Name:

Enrolment No:

UPES

End Semester Examination, December 2024

Course : B.Tech-Biotechnology **Semester : V**

Program : Downstream Processing **Duration : 3 Hours**

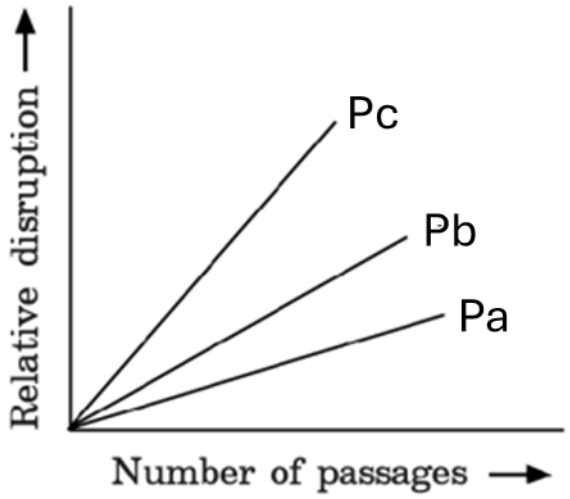
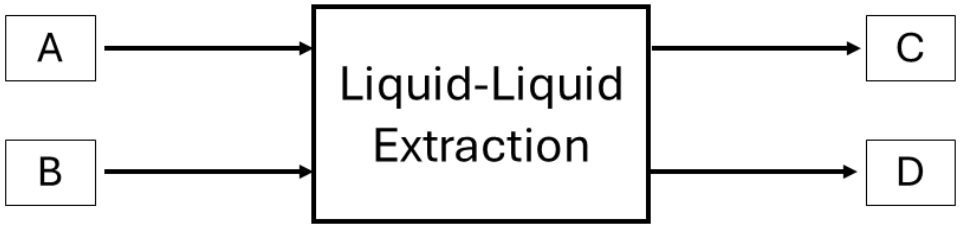
Course Code: HSBT3003 **Max. Marks: 100**

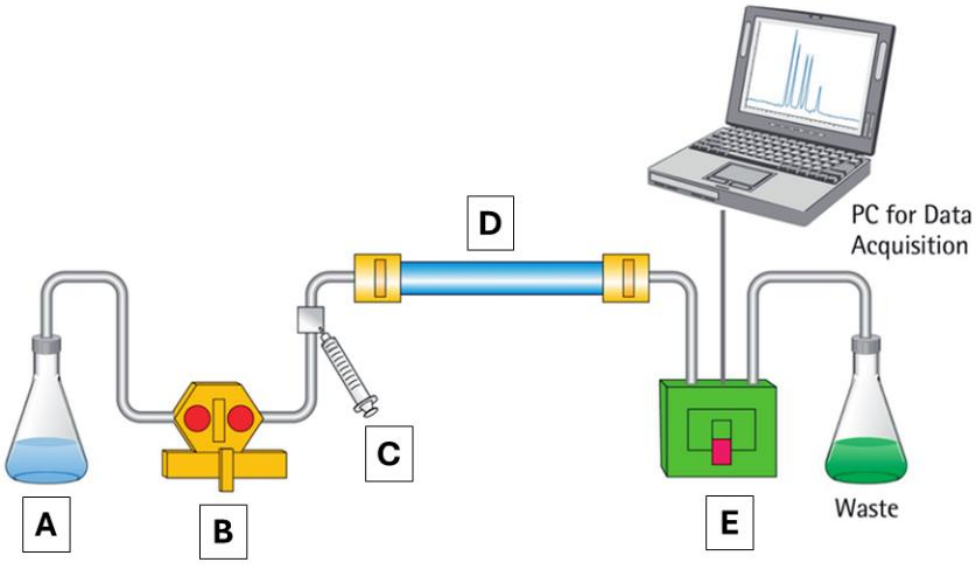
Instructions: All questions are compulsory.

Please read the questions carefully. The paper contains four sections.

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	Choose the organic solvent used to disrupt the fungal cell walls. a.Toluene b. Acetone c. Acetic acid d. Water	1.5	CO1
Q 2	Which detergent is preferred in bioprocessing? a. Non-ionic b. Cationic c. Anionic d. Cationic, anionic	1.5	CO1
Q 3	Alcoholic fermentation is carried by yeast known as _____ a. Lactobacillus b. Bacillus c. Saccharomyces cerevisiae d. Escherichia coli	1.5	CO1
Q 4	True or False: “Biofuels are products of fermentation.”	1.5	CO1
Q 5	Which operation can be the primary step for removing insoluble a. Absorption b. Extraction c. Sedimentation d. Chromatography	1.5	CO1
Q 6	List forces involved in centrifugation.	1.5	CO1
Q 7	TLC and paper chromatography is a type of _____ chromatography. a. absorption b. adsorption c. column d. gas	1.5	CO1

