Registration no: | | | | | | | | | | |

Total Number of Pages: 02 **B.TECH**
PCCH4303

5th Semester Regular / Back Examination 2015-16
PROCESS EQUIPMENT DESIGN
BRANCH: CHEMICAL
Time: 3 Hours
Max marks: 70
Q.CODE: T369

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Following Books are Allowed –
1. **M.V. Jhosi, Process Equipment Design**
2. **Coulson J. M. & Richardson J. F., Chemical Engineering, Vol VI, Pergamon Press**
3. **Data Table (Appendix- Process Heat Transfer-D Q Kern)**

Q1 Answer the following questions: **(2 x 10)**

a) Why nozzle reinforcement is required?
b) When flange joints are used?
c) What is breathing loss?
d) Is the corrosion allowance necessary, if no then when and if yes how much?
e) What is BWG and what for it is used?
f) What is the shell ID, if 562 number of 1 in OD tubes arranged 1.25 in rectangular pitch in 2-4 STHE?
g) What is ligament?
h) Define dirt factor.
i) What is the role of weirs in plate tower?
j) What is the role of liquid distributor and re-distributors in packed tower?

Q2 **a)** A counter current packed tower is used to separate ammonia from coke oven gas by employing water (solute free) as solvent. Inlet gas contains 20% ammonia at a rate of 154 kmol/hr. Outlet gas and liquid contain 2% and 15% ammonia after recovery (all are mole %). Calculate the packing height required if mass transfer coefficient (K_{ya}) is 132 kmol/hr.m^2.(ΔY). Equilibrium relation is y=2x, where x and y are mole fractions of ammonia in liquid and gas phase respectively. **(5)**

b) Draw a neat sketch of packed tower with specifications. **(5)**

Q3 **a)** A horizontal tube single effect evaporator to concentrate 6000kg/hr of 8% (by weight) caustic soda solution to 20% (by weight) with a steam economy of 0.9. The overall heat transfer co-efficient may be taken as 3000 Kcal/ hr.m^2 ^{0}C. Latent heat of vaporization of the steam is 540 Kcal/kg. Tubes of 50mm o.d. (45mm i.d.) and length of 150cm are arranged in 75mm square pitch. Calculate the height and diameter of the evaporator. **(5)**

b) Draw a neat sketch of vertical tube evaporator with specifications. **(5)**

Q4 A methanol-water solution containing 45wt% methanol at 28^0C is to be continuously rectified at 1 std. atm pressure in a plate tower, to provide a distillate containing 97% methanol and a residue containing 1.0% methanol (by wt.). Actual bubble cap trays of 25 numbers are arranged with tray spacing of 75 cm. Gas from re-boiler at 1.5 m/sec and 7200 m^3/hr flow to the tower. Both down take areas are 20% of total cross-sectional area. Calculate the height and diameter for the tower. **(10)**

Q5 **a)** A 1-2 heat exchanger is to supply hot water receiving heat from flue gas at 420 K and cooled to 400 K. 1000 kg/sec of water at 300 K enters the tubes at a velocity of 5m/sec and leaves at 325 K. Gas inlet pressure may be taken as 1atm. Calculate the number of tubes, shell ID, Length of exchanger. **(5)**

Data: Tubes- i.d.= 2.12cm, o.d.= 2.54cm, P_T= 3.175 cm (Δ),
U_D = 1000 Kcal/hr.m^2.K

b) Draw a neat sketch of 1-4 shell and tube heat exchanger with specifications. **(5)**

Q6 **a)** Draw a neat sketch of continuous distillation column (plate tower) with specifications. **(5)**

b) Draw a neat sketch of a sieve tray with specifications. **(5)**

Q7 **a)** Design a shell for storage vessel with at least two different thickness sheets. **(5)**

Data:

Tank diameter	25m
Tank height	20m
Sp. Gr. of liquid	0.8
Material	Carbon Steel (structural)
Permissible stress-	142 N/mm^2
Density	7.7
Modulus of elasticity	2×10^5 .

b) Draw a neat sketch of the bottom plate with annular ring and column supported roof with specifications. **(5)**

Q8 Write short notes on any two: **(5 x 2)**

a) Undesirable operating conditions in continuous distillation operation.
b) Feeding in multi-effect evaporators.
c) Temperature correction factor (F_T) in multi-pass heat exchanger.
d) Dual function heat exchangers.