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B

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, MAY/JUNE 2019

MECHANICAL ENGINEERING

MACHINE DESIGN

01ME6104 : DESIGN OF PRESSURE VESSELS AND PIPING

Answer *any two full* questions from *each* part.
Limit answers to the required points.
Use of Design Data Hand Book and ASME/IS Codes permitted.

Max. Marks: 60 Duration: 3 hours

PART A

1. a. What are the factors to be considered for the design of high pressure monobloc vessels? (3)
   b. Explain the phenomenon dilation of pressure vessels and derive an expression for the dilation of a spherical vessel of internal radius 'r', shell thickness 'h' subjected to an internal pressure 'p', μ - poisson's ratio, E- elastic modulus. (4)
   c. Show that in the case of an ellipsoidal vessel made of steel having poisson's ratio μ=0.3 and the ratio of major diameter to minor diameter > 1.3, the equatorial dilation is negative. (2)
2. a. Deduce an expression for the meridional and hoop stresses developed in an ellipsoidal shaped head used for the end closure of a cylindrical shell of semimajor axis a and semiminor axis b, subjected to an internal pressure p and shell thickness h. (6)
   b. Show the variation of meridional stress and hoop stress for different values of a/b ratios. 'a' semimajor axis and 'b' semiminor axis. Explain the stress reversal process of hoop stress. (3)
3. a. Why compounding of cylinders are necessary? With the help of neat sketches, explain the stresses induced during the development of shrink fit, during the loading and the combined effect. (4)
   b. A steel tube 240mm external diameter is shrunk on another steel tube of 80mm internal diameter. After shrinking, the diameter at the junction is 160mm. Before shrinking, the difference of diameter at the junction was 0.08mm. If the Young's Modulus of steel is 200GPa, find (i) the tangential stress at the outer surface of the inner tube (ii) the tangential stress at the inner surface of the outer tube (iii) the radial stress at the junction. (5)

PART B

4. a. Explain in detail the effect of seismic load in tall vessels. What is "vortex shedding" and "vortex shedding frequency"? (5)
   b. Write a note on the development of pressure vessel construction codes (ASME codes). (4)
5. a. Discuss the variation of stress concentration about a circle and an elliptical hole in a plate under tension. (4)
   b. Explain the design procedure of a tall vessel for wind loads as per ASME codes. (5)
6. a. With the help of neat sketches, give the details of various types of nozzle reinforcement to reduce stress concentration. (5)
   b. Explain the design procedure of a horizontal support for a pressure vessel. (4)

PART C

7. a. Derive the critical buckling or collapsing pressure for a circular ring under buckling under external pressure. (9)
   b. Explain the term inelastic collapse pressure. (3)
8. a. Explain the effect of supports on elastic buckling of cylinders under external pressure. (7)
   b. What is factor-A and factor-B related with ASME Boiler and Pressure codes? (5)
9. a. A pipe with a 1200 mm inside diameter and a 1500 mm outside diameter is subjected to an internal pressure of 35 MPa. Determine the value and place of occurrence of (6)
      a) The maximum tangential stress
      b) The maximum radial stress
      c) The maximum shear stress and also,
      d) The average tangential stress
      e) What percent is this of the maximum tangential stress?
   b. How the flexibility analysis of pipes are done? (4)
   c. What are the different piping software that are in use? (2)