Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: Biomedical transport **Semester : 3rd**

Program: B. Tech Biomedical Engineering

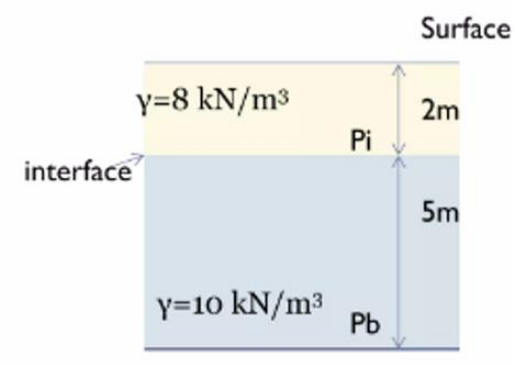
Duration : 3 Hours

Course Code: HSBE2002 **Max. Marks: 100**

Instructions: Attempt all the questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	What does the Michaelis-Menten equation describe?	**1.5**	**CO2**
Q 2	What is the significance of Vmax in enzyme kinetics?	**1.5**	**CO3**
Q 3	How does enzyme concentration affect the initial reaction rate?	**1.5**	**CO3**
Q 4	What is the role of reaction transport in biological systems?	**1.5**	**CO3**
Q 5	How can concentration gradients impact reaction transport?	**1.5**	**CO2**
Q 6	How do enzymes contribute to drug metabolism?	**1.5**	**CO2**
Q 7	What is the significance of understanding enzyme kinetics in drug administration?	**1.5**	**CO3**
Q 8	Define bioconversion in the context of biomedical engineering.	**1.5**	**CO3**
Q 9	Provide an example of a bioconversion process.	**1.5**	**CO3**
Q 10	How are immobilized enzymes utilized in industrial processes?	**1.5**	**CO2**
Q 11	The path traversed by a fluid molecule is known as: a. Streakline	**1.5**	**CO2**

	b. Streamtube c. Mean free path d. Pathline		
Q 12	How fluid mechanics is relevant in the area of biomechanics?	**1.5**	**CO 1**
Q 13	Define fluid statics and fluid dynamics.	**1.5**	**CO 1**
Q 14	The first sound during a heartbeat appears due to: a. Closure of A-V valves b. Closure of S-L valves c. Opening of A-V valves d. Opening of S-L valves	**1.5**	**CO 1**
Q 15	The liquid flow through a microfluidic channel is governed by: a. Pascal's law b. Bernoulli's theorem c. Navier-Stoke's equation d. None of the above	**1.5**	**CO 4**
Q 16	What do you understand by MEMS?	**1.5**	**CO 4**
Q 17	How is specific volume of a liquid related to its density?	**1.5**	**CO 1**
Q 18	Give an example of steady non-uniform flow.	**1.5**	**CO 1**
Q 19	Provide an estimate of the Reynold's number of blood when it flows through the micro-capillaries.	**1.5**	**CO 4**
Q 20	What is the interpretation of the continuity equation?	**1.5**	**CO 1**
Section B (4Qx5M=20 Marks)			
Q 1	In a bioconversion process using enzyme X, researchers observed an unexpected decrease in the reaction rate after a certain period of time, despite maintaining constant substrate concentrations. Propose a logical explanation for this phenomenon and suggest a strategy to overcome it.	**5**	**CO3**
Q 2	A drug, designed to target a specific enzyme in the liver for metabolism, is administered to a patient. However, the therapeutic effects of the drug are not as expected. Provide a logical explanation for this outcome, considering reaction transport and enzyme kinetics, and suggest a potential solution.	**5**	**CO2**

Q 3	An open tank contains 5 m water (γ = 10 kN/m^2) covered with 2 m oil (γ = 8 kN/m^2). Estimate the hydrostatic pressure at the interface of the liquids as shown in Fig. 1.  Fig. 1	**5**	**CO1**
Q 4	How far can a liquid droplet travel through a microfluidic channel of diameter 50 µm if the surface tension is 72 mN/m and contact angle is 5^o? Calculate the distance the droplet can travel if the contact angle rises to 50 ^{o}.	**5**	**CO4**
Section C (2Qx15M=30 Marks)			
Q 1	A new drug candidate exhibits excellent solubility but struggles with permeability across biological membranes. Discuss the implications of this challenge on the drug's pharmacokinetics and propose a strategy to address this issue.	**15**	**CO2**
Q 2	Justify the potential of MEMS-based devices in replacing the conventional biomedical technologies.	**15**	**CO4**
Section D (2Qx10M=20 Marks)			
Q 1	(I) A drug designed to target intracellular enzymes faces challenges in cellular uptake. Discuss the importance of understanding intracellular transport in drug development and propose a logical approach to enhance the drug's cellular penetration. (II) A drug with a short half-life is administered, but its concentration in the target tissue is insufficient for therapeutic effects. Explain the role of drug distribution in this scenario and propose a strategic approach to enhance tissue targeting.	**10**	**CO3**

Q 2	Differentiate between gauge pressure and absolute pressure. Consider a droplet of blood at rest, having radius of 1.4 mm, and is under a pressure of 60 mPa due to vasco-constriction in the z-x plane of the droplet. What will be the pressure on a unit cross section area of the blood droplet facing the x-y plane?	**10**	**2**