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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, APRIL-MAY 2018

Mechanical Engineering

(Machine Design)

01ME6104 Design of Pressure Vessels and Piping

Max. Marks: 60 **Duration: 3 Hours**

Answer any two full questions from Part A, B &C

Limit answers to the required points.

Use of Design Data Hand Book and ASME/IS Codes permitted.

Part A

1 a) What is the dilation of a pressure vessel? Find an expression for the dilation of a cylindrical Pressure vessel? (3)

b) Write a short note on ASME section VIII? (3)

c) Sketch the common heads used in a pressure vessel? (3)

2) a) Derive a relation for the membrane stresses in vessels under internal pressure? Hence arrive at a relation for the hoop and longitudinal stress in an 180^0 bend? (6)

b) Discuss about various type of loads acting on a pressure vessel? (3)

3) A compound cylinder is made by shrink fitting a tube of 200mm internal diameter and 30mm thickness to an external tube of 300mm external diameter. Before shrink fitting there was a radial clearance of 0.04mm between the tubes. Find the radial pressure and also plot the final stresses if the tube was subjected to an internal pressure of $20N/mm^2$ and an external pressure of $5N/mm^2$. E = 200GPa and Poisson ratio = 0.3. (9)

Part B

4) Do the reinforcement of the following pressure vessel nozzle system:

A protruding type nozzle, with outside diameter 12cm and thickness 1.5cm is welded to the shell of inside diameter 150cm and thickness 2.5cm. The protruding length of the nozzle inside the vessel is 2cm. Allowable stress for shell is 500MPa and that of nozzle is 450MPa. Design pressure is $35Kg/cm^2$. Fillet weld size is 1.25cm of equal leg size. (9)

5) Design a tall vessel for the following conditions:

Inside diameter = 2.5m, Outside diameter including insulation thickness= 3m, Height of the vessel = 30m, distance from base to bottom shell joint =1m, Internal pressure = 30Kg/cm^2, wind load = 0.1kg/ cm^2, Allowable stress of the material = 150MPa. An eccentric load of 500Kg is acting at a distance of 4.5m from the center of the vessel. The vessel is fully radiographed. (9)

6) A horizontal vessel with elliptical 2:1 cover and two saddles has the following specifications. Length=20m, Total weight= 100000 kg, outside radius= 2m., internal pressure= 15kg/cm^2, thickness of shell=3cm, allowable stress=350MPa, contact angle = 150^0, Distance from end of the cover to saddle 1.5m, width of saddle 0.75m. Find the longitudinal bending stress and circumferential stress at the saddle and tangential shear stresses? (9)

Part C

7) Derive the equation for finding the critical pressure of a thin vessel under external pressure. Hence arrive at the ASME external pressure design equations? (12)

8) a) Write down the ASME equation for the pipe thickness calculation and explain each term associated with it? (4)

b) Explain the following terms

1) Block flow diagram, 2) process flow diagram, 3) piping and instrumentation diagram. (8)

9) a) Sketch neatly four common flange facings? What is the application of each type of facing? (6)

b) Explain the following terms

1) Allowable stress range, 2) Displacement stress range, 3) Stress intensification factor, 4) Stress range reduction factor (6)