Q. Code:426443

Reg. No. | | | | | | | | | | | | | |

B. E / B. TECH.DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

BT22402 –TRANSPORT PHENOMENA OF BIOPROCESSES

(Biotechnology)

(Regulation 2022)

TIME:3 HOURS **MAX. MARKS: 100**

CO1 Understand the basic concepts of types of fluids and fluid properties.
CO2 Elaborate the concept of fluid flow and mixing in bioprocesses.
CO3 Identify the different mechanisms of heat transfer in solids and fluids.
CO4 Illustrate the different types of heat exchangers used in industries.
CO 5 Interpret the principles and applications of mass transfer in bioprocesses.

PART- A(10x2=20Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Define a differential manometer and explain its use in measuring pressure differences.	**1**	**2**
2.	Differentiate between Newtonian and non-Newtonian fluids, providing examples of each.	**1**	**3**
3.	Explain the concept of specific volume and give its formula.	**1**	**3**
4.	What is the specific weight of a fluid with a density of 1000 kg/m^3?	**1**	**2**
5.	Discuss the challenges in scaling up bioreactors from lab to industrial scale.	**2**	**3**
6.	Explain how power consumption in mixing is related to fluid viscosity and agitator speed.	**2**	**3**
7.	Define mixing time and its significance in industrial processes.	**2**	**2**
8.	Define agitator and mixer, highlighting their differences.	**2**	**3**
9.	What is meant by steady-state conduction?	**3**	**2**
10.	Differentiate between individual and overall heat transfer coefficients.	**3**	**2**
11.	State Fourier's Law of heat conduction.	**3**	**2**
12.	Discuss the process of heat transfer between fluids.	**3**	**3**
13.	Comment on the common heat-transfer configurations used in bioreactors.	**4**	**3**
14.	What is the significance of LMTD in heat exchanger analysis?	**4**	**2**
15.	Name two types of equipment commonly used for heat transfer in industrial processes.	**4**	**2**
16.	Differentiate parallel flow and counter-current flow heat exchanger, with a neat sketch.	**4**	**3**
17.	Explain the concept of film theory in mass transfer.	**5**	**3**
18.	List the methods commonly used for measuring dissolved-oxygen concentrations.	**5**	**3**
19.	Define oxygen solubility and explain its importance in bioprocessing.	**5**	**2**
20.	Define molecular diffusion and provide an example.	**5**	**2**

PART- B (5x 10=70Marks)

			Marks	CO	RBT LEVEL
21. (a)		Define non-Newtonian fluids and classify them based on their flow behavior. Discuss the different types of non-Newtonian fluids, their characteristics, and provide examples of each type.	**(10)**	**1**	**2**
		(OR)			
(b)		Compare and contrast simple manometers, U-tube manometers, and differential manometers as tools for measuring fluid pressure. Discuss their principles of operation, advantages, limitations, and typical applications	**(10)**	**1**	**2**
22. (a)	**(i)**	Discuss the different types of pumps commonly used in industrial processes	**(5)**	**2**	**4**
	(ii)	Evaluate the factors influencing the selection of pumps for specific applications.	**(5)**	**2**	**4**
		(OR)			
(b)		Compare and contrast different flow measurement devices used in industrial applications	**(10)**	**2**	**4**
23. (a)		How are thermal resistances combined in series to analyze heat transfer?	**(10)**	**3**	**4**
		(OR)			
(b)		Discuss the concept of fouling factor in heat transfer. Explain, how it affects heat transfer surfaces, and how fouling factors are used in engineering calculations.	**(10)**	**3**	**4**
24. (a)	**(i)**	Explain the governing equations used in the design of heat transfer systems.	**(5)**	**4**	**3**
	(ii)	Describe the role of heat exchangers in heat transfer system design. Discuss the different types of heat exchangers.	**(5)**	**4**	**3**
		(OR)			
(b)		Explain the design principles and operational characteristics of shell and tube heat exchangers. Give a neat diagram of the same.	**(10)**	**4**	**3**
25. (a)		Define the film theory approach in mass transfer and its relevance in industrial processes. Compare and contrast the concepts of stagnant film and penetration theory.	**(10)**	**4**	**4**
		(OR)			
(b)		Explain the process of oxygen uptake in cell cultures and its significance in bioprocessing. Discuss the factors influencing oxygen uptake rates in cell cultures	**(10)**	**5**	**4**

PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
26.	In a bioreactor, the temperature gradient within the vessel is too high, leading to uneven growth and reduced efficiency of the bioprocess. Give your possible solutions and their diagrammatic representation, to promote uniform temperature distribution within the bioreactor.	**(10)**	**2**	**5**

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