5. a) What is limiting value of the slenderness ratio beyond which Euler's formula is applicable?

   b) What do you mean by equivalent length of a column?

   c) What are the merits of Rankine's load over Euler's load in buckling?

   d) A 5m Long hollow circular steel strut having an outside diameter of 120 mm and an inside diameter of 80 mm with both the ends hinged is initially bent. Assume that the centre line of the strut as sinusoidal with maximum deviation of 6mm. Determine the maximum stress developed due to an axial load of 100 kN.

   Take E = 210 kN/ mm^2.

   OR

   A cast iron column of a hollow circular section with an external diameter of 250 mm and a wall thickness of 45 mm is subjected to an axial compressive load. The column is 7 m long with both ends hinged. Taking factor of safety as 8 determine safe value of 'P'

   Take $\sigma_c = 560 N/mm^2$, $a = \frac{1}{1600}$

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Roll No .....

CE/FT - 303

B.E. III Semester

Examination, June 2015

Strength 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.

1. a) Define modular ratio and poisson's ratio.

   b) Define principal plane and principal stress.

   c) Explain Mohr's circle.

   d) A steel rail 12.6 m long and is laid at temperature of 24°C the maximum temperature expected is 44°C. Determine.

      i) The minimum gap between two rails so that no temperature stresses produced.

      ii) Calculate temperature stress in the rail - if.

         a) No expansion joint is provided

         b) 2 mm gap is provided.

         c) Stresses develop is 20 MPa. What is the gap between the rails. Take E = 2×10^5 MPa, $\alpha = 12\times10^{-6}$/°C.

OR

A solid circular shaft subjected to a bending moment of 60 kN m and a torque of 15 kN m. Design the diameter of shaft by using.

i) Maximum principal stress theory.

ii) Maximum strain energy theory.

Take $\mu = 0.28$, yield strength of shaft is 225 MPa and F.O.S. = 2.5

2. a) Derive the flexure formula.
   b) What do you mean by shear stress in beams?
   c) What is Neutral layer? Why stress and strain are zero in the neutral layer.
   d) A reinforced concrete beam is 200 mm wide and 400 mm deep. The maximum allowable stresses in steel and concrete are 120 and 7.5 N/mm^2 respectively. What area of steel reinforcement is required if both the stresses are developed and steel reinforcement is 60 mm above the tension face. If modular ratio m = 16 determine the moment of resistance of the beam.

OR

A beam ABC 8 m long carries an eccentric load at 'B' such that AB = 3m, BC = 5m. If EI = 5000 kNm^2 determine.

i) Slope at ends A and C and

ii) Maximum deflection.

3. a) Explain torsional rigidity of shaft.
   b) Differentiate between closed coiled and open coiled helical spring.
   c) Why is a thin cylinder wire wound?

   d) A steel shaft of a diameter 100 mm runs at 300 rpm. Thin steel shaft has a 20 mm thick bronze bushing shrunk over its entire length of 2 m. If the maximum shearing stress in steel shaft is not to exceed 40 N/ mm^2. Find

i) Power of engine and

ii) Torsional rigidity of shaft Take $G_{steel} = 84$ kN/mm^2, $G_{bronze} = 42$ kN/mm^2.

OR

A thin cylindrical shell made of 4 mm thick copper plate is filled with oil under a pressure of 2.4N/mm^2. The internal diameter of the cylinder is 200 mm and its length is 800 mm. Determine the additional volume of oil pumped inside the cylinder so to develop the required pressure. Given E for copper = 104 kN/mm^2, V= 0.32 and k of oil =2800 N/mm^2.

4. a) Explain principal moment of Inertia.
   b) Explain product of Inertia.
   c) What do you mean by shear center?
   d) A chain link is made of steel rod 12 mm diameter. The straight portion is 60 mm in length and the ends are 60 mm in radius. Determine the deflection in the link along the direction perpendicular to the load line if the chain link is subjected to a load of 1 kN.
   Take E = 200 kN/mm^2.

OR

A simply supported beam of a length of 2 m carries a load of 4 kN inclined at 30° to the vertical and passing through the centroid of the section. Determine

i) Maximum tensile stress.

ii) Maximum compressive stress

iii) Deflection due to load and direction of neutral axis
Take E = 200 $\times 10^5$ N/cm^2.