Weightage	**-**	**16.68**	**66.64**	**-**	**-**	**16.68**

NOTE: This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Major Equipment / Instruments

Sr. No.	Name of Major Equipment/ Instruments and Software
1	Analytical Balance
2	Autoclave
3	Micropipettes
4	Stains
5	Light Microscope
6	Anaerobic jar
7	UV Chamber
8	Hot Air Oven
9	Centrifuge
10	Electrophoresis
11	SDS PAGE
12	PCR
13	Deep Freezer
`14	Autoradiography
software	Software: Bio4C ™ Processpad software

Suggested Learning Websites

Sr. No.	Name of Website
1	https://www.wur.nl/en/research-results/chair-groups/agrotechnology-and-food-sciences/bioprocess-engineering.html

Reference Books

Sr. No.	Name of Reference Books
1	Principles of Fermentation Technology: Whitekar & Stanbury
2	Comprehensive Biotechnology Murray Moo
3	Fermentation Microbiology and Biotechnology, El Mansi and Bryc