U.S.N.										

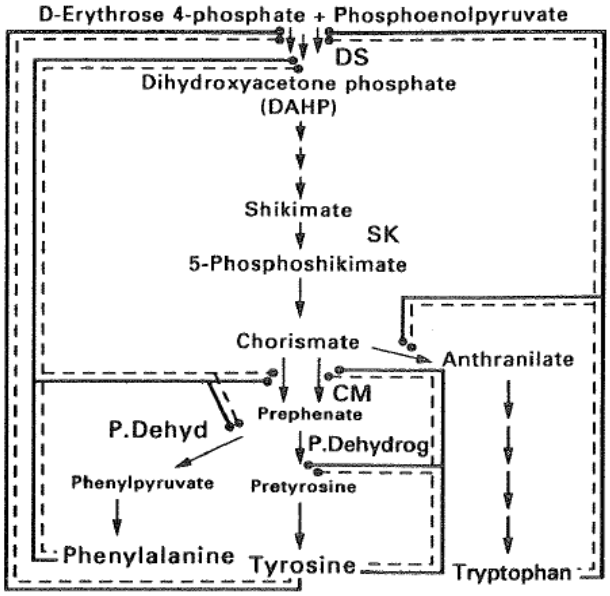
B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

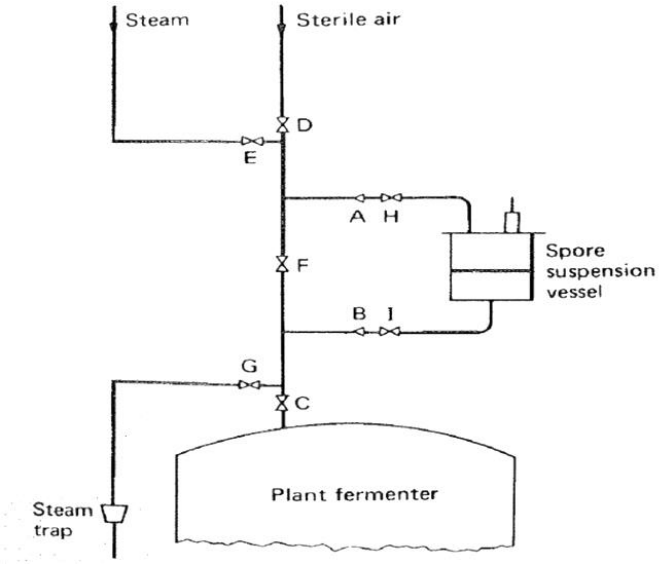
January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 22BT6PCBPT **Max Marks: 100**
Course: BIOPROCESS TECHNOLOGY

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

			CO	PO	Marks
		UNIT – I			
1	a)	A researcher wants to produce a product from an organism *S.aureofaciens.* Suggest a suitable inoculum development process/s for it.	*CO* 1	*PO1*	**06**
	b)	Deliberate the various feedback control mechanisms for the control of biosynthesis.	*CO* 1	*PO1*	**08**
	c)	A biotechnologist is interested to overproduce Phenylalanine through the following controlled biosynthesis of the amino acids in *E.Coli*. Analyse the pathway demonstrate the mechanism of control and Propose a strain improvement technique to overcome it so as to overproduce Phenylalanine. 	*CO 2*	*PO 3*	**06**
		OR			

<table>
<tr><td></td><td>2</td><td>a)</td><td>Propose the models for overproduction of primary metabolites by decreasing the concentration of a repressing/inhibiting end product</td><td>CO 1</td><td>PO1</td><td>06</td></tr>
<tr><td></td><td></td><td>b)</td><td>Elucidate the gradient plate technique for the isolation of analogue resistant strains.</td><td>CO 1</td><td>PO1</td><td>06</td></tr>
<tr><td></td><td></td><td>c)</td><td>Suggest a model for the selection of a desired organism where the competitions between two organisms capable of growth in a continuous enrichment culture exist. List the difficulties and how to overcome them?</td><td>CO 1</td><td>PO1</td><td>08</td></tr>
<tr><td></td><td></td><td></td><td>UNIT – II</td><td></td><td></td><td></td></tr>
<tr><td></td><td>3</td><td>a)</td><td>A researcher is interested to produce X product from Y as carbon substrate. The process organism demands very high oxygen mass transfer coefficient and very sensitive to shear stress. Pertaining to this product:
i. Suggest the most suitable and economical fermenter to carry out the fermentation.
ii. With a neat sketch, describe the construction and working of the above suggested fermenter.</td><td>CO 2</td><td>PO3</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>A researcher was culturing an organism in a reactor. During culturing she added toxic compounds to the medium to kill the organisms immediately. Increase in DO concentration upon addition of toxic compounds followed by the aid of DO analyzer and a recorder. Using the following data, calculate the Volumetric oxygen transfer coefficient (K_La) for the reactor. Saturated DO is 9mg/ml.
<table>
<tr><td>Time(mins)</td><td>CL or DO (mg/l)</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>2</td><td>3</td></tr>
<tr><td>2.5</td><td>4</td></tr>
<tr><td>3</td><td>5</td></tr>
<tr><td>4</td><td>6.5</td></tr>
<tr><td>5</td><td>7.2</td></tr>
</table></td><td>CO 2</td><td>PO1</td><td>05</td></tr>
</table>

