Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: PROCESS DESIGN OF CHEMICAL EQUIPMENTS [CHE 301]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY ONE FULL** question.
- Missing data may be suitable assumed.

1A. Explain in detail as to how the Economic pipe diameter is calculated using Genereaux method? **15**

1B. Estimate the size of hydrocyclone needed to separate 86% of particles with a diameter greater than 0.08 mm, from a dilute slurry with a flow rate of 1250 m^3/day. The density of liquid is 1080 kg/m^3 and that of the solid is 3000 kg/m^3, viscosity 1.5 mNs/m^2 **15**

1C. Synthesis gas has to be cooled from 250 ^oC to 25 ^oC. Cold water is available at 20 ^oC and the output is preferred at 40 ^oC. Design a suitable STHE for the process. **70**

DATA:

	Gas mixture
Specific heat (KJ/kg K)	2.008
Density (kg/m3)	0.51
Viscosity (cP)	0.014
Thermal Conductivity (W/m K)	0.149

Composition of Synthesis gas is as follows:

H_2 – 0.94665 ks/s, CO_2 – 11.066 ks/s, CO – 0.33 kg/s, CH_4 – 0.05 kg/s, N_2 – 0.081 kg/s

- Use $Q_h = Q_c$ without any extra allowance

2A. Carbon dioxide is to be absorbed from air at 24 ^oC and 1 atmosphere pressure using a 30% MEA solution entering with 0.06 moles of CO_2 on solute free basis. The entering gas has 6% O_2, 79% N_2 and the rest CO_2. It leaves with 2% CO_2. Design a counter current Sieve plate absorber. Data of X and Y are in solute free basis. **100**

X	0.05	0.06	0.062	0.064	0.066	0.068	0.072
Y	$6.0*10^{-3}$	$14.23*10^{-3}$	$32.8*10^{-3}$	$65.4*10^{-3}$	0.1213	0.2047	0.3411

PROPERTIES

MEA mol. Wt. = 61.07 kg/kgmole	Liquid density = 1000 kg/m^3
Gas viscosity = 0.0175 cP	Liquid viscosity = 1 cP
Gas diffusivity $D_g = 0.163*10^{-4}$ m^2/s	Liquid diffusivity $D_l = 1.9*10^{-5}$ cm^2/s
σ of solution and water = 67.6 and 72.8 dyne/cm respectively	

Important INFORMATION to be incorporated:

- $(L_m'/ G_m')_{op} = 1.25(L_m'/ G_m')_{min}$
- Use Φ_{dc} as 0.5