MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH. (CHEMICAL ENGINEERING)
END SEMESTER EXAMINATIONS, April 2018

SUBJECT: INTRODUCTION to CHEMICAL ENGINEERING [CHE3281]
REVISED CREDIT SYSTEM
(30.04.2018)

Time: 3 Hours   MAX. MARKS: 50

Instructions to Candidates:

❖ Answer **ALL** the questions.

❖ Missing data may be suitably assumed.

1A.	An aqueous solution of NaCl is created by using 133 g of NaCl diluted to a total solution volume of 1.00 L. Calculate the molarity, molality, and mass percent of the solution, given a density of 1.08 g/mL and MW of NaCl = 58.442 g/mol.	**3**
1B.	What are various modes of heat transfer? Write about Fourier's law of heat conduction.	**3** **(1+2)**
1C.	A gas consists of 70% propane (C_3H_8) and 30% butane (C_4H_{10}) by volume. Find: I. The stoichiometric air-to-fuel ratio II. The percentage excess air present if a dry analysis of the combustion products shows 9% CO_2 (assume complete combustion). $C_3H_8 + 5\ O_2 + 18.8\ N_2 \rightarrow 3\ CO_2 + 4\ H_2O + 18.8\ N_2$ $C_4H_{10} + 6.5\ O_2 + 24.5\ N_2 \rightarrow 4\ CO_2 + 5\ H_2O + 24.5\ N_2$	**4** **(2+2)**
2A.	With the help of a neat flow diagrams explain how a chemical engineer helps in designing, developing and commercializing a product.	**3**
2B.	At 29.6 °C, pure water has a vapor pressure of 31.1 torr. A solution is prepared by adding 86.8 g of "Y", a nonvolatile non-electrolyte to 350 g of water. The vapor pressure of the resulting solution is 28.6 torr. Calculate the molar mass of Y.	**4**
2C.	What mass of carbon dioxide is produced when 96.1 g of propane react with sufficient oxygen? $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$	**3**
3A.	Define mass transfer and explain about Fick's law of diffusion.	**3**

3B.	A textile dryer is found to consume 4 m³/hr of natural gas with a calorific value of 800 kJ/mole. If the throughput of the dryer is 60 kg of wet cloth per hour, drying it from 55% moisture to 9% moisture, estimate the overall thermal efficiency of the dryer taking into account the latent heat of evaporation only. Latent heat of evaporation = 2257 kJ/K	**4**
3C.	I. According to the U. S. Department of Energy, the 2003 model of the Chevrolet Malibu has a highway fuel economy rating of 29 mi/gal. Compute the equivalent value of this fuel consumption rate in units of km/L. II. Highway regulations in a certain jurisdiction state that a truck with two axles may have a maximum weight of 16000 pounds on the front axle and 20000 pounds on the rear axle. Convert these weights to their equivalents in kilograms	**3** **1+2)**
4A.	In a commercial process, nitric oxide (NO) is produced: $$NH_3 + O_2 \;\rightarrow\; NO + H_2O$$ What mass (in grams) of NO can be made from the reaction of 30.00 g NH_3 and 40.00 g O_2? Calculate the yield depending on the limiting reactant. Also, the chemist obtained 25.50 g NO. What is the percentage yield of this reaction?	**4**
4B.	I. Calculate the mole fraction of ethanol and water in a sample of rectified spirit which contains 95% of ethanol by mass. II. What volume (L) of O_2 gas is needed to completely react with 15.0 g of aluminum at STP? $Al(s) + O_2 (g) \rightarrow Al_2O_3(s)$	**3** **(1+2)**
4C.	What is laminar flow and turbulent flow? Write the formula for Reynold's number.	**3**
5A.	Calculate the equivalent weights of HCl (MW = 36.5) and $Sr(OH)_2$ (MW = 122), of H_2SO_3 (MW=82) and LiOH (MW=24) and HNO_3 (MW = 63) and $Ga(OH)_3$(MW = 121) in the following reactions: I. $HCl + Sr(OH)_2 \rightarrow H_2O + Sr(OH)Cl$ II. $HNO_3 + Ga(OH)_3 \rightarrow H_2O + Ga(OH)_2(NO_3)$ III. $H_2SO_3 + LiOH \rightarrow H_2O + LiHSO_3$	**3**
5B.	Clearly explain about any top eight achievements of a chemical engineer in developing the society.	**4**
5C.	Define Newtonian and non-Newtonian fluids. A reservoir of oil has a mass of 825 kg. The reservoir has a volume of 0.917 m³. Compute the density, specific weight, and specific gravity of the oil.	**3** **(1+2)**