QP Code: RA23BTECH125 Reg. No | | | | | | | | | | AY 23

GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR
(GIET UNIVERSITY)

B. Tech (Fourth Semester - Regular) Examinations, April – 2025

23BBTPC24003 – Upstream Process Engineering

(Biotechnology)

Time: 3 hrs Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions		CO #	Blooms Level
a.	Define the term Sphericity and derive its mathematical expression	CO2	K1
b.	Explain the concept of Critical Speed in the context of particle motion in rotating equipment.	CO2	K1
c.	State and explain Newton's Law of Viscosity with its mathematical form	CO1	K2
d.	Interpret the term Critical Thickness of Insulation and discuss its significance in heat transfer	CO2	K1
e.	Define Relative Volatility and explain its importance in the separation of liquid mixtures by distillation	CO2	K3

PART – B **(10 x 5=50 Marks)**

Answer ***ALL*** the questions		Marks	CO #	Blooms Level
2. a.	Define and explain the concept of size reduction. Analyze the main objectives and underlying principles of size reduction, and evaluate how these principles affect equipment selection and process efficiency.	5	CO1	K1
b.	Explain the working principle, construction, and operational features of a Ball Mill as size reduction equipment. Discuss the factors affecting its efficiency and performance in industrial applications.	5	CO2	K2
	(OR)			
c.	Derive the expression for the energy and power consumption in a size reduction machine, incorporating both mechanical efficiency and crushing efficiency.	6	CO1	K1
d.	Compare and contrast open-circuit and closed-circuit grinding systems in mineral processing. Discuss their operational principles, advantages, disadvantages, and typical applications.	4	CO2	K2
3.a.	Derive Bernoulli's equation from Euler's equation of motion for an incompressible, steady, and inviscid fluid flow along a streamline.	6	CO2	K2
b.	Water flows through a horizontal pipe with a varying cross-section. At point 1, the velocity of water is 3 m/s, and the pressure is 150 kPa. At point 2, the velocity is 5 m/s. Calculate the pressure at point 2, assuming the flow is steady, incompressible, and there is no change in elevation.	4	CO2	K1
	(OR)			
c.	Derive the continuity equation for fluid flow through a pipe, assuming steady, incompressible, and non-viscous flow.	5	CO2	K2

d.	Explain the construction, working principle, and applications of a Venturimeter. Derive the equation to calculate the flow rate using the Venturimeter.	5	CO3	K3
4.a.	Derive an expression for steady-state heat conduction in one dimension through a composite wall.	5	CO3	K2
b.	The temperature at the inner and outer surfaces of a boiler wall made of 20 mm thick steel and covered with an insulating material of 5 mm thickness are 300 ^{0}C and 50 ^{0}C respectively. If the thermal conductivities of steel and insulating material are 58W/m^{0}C and 0.116 W/m^{0}C respectively, determine the rate of flow through the boiler wall.	5	CO4	K3
	(OR)			
c.	Derive the expression for heat transfer rate Q under combined conduction and convection	5	CO3	K1
d.	Water flows at the rate of 65 kg/min through a double pipe counter flow heat exchanger. Water is heated from 50 ^oC to75 ^oC by oil flowing through the tube. The specific heat of the oil is 1.780 KJ/kg.K. The oil enters at 115 ^oC and leaves at 70 ^oC.the overall heat transfer co-efficient is 340 W/m2K.calcualte the following	5	CO4	K2
5.a.	What is diffusion and what factors affect the rate of diffusion? How does molecular diffusion differ from bulk or turbulent diffusion?	5	CO4	K1
b.	Derive the Flux Equation in case of in case steady state diffusion of A through No diffusing B in case of Gas.	5	CO3	K2
	(OR)			
c.	Derive the Flux Equation in case of an Equimolecular counter diffusion in case of Liquid.	5	CO4	K1
d.	Derive the Flux Equation in case steady state diffusion of A through Nondiffusiong B in case of Liquid.	5	CO4	K3
6.a.	Do the analysis among mass, heat and momentum transfer? From this mention the Reynolds analogy and Chilton colburn analogy.	5	CO1	K1
b.	Using a component balance, derive the operating line equation for the stripping section of a distillation column.	5	CO2	K2
	(OR)			
c.	Using a component balance, derive the operating line equation for the enriching section of a distillation column.	5	CO1	K1
d.	Derive the Rayleigh's equation in terms of relative volatility in case of differential distillation.	5	CO2	K2

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