(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0429 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION 2013-14

STRENGTH OF MATERIALS

Time : 3 Hours *Total Marks : 100*

Note :— Attempt **all** questions. Any missing data may be assumed suitably.

1. Attempt any **four** parts of the following : **(4×5=20)**
   (a) What are complementary shear stresses ? Explain with diagram.
   (b) In a stressed body, at a point, on two perpendicular planes, normal stresses are +100 MPa and + 60 MPa and the shear stress is τ on these planes. If the maximum principal stress at the point is 136 MPa, what is the magnitude of τ ? Also calculate the maximum shear stress and maximum shear stress at that point.
   (c) The modulus of rigidity of material is 39 GPa. A 10 mm diameter rod of the material is subjected to an axial tensile force of 5 kN and the change in its diameter is 0.002 mm. Calculate the Poisson's ratio of the material.
   (d) In a strained material at a point, the strains are $\varepsilon_{xx} = 600\ \mu$ strain, $\varepsilon_{yy} = 200\ \mu$ strain and $\varepsilon_{xy} = 300\ \mu$ strain. What is the maximum principal strain at the point ?
   (e) Derive and discuss Castigliano's Theorem.

(f) A solid circular shaft is subjected to a bending moment of 3 kN-m and a torque of 1 kN-m. The shaft is to be made in carbon steel for which the yield strength in tension and in shear is 480 MPa and 265 MPa respectively. Calculate the diameter of the shaft using distortion energy theory.

2. Attempt any **two** parts of the following : **(10×2=20)**

(a) A timber beam 80 mm wide and 160 mm deep is reinforced with two steel plates 5 mm thick and 60 mm wide on top and bottom. If bending moment of 800 N m acts at section of this beam, calculate the magnitude of maximum fiber stresses in tensions and compression in wood and steel. Assume $E_s / E_w = 15$.

(b) The load on a simply supported beam of span 6 m varies linearly from 8 kN/m at left support to nothing at the right support. Determine the deflection at mid span if $I = 316 \times 10^6 mm^4$ and E = 200 GPa.

(c) A torque of 4 kN m is applied on a shaft of diameter 60 mm. Calculate the shearing stress at a point just below the surface and at another point which is at distance of 20 mm from the axis. Consider the cylindrical region of radius 15 mm and calculate the torque carried by this cylinder.

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) A closely coiled helical spring is made of 12.5 mm diameter steel wire and its 10 coils have a mean diameter of 250 mm. Find the elongation, intensity of torsional

and total shearing stresses and strain energy per cubic cm when the spring carries an axial load of 180 N. (G = 80 GPa).

(b) A cantilever leaf spring has a clear span of 800 mm and carries a load of 10 kN at the free end. The bending stress in strip and deflection at free end not exceed respectively 320 MPa and 80 mm. Find the number of plates if width of a plate is 8 times the thickness.

(c) A short column of rectangular cross section 200 mm by 150 mm carries a load of 400 kN at a point 50 mm from longer side and 87.5 mm from the shorter side. What are the maximum compressive and tensile stresses ?

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) A steel pipe whose external diameter and thickness are respectively 318.75 mm and 9.375 mm carries water at a pressure of 2.8 N/mm^2. Determine the maximum tensile stress induced in the pipe. By what percent will this stress change if the thickness of the pipe is increased by 33% ?

(b) A thin walled copper alloy spherical shell has diameter of 1 m and thickness of 12 mm. It is filled with unpressurised incompressible liquid. Through a small hole additional $10^6 mm^3$ of same liquid is pumped into the shell thus expanding the shell. Calculate the pressure after addition of liquid and change in diameter. For the copper alloy take $E = 10^5$ MPa and $\mu = 0.28$. Also calculate the resulting stress.

(c) Derive Lami's equation for thick cylinder.

5. Attempt any **two** parts of the following : **(10×2=20)**

(a) Find the maximum bending stress in the cantilever beam shown in Figure 1.

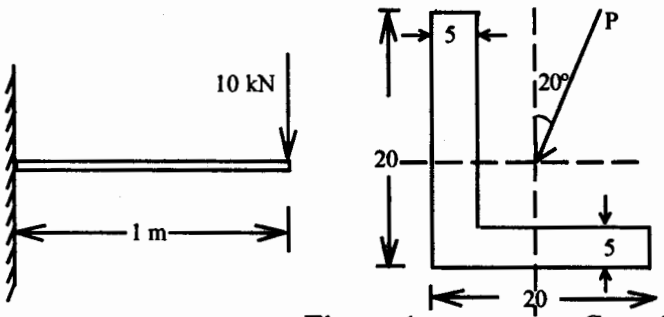

Figure 1 Cross Section

All dimension are in mm otherwise given.

(b) A circular link shown in Figure 2 has a rectangular cross section 100 mm wide and 50 mm thick. Calculate the stress at A and B under a compressive load of 50 kN. All dimensions are in mm.

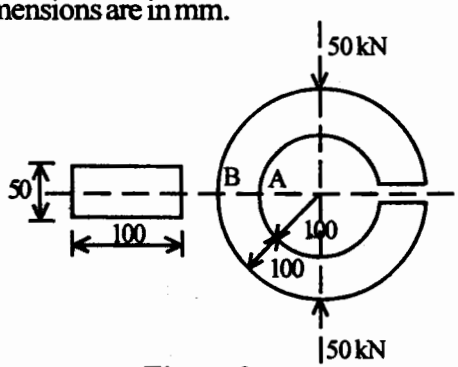

Figure 2

(c) A ring with a mean diameter of 120 mm and a circular cross section of 40 mm diameter is subjected to a diametral compressive load of 20 kN. Calculate the deflection of the ring along the load line. E = 200 GPa.