d) A 4-m long hallow alloy tube with inside and outside diameter as 36mm and 48mm elongates by 3mm under a tensile force of 50kN. Determine the buckling load for the tube when it is used as a column with both end pinned and with a factor of safety of 5.

OR

Discuss in brief any two theories of failure for ductile materials.

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Roll No .....

AE/AU/IP/IEM/ME/PR - 303

B.E. III Semester

Examination, June 2016

Strength And Mechanics of Materials

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each question are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max. 50 words) carry 2 marks, part C (Max. 100 words) carry 3 marks, part D (Max. 400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

v) Assume missing / misprint data if any.

1. a) What is complementary shear stress.

b) Define the term Poisson's ratio and Bulk modulus.

c) What is volumetric strain? Show that it is the algebraic sum of three mutually perpendicular strains.

d) A tension bar tapers from (d+a) diameter to (d–a) diameter. Prove that the error involved in using the mean diameter to calculate the young modulus is $(10a/d)^2$ percent.

OR

A tangential and longitudinal stresses in the plate of cylindrical boiler of 2.2 m diameter and 3.5m in length are 90 MPa and 45 MPa respectively. Determine the increase in its internal capacity. Neglect compressive stress due to steam on inner surface. Take

$$E = 205\,GPa, \frac{1}{m} = 0.3$$

2. a) What do you mean by principal plane and principal stress?
   b) What is the significance of Mohr's circle?
   c) Show that in a direct stress system, the maximum shear stress in a body is half the magnitude of applied stress.
   d) The stresses on two perpendicular planes through a point in a body are 30MPa and 15MPa both tensile along with a shear stress of 25 MPa. Find
      i) Magnitude and direction of principal strain.
      ii) The plane of maximum shear stress.
      iii) The normal and shear stresses on the plane of maximum shearing stress.

OR

Derive the equation for principal stresses from a given two dimensional stress element.

3. a) Define the term 'moment of resistance'.
   b) What assumptions are taken in analysis of shear stress in beam?
   c) Derive the relation between Bendurf moment and shear force in a beam.

   d) State and prove the moment area theorem.

OR

A Beam of length 'l' and hinged at the two ends carries a clockwise couple M at a distance 'a' from the left hand end. Determine the slope at each end and the deflection at the point of application of couple. Also deduce the expression for slope and deflection if couple act at mid span of beam.

4. a) Define torsional rigidity.
   b) State the assumptions made deducing the torsion equation.
   c) How are springs classified? Mention the use of each type.
   d) Deduce an expression for allowable tungsten moment of a thin walled tube. Also find an approximate expression for strength weight ratio of such tube.

OR

A closed coiled helical spring has its free length as 120mm. It absorbs 40 N-m of energy when fully compressed and the coil are in contact. The mean coil diameter is 80mm. Determine the diameter of steel wire required and number of coil, if maximum shear stress is to be 120MPa, G = 80GPa.

5. a) What do you meant by theory of failure what is their importance.
   b) What is the difference between crushing and buckling failure of the column.
   c) What is meant by equivalent length of column? What are its value for different end conditions of column.