



B.E/B.TECH DEGREE EXAMINATIONS: APRIL /MAY 2024

(Regulation 2018)

Fourth Semester

BIOTECHNOLOGY

U18BTT4001: Fluid and Particle Mechanics in Bioprocess

COURSE OUTCOMES

- CO1: Conceptualize fluids properties and its behaviour under static conditions.
 CO2: Identify and analyse the significance of pressure drops and boundary layers concepts.
 CO3: Elucidate the flow measurements and transportation of fluids.
 CO4: Apply the principles of size reduction and equipment's.
 CO5: Solve importance of mixing and agitation and scale up.
 CO6: Elaborate the principles of filtration, centrifugal and sedimentation.

Time: Three Hours

Maximum Marks: 100

**Answer all the Questions: -
 PART A (10 x 2 = 20 Marks)
 (Answer not more than 40 words)**

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| 1. Define Newtons Law of Viscosity. | CO1 | [K ₁] |
| 2. Outline the advantages of dimensional analysis. | CO1 | [K ₂] |
| 3. List out the assumptions made in the derivation of Bernoulli's equation. | CO2 | [K ₁] |
| 4. What is the significance of Ergun equation? | CO2 | [K ₁] |
| 5. Compare constant and variable head meters. | CO3 | [K ₂] |
| 6. Define cavitation. | CO3 | [K ₁] |
| 7. Define ideal screen. | CO4 | [K ₁] |
| 8. Classify size reduction equipment's. | CO4 | [K ₂] |
| 9. What is the purpose of agitator in a bioreactor? | CO5 | [K ₁] |
| 10. Illustrate the ideas involved in constant rate filtration and constant pressure filtration. | CO6 | [K ₂] |

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

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| 11. | a) Compare the characteristics of Newtonian and non-Newtonian fluids. | 6 | CO1 | [K ₂] |
| | b) Explain the classification of fluid flow and list out the various properties of fluids. | 10 | CO1 | [K ₂] |
| 12. | a) List out the types of loss of energy in pipes. | 6 | CO2 | [K ₁] |
| | b) The water is flowing through a pipe having diameters 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm ² , Determine the intensity of pressure at section 2. | 10 | CO2 | [K ₅] |
| 13. | a) Describe the construction and working of a Venturi meter and derive the necessary equations. | 8 | CO3 | [K ₅] |
| | b) Discuss about types of valves and sizing of valves. | 8 | CO3 | [K ₆] |
| 14. | a) Discuss about the detailed classification of pumps in the bio process industries. | 10 | CO3 | [K ₆] |
| | b) Explain about blower, fan and compressors. | 6 | CO3 | [K ₂] |
| 15. | a) A dolomite mixture having the following screen analysis (Weight %) is screened through a standard 100 mesh screen. Determine the effectiveness of the screen and the mass ratios of overflow and underflow to feed. | 8 | CO4 | [K ₅] |

<i>Mesh</i>	<i>Feed</i>	<i>Oversize</i>	<i>Undersize</i>
35	7.07	13.67	0.00
48	16.60	32.09	0.00
65	14.02	27.12	0.00
100	11.82	20.70	2.32
150	9.07	4.35	14.32
200	7.62	2.07	13.34
<200	33.80	0.00	70.02
100	100	100	100

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| 16. | b) Estimate the operating speed of the ball mill from the following data: (i) Diameter of ball mill = 500 mm (ii) Diameter of ball = 40 mm (iii) Operating speed is 50% of the critical speed of the mill. | 8 | CO4 | [K ₅] |
| 16. | a) Prove that $N_{PO} = \Phi \{N_{Re}, N_{Fr}\}$ | 10 | CO5 | [K ₅] |

Where N_{PO} = Power number, N_{Re} = Reynolds number, N_{Fr} = Froude number

Evaluate the correlation using Buckingham Pi method.

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| b) | A filter press is used to filter a sludge forming a nonuniform compressible cake. At a constant pressure difference, 6000 litres of filtrate are obtained in 1 hour. Washing is done with 1200 litres of water; it proceeds exactly as filtration. The filtrate has the same properties as the wash water. Neglecting the resistance of filter cloth, determine the washing time required. Assume the necessary data. | 6 | CO6 | [K ₅] |
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