OR

A closely coiled helical spring of mean diameter 200 mm is made of 30mm diameter rod and has 15 turns. A weight of 3 kN is dropped on this spring. Find the height by which the weight should be dropped before striking the spring so that the spring may be compressed by 150 mm. Take $C = 8 \times 10^4$ N/mm^2.

5. a) What do you mean by 'Theory of failure'? Give the list of various theory of failure.

   b) Write the assumptions made in the Euler's column theory.

   c) How will you justify that Rankine's formula is applicable for all lengths of columns, ranging from short to long columns?

   d) According to theory of maximum shear stress, determine the diameter of a bolt which is subjected to an axial pull of 10 kN together with a transverse shear force of 5 kN. Elastic limit in tension is 225 N/mm^2. Factor of safety is 3 and Poisson's ratio is 0.3.

OR

A hollow cylindrical cast iron column is 4m long with both ends fixed. Determine the minimum diameter of the column if it has to carry a safe load of 250 kN with a factor of safety of 5, take internal diameter as 0.8 times the external diameter, Crushing stress as 550 N/mm^2 and Rankine's constant as 1/1600.

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Roll No .....

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

B.E. III Semester

Examination, December 2015

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.

1. a) Explain creep phenomenon in the material.

   b) Define the term Young's modulus and modulus of rigidity.

   c) Established the relationship among elastic constants.

   d) A 2m steel bar of diameter 15mm is subjected to an axial pull of 75kN. Calculate the change in length, diameter and volume of the bar, if the Poisson's ratio is 0.25. Also find the work done in stretching the bar. Take, E is 200 kN/mm^2.

OR

A compound tube consists of a steel tube 150mm internal diameter and 10mm thickness and an outer brass tube 170mm internal diameter and 10mm thickness. The two tubes are the same length. The compound tube carriers an axial load of 1000kN. Find the stresses and the load carried by each tube and the amount it shortens. Length of each tube is 150mm. Young's modulus for steel and brass are 200kN/mm^2 and 100kN/mm^2 respectively.

2. a) Explain the terms, Principal planes and Principal stresses.
   b) What do you understand by ductile and brittle failures?
   c) A rectangular bar of cross-sectional area 10000 mm^2 is subjected to an axial load of 20 kN. Determine the normal and shear stresses on the section which is subjected an angle of 30° with normal cross-section of the bar.
   d) An elemental cube is subjected to tensile stresses of 30N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10N/mm^2 on these planes. Draw the Mohr's circle of stresses and determine the magnitudes and directions of principal stresses and also the greatest shear stress.

OR

A thin cylinder of inside diameter 450mm is made of 5mm thick plate. The efficiencies of the longitudinal and circumferential joints are 65% and 35 respectively. Find the largest allowable gauge pressure, if the tensile stress of the plate is limited to 90 MPa.

3. a) What do you mean by 'pure bending'?
   b) How will you draw the shear stress distribution diagram for composite section?

   c) Prove that the bending stress in any fibre is proportional to the distance of that fibre from neutral layer in a beam.
   d) Three beams have the same length, same allowable bending stress and the same bending moment. The cross-section of the beams are a square, rectangle with depth twice the width and a circle. Find the ratios of weights of the circular and the rectangular beams with respect to square beams.

OR

A beam of length 6 m is simply supported at its ends and carries two points loads of 40 kN and 50 kN at a distance of 1.5m and 3.5m respectively from the left support, determine; deflection under each load, maximum deflection, and the point at which maximum deflection occurs. Take E = 2×10^5 N/mm^2 and I = 85×10^6 N/mm^4.

4. a) What do you mean by 'strength of a shaft'?
   b) What is a spring? Write characteristics of a spring.
   c) Find the maximum shear stress induced in a solid circular shaft of diameter 150 mm when the shaft transmits 150 kW power at 150 rpm.
   d) Derive the relation for a circular shaft when subjected to torsion as given below;

$$\frac{T}{j} = \frac{\tau}{R} = \frac{C\theta}{L}$$

Where T = Torque transmitted
J = Polar moment of inertia
R = Radius of shaft
τ = Max. shear stress
C = Modulus of rigidity
θ = Angle of twist
L = Length of the shaft