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B. Tech 3rd Semester Examination

Strength of Material-I (N.S.)

ME-211

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, select one question from each sections A, B, C and D. Section E is compulsory.

SECTION - A

1. (a) At a point in a bracket, the normal stresses on two mutually perpendicular planes are 120 N/mm^2 tensile and 60 N/mm^2 tensile. The shear stress across these planes is 30 N/mm^2. Find using the Mohr's stress circle the principal stresses & max shear stress at the point.

   (b) A shift section 100 mm in diameter is subjected to a bending moment of 4000 Nm and a torque of 6000 N.m. Find the maximum direct stress induced on the section and specify the position of the plane on which it acts. Also find what stress acting alone can produce the same max strain. Take Poisson ratio = 0.25. **(10+10=20)**

2. A solid shaft transmits 1000 kW at 3000 rpm, max torque is 2 times the mean. The shaft is subjected to a bending moment which is 1.5 times the mean torque. The shaft is of ductile material for which the permissible tensile and shear stresses are 120 mPa & 60 mPa resp. Determine the shaft diameter using suitable theory of failure. Give justification of the theory used. Find result by use of max principal stress theory also. **(20)**

SECTION - B

3. State and prove castigliano's theorem. Apply this to find deflection at the free end of a cantilever carrying a concentrated load at free end. Assume uniform flexural rigidity. **(20)**

4. Determine the deflection of beam subjected to point load or in general discontinuous bonds using MACAULAY's method of double integration, also apply boundary conditions, continuity conditions and symmetry conditions. **(20)**

SECTION - C

5. Find the direct and shear stresses in a beam 3m long simply supported at ends carrying a load of 10kN at the centre, at a point on cross-section of the beam 1m from the left end of beam & 2 cm above the neutral axis. The beam is rectangular in section 8 cm wide × 12 cm deep. Show stresses on a small square. What are the principal stresses and max shear stress at the point? **(20)**

6. A round steel rod of diameter 15 mm and length 2m is subjected to gradually increasing axial compressive load. Use Euler's formula to find the buckling load. Also find the max lateral deflection corresponding to the buckling condition. Both ends of the rod may be taken as hinged. Take $E = 2.1 \times 10^5 N/mm^2$ and yield stress of steel=250 N/mm^2. **(20)**

SECTION - D

7. A beam of 6 m span is fixed horizontally at the ends. A downward vertical load of 12 kN acts on the beam at a distance of 2m from left end and an upward vertical force of 80 kN acts a distance of 3m from the right end. Determine the end reactions and fixing moments and draw SF and BM diagram. **(20)**

8. A carriage spring of span 1000 mm consists of 75 mm wide, 15 mm thick and has to carry a central load of 10 kN. The bending stress being limited to 160 N/mm^2. Find the central

deflection and also the initial radius to which the plates have to be bent in order. They straighten out under the action of load. Take E = 2×10^5 N/mm^2. **(20)**

SECTION - E

9. (a) Write max shear stress theory.

   (b) Which of following two columns is stronger?

   (1) Column 50 cm long having square section with each side 1 cm.

   (2) Column 5 m long having square section with each side 20 cm.

   (c) Mohr's theorem.

   (d) Compare the strain energy of two shaft subjected to max shear stress in torsion (i) A hollow shaft having outer diameter n times inner diameter. (ii) A solid shaft, mass length material of two shafts are same. **(4×5=20)**