		c)	Analyse the diagram and demonstrate the aseptic inoculation of a plant fermenter from a spore suspension vessel.  	***CO*** 2	***PO3***	**05**
			OR			
	4	a)	A biotechnologist is interested to design and optimise a media for a fermentation process with 4 independent factors and 3 dummy factors using Plackett Burman design. The results of different experimental trials are as follows: FACTORS EXPERIMENT | A | d1 | B | d2 | C | d3 | D | Result y 1 | + | – | – | – | + | + | + | 7 2 | – | + | + | – | + | – | + | 9 3 | + | + | + | – | – | + | – | 10 4 | + | + | – | + | – | – | + | 9 5 | + | – | + | + | + | – | – | 8 6 | – | + | – | + | + | + | – | 7 7 | – | – | + | + | – | + | + | 10 8 | – | – | – | – | – | – | – | 7 Pertaining to this process, how she can apply the PB design to determine the significance of each independent factor.	***CO***2	***PO3***	**12**
		b)	If unsterile broth was shown to contain 10^{11} viable organisms cm^{-3} in a 1000dm^3 vessel and acceptable risk of contamination is 1 in 1000 then i. Calculate the Del factor. ii. If a fermentation broth were heated from 100^0C to 121^0C in 30 minutes & cooled from 121^0C to 100^0C in 17 minutes and if the Del factor for both heating and cooling is 12.549 then calculate Del factor for heating and cooling cycles. iii. Calculate the holding Del factor. iv. Calculate the holding time, if specific death rate at 121^0C is $2.54min^{-1}$, also calculate the same if contribution made by the heating and cooling parts of the cycle were ignored. v. If the size of the fermenter is increased to 5000dm^3 and if you want to achieve the same sterility then calculate the Del factor. vi. Comment on all the results.	***CO***3	***PO2,5***	**08**

			UNIT – III			
	5	a)	Compare and contrast the different classes of bio-products based on their various characteristics.	***CO*** 4	***PO1***	**06**
		b)	A biotechnologist is interested to separate the dispersed material in the medium on a large scale operation in continuous mode with a system for removing the suspended material continuously that is formed. The slurry has high proportion of solids and the density difference is not noticed much between the dispersed material and the medium in which they are dispersed. Pertaining to this separation: i. Suggest most suitable separation equipment. ii. Also describe the construction and working of the suggested separation equipment with a neat diagram.	***CO*** 4	***PO1***	**07**
		c)	A researcher is interested to produce alcohol from yeast and he/she also wanted to efficient recover alcohol as well as intended to have a value addition for the waste. Pertaining to this: i. Suggest a most suitable technology solution. ii. Also demonstrate the construction and working of the suggested technology solution with a schematic representation.	***CO*** 4	***PO1***	**07**
			OR			
	6	a)	Demonstrate how Darcy's law is used in selection of the appropriate filtration equipment for separation of solids from slurry.	***CO*** 1	***PO1***	**08**
		b)	Discuss how the properties of biological substances are useful to select a suitable bioprocess separation technique. i.Solubility and Diffusivity ii.Partition coefficient and volatility	***CO*** 1	***PO1***	**04**
		c)	Demonstrate the process design criteria for the production and recovery of Monoclonal antibodies.	***CO***4	***PO1***	**08**
			UNIT – IV			
	7	a)	A process fluid with a concentration of 4.4 g/1 is filtered using a spiral wound membrane module, which totally retains the product. At a certain trans membrane pressure the permeate flux is 1.3×10^{-5} m/s. The diffusivity of the product is 9.5×10^{-11} m^2/s while the wall concentration at this operating condition is estimated to be 10 kg/m^3. Predict the thickness of the boundary layer. If the permeate flux is increased to 2.6×10^{-5} m/s while maintaining the same hydrodynamic conditions within the membrane module, what is the new wall concentration?	***CO*** 4	***PO1***	**08**
		b)	A biotechnologist is interested to separate a product from a source in a batch mode system. The product is highly liable to heat. Pertaining to this separation: i. Suggest most suitable separation equipment. ii. Also demonstrate the construction and working of the suggested separation equipment with a schematic representation.	***CO***4	***PO5***	**07**
		c)	A researcher is interested to enhance the productivity and he wanted to remove compounds that have relatively low water solubility. Refer to this; suggest the possible technology solutions to address the issue.	***CO*** 4	***PO5***	**05**

			OR			
	8	a)	A biotechnologist is intent to separate a heat liable product Y from a source X in a batch type method. Pertaining to this separation: i. Suggest most suitable separation equipment. ii. Also demonstrate the construction and working of the suggested separation equipment with a schematic representation.	***CO*** 4	***PO5***	**10**
		b)	Compute the volumetric permeate flux at a trans membrane pressure of 50 KPa when a solute with 0.8 micron average diameter separated in the cross-flow mode using a MF membrane having an area of 100 cm^2. The steady state cake layer formed on the membrane has a thickness of 10 microns and a porosity of 0.35. If the viscosity of the filtrate obtained is 1.4 cp. When water (viscosity = 1 cp) was filtered through the same membrane at the same trans-membrane pressure, the permeate flux obtained was 0.1mm/s.	***CO*** 4	***PO5***	**10**
			UNIT – V			
	9	a)	With a schematic representation, demonstrate the design of circulating liquid evaporator-crystallizer.	***CO*** 1	***PO1***	**07**
		b)	Suggest a most widespread product polishing operation for the most of bulk pharmaceuticals and organic fine chemicals which are manufactured in crystalline form. Comment on necessity of such operations.	***CO*** 1	***PO1***	**05**
		c)	With a schematic representation demonstrate the freeze drying technique.	***CO***4	***PO1***	**08**
			OR			
	10	a)	With a schematic representation, demonstrate the design of circulating magma evaporator-crystallizer.	***CO***4	***PO1***	**06**
		b)	With a schematic representation discuss the liquid-liquid extraction process	***CO***4	***PO1***	**07**
		c)	With a schematic diagram discuss the construction and working of Screen Conveyor Dryers.	***CO***4	***PO1***	**07**

****