GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
UNIT OPERATION OF CHEMICAL ENGINEERING I
FT403A

TIME ALLOTTED: 3 HOURS **FULL MARKS: 70**

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)

1.Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

		Marks	CO No.
1. (i)	Stokes is the unit of a) Length b) area c) viscosity d) kinematic viscosity	1	CO1
(ii)	When the value of $N_{Re} > 4000$ the state of fluid flow is a) laminar b) transition c) turbulent d) none of these	1	CO2
(iii)	What is the unit of thermal conductivity? a) Kcal/hr.m2 ^{0}C b) Kcal/hr.m. ^{0}C c) Kcal/hr.m d) Kcal/hr.^{0}C	1	CO4
(iv)	When warm and cold liquids are mixed, the heat transfer is mainly by a) conduction b) convection c) radiation d) both (a) and (b)	1	CO4
(v)	Which of the following is a shear-thickening fluid? a) Bingham plastic b) Thixotropic c) Dilatant d) Pseudoplastic	1	CO2
(vi)	The kinematic viscosity of a water having viscosity 0.8 cP is a) 8 stokes b) 0.8 stokes c) 0.08 stokes d) 0.008 stokes	1	CO2

(vii)	Which of the following is a fine Crusher? a) Black Jaw Crusher b) Gyratory Crusher c) Toothhed Roll Crusher d) Dodge Jaw Crusher	1	CO5
(viii)	Which of the following is correct ? a) Rate = Driving force * Resistance b) Driving force = Rate * Resistance c) Resistance = Driving force * Rate d) Rate = Resistance/Driving force	1	CO1
(ix)	Cavitation occurs in a centrifugal pump when a) the suction pressure < vapour pressure of the liquid at that temperature b) the suction pressure > vapour pressure of the liquid at that temperature c) the suction pressure = vapour pressure d) the suction pressure = developed head	1	CO3
(x)	Which area is used in case of heat flow by conduction through a cylinder? a) Logarithmic mean area b) Arithmetic mean area c) Geometric mean area d) None of these	1	CO4
(xi)	Po Which of the following is an advantage of size reduction? a) a)Enhanced heat/mass transfer b) Intimate contact with certain food items c) Enhanced heat/mass transfer & intimate contact with certain food items d) None of the mentioned	1	CO5
(xii)	A ball mill uses _____ a) Impact b) Attrition c) Impact & Attrition d) None of the mentioned	1	CO5

GROUP – B
(Short Answer Type Questions)

(Answer any *three* of the following) **3 x 5 = 15**

		Marks	CO No.
2. (a)	Define Laminar and Turbulent flow.	2	CO2
(b)	Find the type of flow of an oil of specific gravity 0.9 and dynamic viscosity of 20 poise flowing through a pipe of diameter 20 cm and giving a discharge of 10 Lit/S.	3	CO2
3.	A venturimeter is installed in a horizontal pipe line of 30 cm diameter. The difference of pressure at entrance and throat read by mercury manometer is 5 cm when water is flowing at a rate of 50 lit/s. Find the diameter of the venturimeter at the throat, if the coefficient of discharge is 0.96.	5	CO3
4.	Explain the condition of fluidization	5	CO2

5.	Orifice and Venturimeters are variable head meter but Rotameter is variable area meter- Explain	5	CO3
6. (a)	Define work index.	2	CO5
(b)	State and explain Bond's law of crushing	3	CO5

GROUP – C
(Long Answer Type Questions)

(Answer any *three* of the following) **3 x 15 = 45**

		Marks	CO No.
7.(a)	Derive Hagen-Poiseuille Equation of Friction losses in laminar flow through a circular tube.	10	CO2
(b)	A pipeline 600 m long and of 15 cm diameter is discharging an oil with velocity of 50 cm/sec. If the kinematic viscosity of oil is 19 cm^2/sec, find the loss of head due to friction.	5	CO2
8 (a)	Derive a relation between overall heat transfer coefficient & individual heat transfer coefficient based on inside and outside area.	10	CO4
(b)	A steam pipe line, 150/160 mm. in diameter, is covered with a layer of insulating material of thickness 50 mm. The thermal conductivity of the pipe is 50 w/m-k & that of insulating material is 0.08 w/m-k. The temperature inside the pipeline is 120 ° C & that of the outside surface of the insulation is 40 ° C. Calculate the rate of heat transfer per 1 m length of pipe.	5	CO4
9 (a)	Discuss the mechanism of condensation heat transfer.	5	CO4
(b)	Determine the heat transfer coefficient for water flowing in a tube of 16 mm. diameter at a velocity of 3m/s. The temperature of the tube is 24 ° C, the water enters at 80 ° C & leaves at 36 ° C using the Dittus – Boelter equation. where a = 0.3 and the properties of water at the arithmetic mean bulk temperature are $\rho = 984.1$ kg/m^3, $C_p = 4178$ J / Kg K, $\mu = 485 \times 10^{-6}$ $P_a - S$, K = 0.657 W/ m-k	10	CO4
10 (a)	What do you understand by the mean area of heat transfer?	3	CO4
(b)	Explain the heat transfer by conduction through a composite plane wall.	4	CO4
(c)	Hot water flowing through a tube with a diameter of 16 mm. and a length of 2m. transfers heat through the wall of the tube to the surrounding medium. The rate of flow of water through the tube is 0.01 Kg/s, the water inlet temperature is 80°C & outlet temperature is 36°C & the mean temperature of the wall of the tube is 24°C. given, C_p= 4.178 KJ/Kg K for water. Calculate the heat transfer coefficient based on (i) the arithmetic mean difference (ii) the logarithmic mean difference between the temperature of the water & the wall of the tube.	8	CO4
11 (a)	Describe the objectives of size reduction.	4	CO5
(b)	What do you understand by crushing efficiency ?	4	CO5
(c)	A certain crusher accepts a feed of rock having volume- surface mean diameter of 0.75 inches & discharges a product of diameter of 0.20 inches. The power required to crush 15 T/hr in 12 h.p. What should be the power consumption if the capacity is reduced to 10T/hr & volume surface mean diameter to 0.15 inches by using Rittinger's law.	7	CO5