(3 hours) Maximum marks: 80

N.B.

1. Question No. 1 is **compulsory**.
2. Attempt any **three** questions out of remaining **five** questions.
3. Assume any suitable data wherever required.
4. Draw figures wherever needed.

1. Write short notes on any **four**. (20)
   a) Expansion bellows
   b) Multilayered high pressure vessels
   c) Types of downcomers
   d) Rotary drum filter
   e) Entrainment separators

2. Design a Fixed-tubesheet heat exchanger for the following data:

Shell side:

Design pressure = 0.5 N/mm^2

Permissible stress for shell material, Carbon steel = 95 N/mm^2

Tube side:

Number of tubes = 60

Tube outside diameter = 20 mm

Design pressure of tube side fluid = 2.5 N/mm^2

Permissible stress of tube material = 120 N/mm^2

Tube pitch = Square

Channel flange

Flange material of construction – carbon steel

Permissible stress for flange material = 95 N/mm^2

Permissible stress for bolt material = 140 N/mm^2

Joint with tube sheet – Ring facing

Ring gasket width = 18 mm

Gasket factor = 5.5

Gasket seating stress = 126 N/mm^2

Permissible stress for flange and tube sheet material= 100 N/mm^2

Design

I) Shell (diameter and thickness) (8)
II) Flange between channel and tubesheet (6)
III) Tube sheet thickness (4)
IV) channel cover thickness (2)

3. (a) Write the design procedure of calculating shell wall thickness of a tall column. Design should include determinaion of various stresses, calculation of resultant longitudnal stress and the resultant stress. (12)

(b) Write notes on column internals for a packed column. (8)

4.Design a calendria type evaporator with the following data assuming that it has baffle for entrainment separation.

Evaporator drum under vacuum	= external pressure 0.1 N/mm^2
Amount of water to be evaporated	= 3,000 kg/hr
Heating surface required	= 250 m^2
Steam pressure	= 0.2 N/mm^2
Density of liquid	= 1000 kg/m^3
Density of vapor	= 0.085 kg/m^3
Effective Tube length	= 1500 mm
Tube outside diameter	= 100 mm
Tube thickness	= 1.5 mm

Tubes laid on triangular pitch
Assume downtake pipe as 50% of the total tube cross sectional area
Permissible stress for evaporator material = 98 N/ mm^2
Poisson's ratio = 0.3
Modulus of elasticity for carbon steel = 2 x 10^{5}N/mm^2
Modulus of elasticity for brass = 9.5 x 10 ^{4} N/mm^2

Design the
(i) Calendria(Diameter and thickness) (8)
(ii) Vapor drum (Diameter and thickness) (8)
(iii)Top torispherical head (4)

5.(a) Show the symbols for the following components
(i)Needle valve (ii) Centrifugal pump (iii) Filter press (iv) Tray drier (v) Jacketed vessel (5)
(b)Write notes on
i) Block diagram ii) Piping and Instrumentation Diagram (10)

(a) Estimate the optimum pipe diameter for a water flow rate of 12 kg/s at 20°C. Carbon steel pipe is used. Density of water 1000 kg / m^3 Viscosity of water at 20°C is 1.1 x 10 $^{-3}$ Ns/m^2. Also find whether flow is laminar or turbulent. (5)

6. A high pressure compound cylinder consists of an inner tube of inner diameter 20 mm and outer diameter of 40 mm. On it is shrunk fit a tube of external diameter 60 mm. The shrink fit should be so done that the contact pressure at the two surfaces do not exceed 1.602 N/mm^2. The cylinder is then subjected to an internal pressure of 10 N/mm^2. Calculate the original dimensions of the tubes and plot the stress distribution.
Coefficient of thermal expansion = 12 x 10^{-6} per ^{0}C , E = 200 x 10^3 N/mm^2