

# NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

## Odd Semester Mid-Term Examination, 2023-24

Course Code: CHE711

Full Marks: 25

Course Name: Bioprocess and Bioreactor Engineering

Time: 90 Minutes

Instructions: Answer all the questions.

Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO														
1	How does the specific growth rate change at different phases of batch growth culture? Explain using batch growth curve.What do you mean by doubling time in cell culture?	3	CO1														
2	How will you compare the Logistic and Monod kinetic model for biomass growth reaction?	2	CO1														
3	Develop design equation for batch reactor for cell culture using Logistic kinetic equation.	5	CO2														
4	Discuss about Michaelis-Menten equation. How can you calculate the kinetic parameters of Thomas equation from experimental data as follows:	4	CO1														
	<table><tr><td>S:mg/L</td><td>960</td><td>640</td><td>560</td><td>480</td><td>466</td><td>457</td></tr><tr><td>t:hrs</td><td>0</td><td>6</td><td>12</td><td>18</td><td>24</td><td>28</td></tr></table>	S:mg/L	960	640	560	480	466	457	t:hrs	0	6	12	18	24	28		
S:mg/L	960	640	560	480	466	457											
t:hrs	0	6	12	18	24	28											
5	What is Hill Kinetics? Discuss with examples. What is the relation of substrate concentration with reaction velocity for allosteric enzymes? What do you understand by the term co-operativity of the allosteric enzyme? How it effect the overall Productivity?	4	CO1, CO2														
6	Discuss the Bioreactor system design based on product requirement with a flow diagram. Calculate the kinetic parameters for the reactor design from the following data:	7	CO3														
	<table><tr><td>C<sub>urea</sub> (kmol/m<sup>3</sup>)</td><td>0.2</td><td>0.02</td><td>0.01</td><td>0.005</td><td>0.002</td></tr><tr><td>-r<sub>urea</sub> (kmol/m<sup>3</sup>.s)</td><td>1.08</td><td>0.55</td><td>0.38</td><td>0.2</td><td>0.09</td></tr></table>	C <sub>urea</sub> (kmol/m <sup>3</sup> )	0.2	0.02	0.01	0.005	0.002	-r <sub>urea</sub> (kmol/m <sup>3</sup> .s)	1.08	0.55	0.38	0.2	0.09				
C <sub>urea</sub> (kmol/m <sup>3</sup> )	0.2	0.02	0.01	0.005	0.002												
-r <sub>urea</sub> (kmol/m <sup>3</sup> .s)	1.08	0.55	0.38	0.2	0.09												

### Course Outcomes

CO1: Apply kinetics of biochemical reactions for design of bioreactor.

CO2: Analyze performance of ideal and non-ideal bioreactors.

CO3: Integrate different type of reactor and reactor assembly.



**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR****Odd Semester Mid-Term Examination, 2023-24****Course Code:** CHE715

Full Marks: 25

**Course Name:** Membrane Separation Processes

Time: 90 Minutes

Instructions: Answer all the questions.

Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO
1	What is the importance of membrane separation processes? Why vacuum is used in Pervaporation (PV) process. Explain different modification techniques to the polymeric membrane materials for improving separation properties in PV.	1+2+1	CO1
2	Define sharp and diffuse cut off membrane. What is concentration polarization? Why poiseuille flow equation is not used to describe gas transport through membranes.	2+2+1	CO1
3	Air (O <sub>2</sub> – 21%, N <sub>2</sub> – 79%) is passing through a barrier where the mean free path of the gas molecules is large compared to pore dimensions. A large pressure gradient is maintained across the barrier under isothermal condition. What would be the eventual composition of the air at the low-pressure side? <b><u>Mention the assumptions made and conclude the process.</u></b>	7	CO2
4	(i) Propose a suitable technique/method to synthesize asymmetric polymeric membranes. (ii) Explain some characterization techniques to be followed for the above-synthesized membrane. (iii) Outline the factors responsible for changing the properties of membrane synthesized through the phase inversion technique.	3+3+3	CO1

**Course Outcomes**

CO1: Learn fundamentals of membrane separation processes and current market scenario

CO2: To solve related problems of different difficulty levels through tutorials





**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR****Odd Semester Mid-Term Examination, 2023-24****Course Code:** CHE719

Full Marks: 25

**Course Name:** Energy Management and Process Optimization in Chemical Industry

Time: 90.Minutes

Instructions: Answer any five questions.

Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO
1	Explain process energy intensity. Explain energy performance index method.	5	CO1
2	What is fuel equivalent and why it is used? Define fuel equivalent of steam and power.	5	CO2
3	What you understand by energy benchmarking of chemical plant? Explain how energy benchmarking done in chemical industry.	5	CO1
4	What is cross pinch heat transfer ? If cross pinch heat transfer is allowed what could happen?	5	CO2
5	Explain in detail with proper diagram how you can calculate pinch temperature , minimum hot and cold utility for a chemical plant.	5	CO2
6	Write 3 basic pinch golden rules. Violating any of these rules will lead to penalty in both hot and cold utilities beyond the target-explain why?	5	CO2

**Course Outcomes**

CO1: Acquire an idea about the energy intensity in industry context and benchmarking energy intensity  
 CO2: To learn the step by step methodology for energy assessment in industry, finding optimization opportunities and how to exploit them in industry  
 CO3: To learn the fundamental knowledge of different process Optimization techniques to increase profit