Reg. No. :

Question Paper Code : 90102

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Third Semester

Civil Engineering

CE 8301 – STRENGTH OF MATERIALS – I

(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Recall Poisson's Ratio.
2. Show that in a strained material subjected to two-dimensional stress, the sum of the normal components of stresses on any two mutually perpendicular planes is constant.
3. A beam of triangular section having base width 20 cm and height of 30 cm is subjected to a shear force of 3 kN. Calculate the value of maximum shear stress.
4. State the relationship between intensity of load, shear force and bending moment.
5. In what situation, conjugate beam method is preferred ?
6. A beam 5 m span of 200 mm width and 300 mm depth is simply supported, carries a uniformly distributed load of 9 kN/m. If E = 10^4 N/mm² find slope at support and maximum deflection.
7. List four assumptions made in determination of torsion of shafts.
8. Compare open coiled and closed coiled helical springs.
9. Outline determinate and indeterminate structures.
10. Define : Tension Coefficient.

PART – B (5×13=65 Marks)

(Restrict to a maximum of 2 sub-divisions)

11. a) A tie bar 300 mm long has enlarged ends of square section 60 mm × 60 mm. If the middle portion of the bar is also of square cross section, find the size and length of the middle portion, if the stress there is 140 MN/m². The bar is subjected to an axial pull of 87.5 kN and the total extension of the bar is 0.14 mm. Take E = 200 GN/m².

(OR)

b) A rectangular block of material is subjected to a tensile stress of 100 MN/m² on one plane and a tensile stress of 50 MN/m² at right angle, together with the shear stresses of 60 MN/m² on the same planes. Find
   i) the magnitude of the principal stresses,
   ii) the direction of the principal planes and
   iii) the magnitude of the greatest shear stress.

12. a) i) Enlist the assumptions made in the theory of pure bending. **(5)**

ii) Obtain the ratio of section modulii of a plane solid circular section of 100 mm to a hollow circular section of external diameter 100 mm and internal diameter 25 mm. **(8)**

(OR)

b) i) Classify beams depending upon the type of supports with suitable sketches. **(5)**

ii) A hollow circular bar having outside diameter twice the inside diameter is used as a beam. The bar is subjected to a bending moment of 40 kNm. If the allowable bending stress in the beam is limited to 100 MN/m^2, find the inside diameter of the bar. **(8)**

13. a) A simply supported beam 6 m long carries a concentrated moment of 150 kNm (clockwise) and concentrated load of 300 kN, both at 2 m from the right support. If the flexural rigidity of the beam is 8×10^4 kNm^2, find the maximum deflection and slope at the loaded point using MaCaulay's method.

(OR)

b) Using conjugate beam method, find the slopes and deflections at A, B, C and D in the beam shown in Fig. 13 (b). Given E = 200×10^6 kN/m^2 and I = 300×10^{-4} m^4.

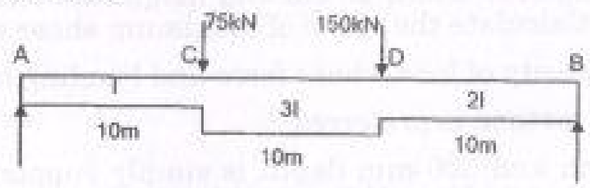

Fig. 13 (b)

14. a) A solid cylindrical shaft is to transmit 300 kW at 100 r.p.m. (i) If the shear stress is not to exceed 80 MN/m^2, find it diameter. (ii) What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, the material and maximum shear stress being the same ?

(OR)

b) A closely coiled helical spring is made out of 10 mm diameter steel rod. The coil consists of 10 complete turns with a mean diameter of 120 mm. The spring carries an axial pull of 200 N. Find the maximum shear stress induced in the section of the rod. If C = 80 GN/m^2, find the deflection in the spring, the stiffness and strain energy stored in the spring.

15. a) Analyse the pin jointed plane determinate truss shown in Fig. 15 (a) by the method of joints.

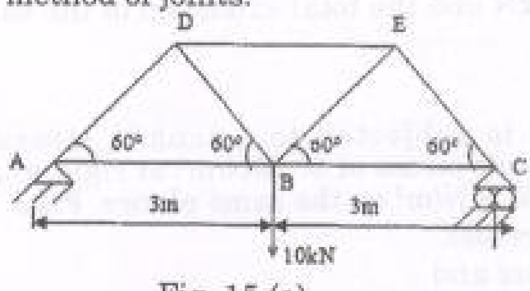

Fig. 15 (a)

(OR)

b) Determine the forces in the members of the space truss shown in the Fig. 15 (b) by tension coefficient method.

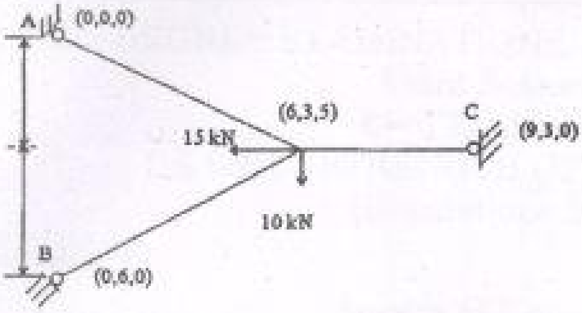

Fig. 15 (b)

PART – C **(1×15=15 Marks)**

16. a) A horizontal beam AB 8 m long is supported at A and C, 6 m from A. The beam supports a uniformly distributed load of 1.5 kN/m over its entire length and also concentrated loads of 3 kN and 1.5 kN at D and B respectively, D being 2 m from A. Plot shear force and bending moment diagrams. Determine the magnitude and position of maximum bending moment.

(OR)

b) A composite bar made up of aluminium and steel is held between two supports as shown in Fig. 16 (b). The bars are stress free at a temperature of 40°C. What will be the stresses in the two bars when the temperature is 20°C if (i) the supports are non-yielding, and (ii) the supports come nearer to each other by 0.1 mm. The change of temperature is uniform along the length of the bar. Take E_s = 210 GN/m², E_a = 74 GN/m², $\alpha_s = 11.7 \times 10^{-6}$ per °C and $\alpha_a = 23.4 \times 10^{-6}$ per °C.

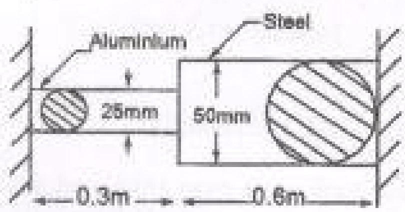

Fig. 16 (b)