Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VI SEMESTER B.TECH (CHEMICAL ENGINEERING)
END SEMESTER EXAMINATIONS, MAY 2016
SUBJECT: PROCESS DESIGN AND DRAWING IN CHEMICAL ENGINEERING

(CHE302)

Time: 4 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY ONE FULL** question.
- Missing data may be suitably assumed.
- Use of IS 2825-1969 and IS 4507- 1967 is permitted

1. The mechanical design of a standard (calendria) vertical short tube evaporator with the help of the following data:

Evaporator drum : operating under vacuum Amount of water evaporated : 2500kg/hr Heat transfer area : 220m^2 Steam pressure : 0.15 N/mm^2 Density of liquid : 1000kg/m^3 Material of construction (MOC) : Evaporator : carbon steel IS- 2062 Tubes : brass Permissible stress for carbon steel : 98N/mm^2 Modulus of elasticity : Carbon steel : 19.0 x 104 N/mm^2 Brass : 9.5 x 104 N/mm^2 Conical head bottom : cone angle 120^0 Torispherical head at top : (100-10) Poisons ration : 0.3	**Calendria with vertical tubes** **Tubes and tube lay out :** Tube diameter (outside) : 100mm Tube thickness : 1.5mm Tube length : 1220mm The effective tube length : 1165mm Tube lay out : triangular pitch : 125mm **Bottom flange of the calendria** Flange material – IS-2004-1962 Class -2 Bolting material : 5% Cr Mo Steel Gasket material : asbestos composition (1.6mm thickness) Out side diameter : 3894mm Pitch circle diameter : 3825mm Number of bolts : 112 Flange joint : Lap joint
Support (Bracket) design: Height of vessel : 5 m Clearance from bottom to foundation – 1mm Density of carbon steel – 7820 kg/m^3 Density of brass – 8450kg/mm^3 Wind pressure – 128.5 kg/m^2 Number of brackets – 4 Height of bracket from foundation – 2.25m Permissible stress for structural steel: Tension – 1400kg/cm^2, Compressive – 1233 kg/cm^2, Bending – 1575 kg/cm^2.	Length of drum – 4000mm Operating temperature – 120^oC Top head connected with drum : Flange (IS-2004-1962 Class -2)

2. Design shell and tube heat exchanger (2 pass STHE) with the help of following data

Shell side MOC: carbon steel Number of shell : 1 Number of passes : 1 Fluid : liquid Working pressure : 0.33 N/mm^2 Design pressure : 0.50 N/mm^2 Temperature inlet : 30^oC Temperature outlet : 50^oC Segmental baffles (25% cut) with tie rods spacers Head Crown radius : 400mm Knuckle radius : 40mm Shell flange : female facing Gasket : flat metal – jacketed asbestos filled Bolts – steel Nozzles – inlet and outlet – 75mm Vent - 25mm Drain – 25mm Opening for relief valve – 50mm Permissible stress for carbon steel – 95 N/mm^2 Permissible stress for bolt material–140.6N/mm^2	**Tube side** Tube and tube sheet material : stainless steel (SS 304) Number of tubes – 54 Outside diameter – 18mm Length (maximum U) – 12m Pitch (square) – 25mm Fluid – gas Working pressure – 19 N/mm^2 Design pressure – 21.5 N/mm^2 Inlet temperature – 150^oC Outlet temperature – 55^oC Permissible stress – 100.6 N/mm^2 **Channel and channel cover** Material – carbon steel (IS-2062) Joint with tube sheet – ring facing Gasket – steel jacked asbestos Nozzle – inlet and outlet dia. – 75mm Permissible stress – 95 N/mm^2