Q 8	What are the constituents of polyelectrolytes? a. Cations b. Anions c. Both Cation and anions d. Neutral ions	1.5	CO1
Q 9	Which of the following is considered a pretreatment to the biological feeds? a. Heating to denature the proteins b. The addition of filters aids in increasing porosity c. Addition of electrolytes d. All of the above	1.5	CO1
Q 10	Which of the operations do not come under upstream processing? a. Media preparation b. Inoculum development c. Effluent treatment d. Storage of raw material	1.5	CO1
Q 11	Which of the following is an upstream process? a. Product recovery b. Product purification c. Media formulation d. Cell lysis	1.5	CO1
Q 12	Which of the following is not a criterion of separation through centrifugation? a. Physical properties of sample b. The viscosity of the medium c. Speed of the centrifuge rotor d. Size of the sample to be separated	1.5	CO2
Q 13	Salting in is caused by a pH change b. Change in dielectric constant c. Ionic strength change d. Change in water availability	1.5	CO2
Q 14	True or False: “Recovery of desired product is the only application of centrifugation.”	1.5	CO2
Q 15	True or False: “Adsorption is a bulk phenomenon.”	1.5	CO2
Q 16	True or False: “Adsorption used in downstream process involves physical interactions.”	1.5	CO2
Q 17	What stage of downstream processing is spray drying used at?	1.5	CO2
Q 18	Define crystallization.	1.5	CO2
Q 19	What is the limitation of using lysozyme? a. Less availability b. Harmful effect on product c. High cost d. Unstable enzyme	1.5	CO2
Q 20	Describe the primary purpose of downstream processing in biotechnology.	1.5	CO2

Section B **(4Qx5M=20 Marks)**			
Q 21	Define any three downstream processes used for solid-liquid separation.	5	CO1
Q 22	a. Define precipitation in downstream processing. **(1 mark)** b. How are proteins solubilized in an aqueous solution? Explain with the help of a diagram. (2 marks) c. You have to isolate lysozyme (pI=11). Select the pH conditions you will use for precipitation and explain why. **(2 marks)**	5	CO2
Q 23	The disruption of baker's yeast as a function of a number of passages at different operating pressures (Pa, Pb, Pc) is a first-order relationship as shown in the graph below. a. Arrange Pa, Pb, Pc in **decreasing** order. **(3 marks)** b. Explain your answer using the graph shown below **(2 marks)**  	5	CO3
Q 24	Methods of cell disruption are majorly divided into three categories. Draw a line diagram showing these categories and their subcategories.	5	CO4
Section C **(2Qx15M=30 Marks)**			
Q 25	a. Define liquid-liquid extraction. **(1 mark)** b. Label A, B, C, and D in the schematic for liquid-liquid extraction. **(0.5*2=2 marks)**  c. Derive the relation between product and feed concentration of solute in single-stage batch mode using analytical method. **(3 marks)** b. Illustrate the formation of reverse micelle using a labeled diagram. **(3 marks)**	15	CO4

	c. Demonstrate the use of the reverse micellar extraction method to isolate hydrophilic proteins. **(2 marks)** d. Differentiate between reverse micelle extraction and filtration for isolation of proteins by listing one advantage and one disadvantage of each. **(1*4 = 4 marks)**		
Q 26	a. What does HPLC stand for? **(1 mark)** b. An HPLC instrument flow has been shown in the figure below. Label parts A, B, C, D, and E. **(0.5*5 = 2. 5 marks)** c. Explain the role of A, B, C, D, and E parts briefly. **(1*5 = 5 marks)**  You have a sample containing Na^{+}, Ca^{2+}, Al^{3+}. d. Which chromatography column will you use? **(1.5 mark)** e. Explain the working mechanism of the column chromatography you chose above (in option d). **(2 marks)** f. Draw a chromatogram (voltage v/s time) showing the order in which Na^{+}, Ca^{2+}, and Al^{3+} will be eluted and explain the reason behind it **(1+2 = 3 marks)**	15	CO5
Section D **(2Qx10M=20 Marks)**			
Q 27	a. Explain membrane-based separation? **(2 marks)** b. Mention which membrane-based filtration is used in blood filtration in patients with kidney failure. Demonstrate the working mechanism with the help of a diagram. **(8 marks)**	10	CO3
Q 28	Select a bioproduct of your choice. Design a detailed flowchart outlining the key steps involved in its production. Discuss each step's specific role in production, isolation, purification, concentration, or recovery of the bioproduct. Ensure that your flowchart includes at least five distinct stages, and briefly explain the processes or techniques used at each stage to optimize the final product. **(5*2 = 10 marks)**	10	CO5