

2013

DDE

M.Sc. Part-I Examination

CHEMISTRY

PAPER—IV

Full Marks : 75

Time : 3 Hours

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*Illustrate the answers wherever necessary.*

*Answer any five questions.*

1. (a) Discuss the working principles of a Venturimeter with a neat sketch. Explain its merits and demerits over other meters.
- (b) A horizontal venturimeter of throat diameter 75 mm is connected to a water pipeline of 125 mm diameter. If the mercury manometer attached to this system shows a reading of 375 mm, calculate the rate of discharge of water through the pipe. The venture co-efficient can be taken as 0.98. 5+10

(Turn Over)

2. (a) Define Newtonian and non-Newtonian fluids. Classify non-Newtonian fluids with suitable examples. Draw stress-strain curves for Newtonian and non-Newtonian fluids. 2+2+2
- (b) Derive Bernoulli's equation for frictionless flow of a fluid starting from momentum balance equation. State the assumptions made, if any, in the analysis. Write down the final equation incorporating the effect of friction and work done by the pump. 9
3. (a) What do you mean by filter medium resistance and cake resistance? Derive an expression for the constant pressure filtration connecting the volume of the filtrate collected and the time required for the collection.
- (b) Discuss different types of filtration equipments most commonly used for industrial applications. 5+10
4. (a) State and explain Fourier's Law of molecular transport of heat.
- (b) Show that the Prandtl Number is a ratio of two diffusivities.
- (c) Derive the expression of LMTD for a counter-current shell and tube heat exchanger.
- (d) Describe with a sketch, the operation of a shell and tube heat exchanger. 2+3+5+5
5. (a) Why is the counter flow heat exchanger more efficient than parallel flow heat exchanger? Under what condition, do these exchangers become equally efficient? 5

- (b) Why are the baffles used in shell and tube heat exchanger? 5
- (c) Derive an expression for overall heat transfer coefficient based on outside area of the pipe incorporating the effect of metal wall. 5
6. (a) State and explain Fick's law of diffusion.
- (b) Derive the expression for overall gas-phase mass transfer coefficient in terms of individual mass transfer coefficients.
- (c) A feed (binary mixture of constant relative volatility) of known composition is to be distilled in a continuous distillation column (plate type). The liquid reflux from the condenser is returned to the plate. The distillate composition,  $X_D$  is 0.80, and the reflux ratio is 2.0. Calculate the slope of the operating line on  $x - y$  plot, and the value of intercept on the  $y$ -axis. 2+3+10
7. (a) For a steady state process, what is the relationship between 'mass in' and 'mass out'? What other additional parameters should be considered for unsteady state process?
- (b) Derive an expression for converting mole fraction into mass fraction.
- (c) A feed of liquid mixture containing 42 mol% benzene and 58 mol% toluene is to be fractionated at a rate of 200 mol/h to give a distillate containing 97 mol% benzene and a bottoms containing 98.9 mol% toluene. Calculate the mol/h distillate and mol/h bottoms. (1+2)+2+10



8. (a) Give some examples of conventional fuels.  
(b) What are synthetic fuels?  
(c) Describe the processing of crude petroleum for production of various conventional fuels.

2+3+10

9. (a) Differentiate between renewable and non-renewable fuels with examples.  
(b) Why net calorific value is less than gross calorific value?  
(c) What is the significance of octane number?  
(d) Describe with a flow sheet the three stage processing of petroleum crude.

2+2+2+9

10. (a) With proper definition of the term "ORE" Justify the statement 'sometimes ORE is MINERAL and MINERAL is ORE'.  
(b) Discuss the factors to be considered for mining & processing of any ORE.  
(c) Discuss the principles of FROTH FLOTATION PROCESS for the separation of the metal from the complex ORE Pb-Zn-Cu.

5+5+5