Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

IV SEMESTER B.TECH.

END SEMESTER EXAMINATIONS, April 2017

SUBJECT: INTRODUCTION TO CHEMICAL ENGINEERING [CHE3281]

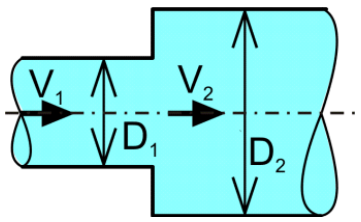
REVISED CREDIT SYSTEM

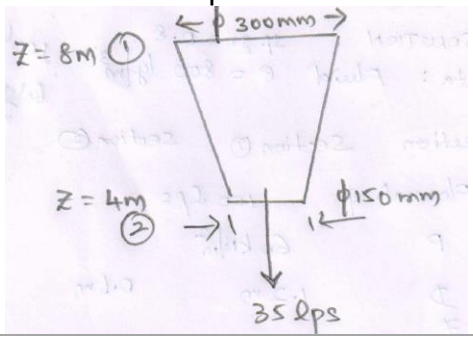
Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ALL** the questions.
- Atomic Mass- Na- 23, K-39.1, C-12. O-16, H-1
- Missing data may be suitable assumed.

1A.	i) Explain the difference between unit operation and process. ii) Calculate the moles of CO_2 formed when 4.30 moles of C_3H_8 reacts with (the required) 21.5 moles of O_2 $C_3H_8(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$	**6** **3+3**
1B.	i) A particularly fine variety of cheese is sold for $1.47 per ounce. What is this price in dollars per kilogram? ii) In a commercial process, nitric oxide (NO) is produced: $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$ What mass (in grams) of NO can be made from the reaction of 30.00 g NH_3 and 40.00 g O_2 finding the limiting reactant?	**6** **2+4**
1C.	i) Define Molarity, Molality and Normality (with the formulae). ii) A small teaspoon of baking soda weighs 4.2g.Calculate the moles, mass and volume of carbon dioxide formed when it is thermally decomposed in the oven. $2NaHCO_{3(s)} \Longrightarrow Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$	**8** **3+5**
2A.	i) How many grams of nonvolatile compound B (molar mass= 97.80 g/mol) would need to be added to 250.0 g of water to produce a solution with a vapor pressure of 23.756 torr? The vapor pressure of water at this temperature is 42.362 torr. ii) Define the term colligative property and list two physical properties of a solution that can be classified as colligative properties	**7** **5+2**
2B.	Calculate the equivalent weights of HCl (MW = 36.5) and $Sr(OH)_2$(MW = 122) in the following reactions and also explain the reason behind it. (a) $HCl + Sr(OH)_2 \rightarrow H_2O + Sr(OH)Cl$	**8**

	(b) $2HCl + Sr(OH)_2 \rightarrow 2H_2O + SrCl_2$	
2C.	Define a process. Write about process classification explaining them with help of an example.	**5**
3A.	Define Chemical Engineering. Explain about any four applications of chemical engineering?	**6**
3B.	A coal has the following ultimate analysis: % by mass Carbon 90 Hydrogen 3 Oxygen 2.5 Nitrogen 1 Sulfur 0.5 Ash 3 Calculate: (a) the volumetric air supply rate required if 500 kg/h of coal is to be burnt at 20% excess air (b) the resulting $\%CO_2$ (dry) by volume in the combustion products.	**8**
3C.	If 35,000kg of whole milk containing 4% fat is to be separated in a 6 hour period into skim milk with 0.45% fat and cream with 45% fat, what are the flow rates of the two output streams from a continuous centrifuge which accomplishes this separation?	**6**
4A.	Define Material Balance and with the help of a neat diagram explain the basic principles in material balance using law of conservation of mass.	**8**
4B.	i) On a circular conduit there are different diameters: diameter D1 = 2 m changes into D2 = 3 m. The velocity in the entrance profile was measured: v1 = 3 ms^{-1}. Calculate the discharge and mean velocity at the outlet profile. Determine also type of flow in both conduit profiles (whether the flow is laminar or turbulent). The kinematic viscosity of water is $124\chi10^{-6}$ m^2s^{-1}.  ii) A manometer is used to measure the pressure drop across an orifice. Liquid A is a mercury with *density* = 13590 kg/m^3 and fluid B flows through the orifice and filling the manometer leads is brine with density = 1260 kg/m^3. When pressure at the taps are equal, the level of Hg in the manometer is 0.9 m below the orifice taps. Under operating conditions, the gauge pressure at the upstream tap is 0.14 bar and the pressure at the downstream tap is 250 mm Hg below atmospheric. Calculate the reading of the manometer.	**7** **4+3**
4C.	Write any 3 differences between ideal and real gas. Define Boyle's and Avogadro's laws.	**5**
5A.	i) Define Newton's law of viscosity. What is the difference between	**5**

	Newtonian and non-Newtonian fluids? ii) A reservoir of oil has a mass of 825 kg. The reservoir has a volume of 0.917 m^3. Compute the density, specific weight, and specific gravity of the oil.	**2+3**
5B.	i) How does the mode of Heat transfer takes place in Conduction, Convection and Radiation? ii) A 1.00L sample of dry air at 25°C and 786mmHg contains 0.925g of N_2, and other gases. (a) What is the partial pressure of N_2 in the air sample? (b) What is the mole fraction and mole percent of N_2 in the air?	**7** **3+4**
5C.	i) Define Fick's law of Diffusion. ii) Water is flowing through a tapering pipe having diameter of 300 mm and 150 mm at section 1 and section 2 respectively. Discharge through the pipe is 35 litre/s. Section 1 is 8 m above the datum line and section 2 is 4 m above the datum line. Find the pressure intensity at section 2 if the pressure at section 1 is 400 kN/m^2. 	**8** **2+6**