Duration: 3 hours Total Marks: 80

N. B. (i) Question number one is compulsory.
(ii) Answer any three questions from the rest.
(ii) Assume suitable data wherever necessary.

Q. 1 Write short note on any four 20

(a) tall column internals

(b) Theories of failure

(c) types of high pressure vessel

(d) Types of heat exchanger

(e) Types of packings

Q. 2 Design a U-tube heat exchanger for the following data-

a) Data –

(i) Shell Side:-

No. of shells – 1, No. of passes – 1,
Fluid – Water, Design Pressure – 0.45N/mm^2
M.O.C. – Carbon Steel,
Permissible stress for C.S. – 100N/mm^2
Standard torrispherical head with knuckle radius as 6% of crown radius
25%cut segmental baffles with tie rods and spacers
M.O.C. for head and all flanges- Carbon steel
Gasket on shell side – Flat metal jacketed asbestos filled
Gasket factor – 3.75, Gasket seating stress -53N/mm^2

(ii) Tube Side:-

Tube and tube sheet material – S.S., No. of tubes – 60
Outside diameter – 20mm, Pitch (Δ^{lar}) – 30mm
Fluid – Carbon Dioxide, Design Pressure – 1.5N/mm^2
Permissible stress for S.S. – 105N/mm^2

(iii) Channel and Channel Cover:-

Material of construction – same as shell
Joint with tube sheet – Ring Facing,
Gasket – Steel jacketed asbestos Gasket factor – 5.5,
Gasket seating stress – 126N/mm^2

Design should include-

(a) Shell, 06
(b) Head, 02
(c) Flange joint between shell and tube sheet, 06
(d) Tube sheet thickness, 03
(e) Channel and Channel cover 03

Q. 3 Design a Standard Vertical Short Tube Evaporator for the following Data –

Evaporator drum under vacuum – external pressure = 0.12N/mm^2
Amount of water to be evaporated = 24,500 N/hr
Heating surface area = 240m^2,
Steam Pressure = 0.12 N/mm^2

Density of Liquid = 9800 N/mm^3,
Density of Vapor = 0.86 N/mm^3
M.O.C. = Low Carbon Steel,
Permissible Stress for Low Carbon Steel = 100 N/mm^2
E for L.C.S. = 20 x 10^4 N/mm^2,
E for Brass = 9.6 x 10^4 N/mm^2
Tube Material = Brass,
O.D. of Tube = 80mm,
Tube Thickness = 1.8mm
Effective length of Tube = 1195mm,
Pitch of tube (Δ^{lar}) = 120mm
Conical heads at top and bottom cone angle = 120^0
Bottom Flange of Calendria: -
Thickness of Flange = 46mm No. of bolts = 120,
P.C.D. = 4250mm, Size of bolts = 20mm dia,
Factor of safety = 3
Design should include-

	(a) Diameter of tube sheet,	04
	(b) Calendria sheet thickness,	04
	(c) Tube sheet thickness,	04
	(d) Evaporator drum thickness and diameter,	06
	(f) Head thickness	02
Q. 4 (a)	Explain the design procedure for shell wall of a tall column. Design procedure should incoroporate calculation of all the stresses acting on the shell.	12
(b)	Draw neat diagram of distillation column with internals	8
Q. 5	A high pressure compound cylinder consist of an inner tube of inner diameter 200 mm and O.D. 250 mm all it is shrunk fit or tube of external dia. 300 mm. The shrink fit so alone that the contact pressure at the two tubes surfaces do not exceed 7.85MPa. The cylinder is then subjected to an internal pressure of 83MPa. Calculate original dimensions of tubes and plot the stress distribution diagram. If coefficient of thermal expansion is $12\times10^{-6}/^oC$. Calculate by what temperature the outer tube should be heated to achieve the necessary shrink fit. Assume E(Modulus of elasticity) = 200×10^3 N/mm^2. Also find reduction in maximum stress by compounding when compared to a single tube of I.D. 300 mm.	10

Data:

D1 = 200 mm D2 = 250 mm
D3 = 300 mm Pi = 83 MPa
Pf = 7.85 MPa E = 200×10^3 N/mm^2
α = 12×10^{-6} / ^oC t =? (temp. difference)
stress distribution =?

To calculate original dimensions of tube so, as to develop a contact pressure of 7.85 N/mm^2. (Calculation of deformation of tube).

Q. 6		10
(a)	State Different NDT techniques. Explain ant two in detail.	
(b)	Write notes on: - 1) PFD 2) PID	10
