QP Code : 31271

(4 Hours) [Total Marks : 80

N. B. : (1) Question No.1 is compulsory.
(2) Attempt any three questions from question Nos. 2 to 6.
(3) Assume any suitable data wherever required.
(4) Draw figures wherever needed.
(5) Figures to the right indicate full marks.

1. Write short notes on any four. 20
(a) Expansion provision in heat exchanger
(b) Entrainment separators
(c) Material of construction of high pressure vessels
(d) Buried pipeline
(e) Design considerations for crystallizers

2. Design a U-tube heat exchanger for the following data:
Shell side:
Design pressure= 0.8 N/mm^2
Permissible stress for shell material= 100 N/mm^2
Standard torispherical head with knuckle radius as 6% of crown radius
25% cut segmental baffles are provided
Gasket on shell side- Flat metal jacketed asbestos filled
Gasket factor= 3.75
Gasket seating stress= 53 N/mm^2
Tube side:
Number of tubes= 40
Tube outside diameter= 20 mm
Design pressure of tube side fluid = 2.0 N/mm^2
Permissible stress of tube material= 120 N/mm^2
Tube pitch =square
Channel and channel cover:
Material of construction- same as shell
Joint with tube sheet- Ring facing with 18mm width
Gasket factor = 5.5
Gasket seating stress= 126 N/mm^2
Allowable stress for bolt material = 140 N/mm^2

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(a) Design

(i)	Shell (diameter and thickness)	3
(ii)	Head	2
(iii)	Flange joint between shell and tubesheet	3
(iv)	Flange joint between channel and tubesheet	3
(v)	Tube sheet thickness	2
(vi)	Channel and channel cover thickness for a flat cover	2

(b) Draw to a recommended scale the assembly drawing of the above designed U-Tube heat exchanger. 5

3. (a) Write the design procedure of shell wall of a tall column. Design must include all the stresses working on a tall vessel. 12

(b) Describe various types of constructions for high pressure vessels with neat sketches. 8

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

Evaporator drum under vacuum	= external pressure 0.1 N/mm^2
Amount of water to be evaporated	= 3000 kg/hr
Heating surface required	= 350 m^2
Steam pressure	= 0.2 N/mm^2
Density of liquid	= 995 kg/m^3
Density of vapor	= 0.83 kg/m^3
Effective Tube length	= 1750 mm
Tube outside diameter	= 40 mm
Tube thickness	= 1.5 mm

Tubes laid on triangular pitch

Top head is torispherical

Modulus of elasticity for shell material = 20×10^4 N/mm^2

Modulus of elasticity for tube material= 9.5×10^4 N/mm^2

Assume downtake pipe as 50% of the total tube cross sectional area

Permissible stress for evaporator material= 98 N/mm^2

(a) Design the

(i)	Calendria (Diameter and thickness)	4
(ii)	Tubesheet thickness	4
(iii)	Vapor drum (Diameter and thickness)	4
(iv)	Top torispherical head	2

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(b) Draw to a recommended scale the sectional front view of the above designed calendria. 6

5. (a) Show the symbols for the following components 6
   (i) Needle valve
   (ii) Filter press
   (iii) Centrifuge
   (iv) Autoclave
   (v) Ball mill
   (vi) Centrifugal pump

(b) Write notes on 8
   (i) Process flow diagram
   (ii) Piping and Instrumentation Diagram

(c) 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 is 995 kg/m^3 and viscosity of water at 20°C is 1.1 x 10^{-3} Ns/m^2. Also find whether flow is laminar or turbulent. 6

(a) A high pressure compound cylinder consists of an inner tube of inside diameter as 200 mm and outside diameter as 250 mm. A tube of 300 mm external diameter is shrunk fit on it. The contact pressure at the 2 tube surfaces after shrink fit is 7.85 N/mm^2. The combination of the cylinder assembly is then subjected to an internal pressure of 83 N/mm^2. Design the original dimensions required for the tubes and determine the stress distribution. If the co-efficient of thermal expansion is 12x10^{-6}/°C determine what temperature the outer cylinder should be heated to achieve the necessary shrink fit. 12
Assume E = 2 × 10^5 N/mm^2.

(b) Plot the stress distribution along the wall of the above designed high pressure vessel. 8
