1T00537 - B.E.(Chemical Engineering)(SEM-VII)(Choice Base Credit Grading System) (R- 20) (C Scheme) / 41972 - Chemical Engineering Equipment Design
QP CODE: 10015664 DATE: 12/12/2022

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) List out types of supports. Explain any one in detail.

(b) Explain constructional features of high pressure vessel

(c) Explain different tall column internals.

(d) Explain types of supports with neat diagram.

(e) Classification of heat exchangers and evaporators.

(f) Explain types of losses in storage of volatile liquids.

Q.2 (a) Design a pressure vessel subjected to internal pressure for the following data: **12**

A) Shell and head data: Design pressure = 0.5 N/mm^2,
ID of the shell = 1000 mm
Permissible stress for shell material = 140 N/mm^2,
Corrosion allowance = 2 mm
Weld joint efficiency = 0.85
Crown radius = Shell ID
Knuckle radius = 10 % of shell ID

B) Flanged joint: Gasket factor = 3.75,
Min gasket seating stress = 52.5 N/mm^2
Flange material same as shell material.
Permissible stress for bolt material = 138 N/mm^2

C) Nozzle data: Shell side
ID = 150 mm
Nozzle material same as shell material.
Design should include Shell, Nozzle and reinforcement.

Q.2(b) Write the design procedure to calculate the height of the tall column including the stresses developed in the column. **8**

Q3 (a) Design a U tube heat exchanger for the following data- **12**

Data –
(i)Shell Side:- M.O.C. – Carbon Steel,
No. of shell – 1, No. of passes – 1,
Fluid – Water, Internal Pressure – 0.45N/mm^2
Permissible stress for C.S. – 95 N/mm^2
Pitch : triangular, Standard torispherical head,
B = proportionality constant = 2 mm, Corrossion allowance = 0.85

Weld joint efficiency = 0.85, 25%cut segmental baffles
M.O.C. for head and all flanges- Carbon steel,
Gasket on shell side – Flat metal jacketed asbestos
Gasket factor – 3.75, Gasket seating stress -53N/mm^2

(ii)Tube Side:-
Tube and tube sheet material – S.S., No. of tubes – 40
Outside diameter – 18mm, Fluid – Carbon Dioxide,
Effective Length of the tube = 12 m
Design Pressure – 21.5N/mm^2 Permissible stress S.S. – 105N/mm^2
Permissible stress for bolt material – 105N/mm^2
Factor F = 1.25, Factor k for channel = 0.30

(iii) Channel moc = CS
Design should include-
(a) Shell,
(b) Channel
(c) Tube sheet

Data for minimum shell thickness:

Diameter (mm)	Thickness (mm)
150	5
200 to 400	6..3
500 to 600	8
700 to 1000	10

Q.3 (b) Explain different types jackets with neat diagram. **08**

Q 4 (a) Design Turbine agitator shaft (shaft diameter) for a vessel of 1500 mm diameter with following data: **12**
Internal pressure in vessel = 0.5 N/mm^2
Diameter of agitator = 500 mm
Speed of agitation = 200 rpm
Specific gravity of liquid in vessel = 1.2
Viscosity of liquid in vessel = 600 cp
Overhang of agitator = 1300 mm
No of blades = 06
Width of blade = 75 mm
Thickness of blade = 8 mm
No of baffles = 04
Shear stress in shaft = 55 N/mm^2
Elastic limit in tension = 246 N/mm^2
Modulus of elasticity = 1.95 x 10^5 N/mm^2
Power no = 4.5
Density of shaft material = 7580 kg/m^3
Consider Gland loss = 5%, power transmission loss = 5%

Q 4(b) Design storage tank for following data: (Shell plates and bottom plates) **12**

Tank diameter = 3 m
Tank ht = 6 m
Density of liquid = 980 kg/m^3
Superimposed load = 1200 N/m^2
MoC = CS
Permissible stress = 95 N/mm^2
Density of MoC = 7800 kg/m^3
Corrossion allowance = 2 mm
E = 2*10^5 N/mm^2
Weld joint efficiency = 0.85
Shell plate and bottom plate size = 5000 x 2000 mm (L x W)

Q 5(a) Write the design procedure for a Standard Vertical Short Tube Evaporator for the following data- **10**

Design should include-
(a) Diameter of tube sheet,
(b) Calendria sheet thickness,
(c) Tube sheet thickness,
(d) Evaporator drum thickness and diameter,

Q5 (b) A cylinder has an ID of 100 mm and an internal pressure of 50MPa. Find the needed wall thickness if the factor of safety is 2.0 and the yield stress is 250 MPa. Use the maximum shear stress theory. **10**

Q.6 (a) List out types of NDT method. Explain any one detail with neat diagram. **10**

Q6 (b) Explain with neat diagram different types of agitators and their applications. **10**