

Seat  
No.

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माला - 002

ELECTIVE - I

**Design of Pressure Vessel  
(1051)**

P. Pages : 3

Time : Three Hours

Max. Marks : 100

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Answer **any five** questions.
5. Neat diagram must be drawn wherever necessary.
6. Assume suitable data if necessary.
7. Use of non programmable calculator is allowed.

1. a) What are the different supports used for vertical & Horizontal pressure vessel. Explain with neat sketches shortly. 8  
b) Design a skirt support for a vertical cylindrical pressure vessel with following specifications.
  - Diameter of vessel = 3m
  - Height of vessel = 40 m
  - Mass of vessel & its content =  $2 \times 10^5$  kg
  - Diameter of skirt = 3 m
  - Height of skirt = 4 m
  - Wind pressure up to 20 m height =  $1.2 \text{ KN/m}^2$
  - Wind pressure above 20 m height =  $1.5 \text{ KN/m}^2$
  - Allowable tensile stress for steel skirt =  $65 \text{ N/mm}^2$
  - Allowable compressive stress for steel skirt =  $98 \text{ N/mm}^2$  12
2. a) Draw stress distribution diagram for thick cylinder subjected to, 8
  - i) Internal pressure.
  - ii) External pressure.

- b) A compound cylinder consists of an inner steel tube with inner & outer diameter of 40 mm & 60 mm respectively. It is reinforced by shrinking a steel jacket of outer Diameter 80 mm. The compound cylinder is subjected to an internal pressure of  $60 \text{ N/mm}^2$ . The shrinkage allowance is such that the maximum circumferential stresses in inner tube & jacket are same. Calculate
- 1) Interference pressure.
  - 2) Original dimension of inner tube & jacket. Assume  $E = 207000 \text{ N/mm}^2$  12
3. a) Derive the Lamé's equation for the analysis of Thick subjected to internal & external pressure. 12
- b) What is prestressing of thick cylinder. Explain autofrettage. 8
4. a) A process vessel is to be designed for maximum operating pressure of  $500 \text{ KN/m}^2$ . The vessel has nominal diameter of 1.2 m & length 2.4 m. The vessel is made with quality steel having design stress value  $118 \text{ MN/m}^2$  at working temperature. The corrosion allowance is 2 mm. The vessel is fabricated with class -2 with weld joint efficiency = 0.85 determine.
- 1) Plate thickness to fabricate vessel.
  - 2) If spherical vessel having same diameter & thickness is fabricated with same quality steel, what maximum pressure the sphere will withstand safely. 10
- b) Explain the following terms used in vessel design 10
- 1) Excessive elastic deformation.
  - 2) Plastic instability.
  - 3) Brittle Rupture
  - 4) Creep
5. a) Explain with neat sketches different types of form heads used as end closures. State their Advantages, Disadvantages & Applications. 8
- b) A cylindrical pressure vessel of inside diameter 1500 mm is subjected to an internal pressure of 2 MPa. The shell as well as head are made of low alloy steel with  $\text{SUT} = 450 \text{ N/mm}^2$ . The double welded butt joint which are spot radio graphed are used to fabricate the vessel. The corrosion allowance is 3 mm. Determine the thickness of shell & thickness of head if heads are,
- 1) Flat
  - 2) Semi elliptical with ratio of major to minor axis is 2
  - 3) Torispherical with crown radius of 1125 mm 12

6. a) Explain how, design of pipes & tubes under external pressure. 4
- b) The following is the data refer to the vertical pressure vessel made of plain carbon steel having  $s_{ut} = 425 \text{ N/mm}^2$  &  $s_{yt} = 250 \text{ N/mm}^2$ .
- Gauge pressure inside the pressure vessel =  $1 \text{ N/mm}^2$
  - Inner diameter of vessel shell =  $2 \text{ m}$
  - Height of the vessel =  $6 \text{ m}$
  - Thickness of vessel shell =  $10 \text{ mm}$
  - Weight of each end cover =  $4 \text{ KN}$
  - Weight of the content in vessel =  $125 \text{ KN}$
  - Wind pressure on vessel surface =  $1.25 \text{ KN/mm}^2$
  - Torque due to the offset piping on shell =  $1.5 \text{ KN-m}$
- Determine
- 1) Maximum resultant stress in the vessel shell and
  - 2) Factor of safety available
- Also comment about the safety of design. 16
7. a) Explain in brief the procedure to Design bottom design & shell design in storage vessel. 12
- b) Write a short note on: 8
- 1) Spherical vessel for storing gas.
  - 2) Floating roof storage tank for volatile liquid.
8. A fractionating tower is  $4 \text{ m}$  outside diameter &  $6 \text{ m}$  in length from tangent line to tangent line of closers. The tower contains removable trays on a  $1 \text{ m}$  tray spacing & is to operate under Vacuum at  $400^\circ\text{C}$ . The material of construction is IS 2002 – 1962Gr-1 Plain carbon steel.
- 1) Determine the required thickness of sheet without stiffeners & then with Stiffener located at the tray positions.
  - 2) Design the stiffening ring. Evaluate if the use of stiffening ring will be advantageous.
- Assume,  
 Torispherical head at both ends of tower having  $R_i = D_o$  &  $r_i = 0.1 D_o$ , where  $R_i$  = inner Crown radius,  $r_i$  = Knuckle radius,  $D_o$  = outer diameter of vessel &  $E = 1.67 \times 10^5 \text{ MN/m}^2$ . 20

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