Reg. No. | | | | | | | | | | | | |

**Question Paper Code : 57150**

**B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016**

**Third Semester**

**Mechanical Engineering**

**CE 6306 – STRENGTH OF MATERIALS**

**(Common to MecHatronics Engineering, Industrial Engineering and Management, Industrial Engineering, Manufacturing Engineering, Mechanical Engineering (Sandwich), Material Science and Engineering and also Common to Fourth Semester Automobile Engineering, Mechanical and Automation Engineering and Production Engineering)**

**(Regulations 2013)**

**Time : Three Hours** **Maximum : 100 Marks**

**Answer ALL questions.**

**PART – A ($10 \times 2 = 20$ Marks)**

1. Define principal planes.
2. Obtain the relation between E and K.
3. Discuss the fixed and hinged support.
4. What are the advantages of flitched beams ?
5. Draw and discuss the shafts in series and parallel.
6. List out the stresses induced in the helical and carriage springs.
7. How the deflection and slope is calculated for the cantilever beam by conjugate beam method ?
8. State the Maxwell's reciprocal theorem.
9. Differentiate between thin and thick cylinders.
10. Describe the Lame's theorem.

## PART – B (5 × 16 = 80 Marks)

11. (a) (i) A steel bar 20mm in diameter, 2m long is subjected to an axial pull of 50 kN. If $E = 2 \times 10^5$ N/mm$^2$ and m = 3. Calculate the change in the (1) length, (2) diameter and (3) volume. **(8)**

(ii) A mild steel bar 20mm in diameter and 40 cm long is encased in a brass tube whose external diameter is 30mm and internal diameter is 25mm. The composite bar is heated through 80 °C. Calculate the stresses induced in each metal. $\alpha$ for steel = $11.2 \times 10^{-6}$; $\alpha$ for brass = $16.5 \times 10^{-6}$ per °C. E for steel = $2 \times 10^5$ N/mm$^2$ and E for brass = $1 \times 10^5$ N/mm$^2$. **(8)**

**OR**

(b) (i) Two steel rods and one copper rod, each of 20 mm diameter, together support a load of 20kN as shown in Fig. Q. 11 (b) (i). Find the stresses in the rods. Take E for steel = 210kN/mm$^2$ and E for copper = 110 kN/mm$^2$. **(8)**

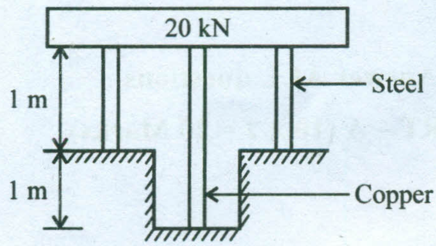


**Fig. Q. 11 (b) (i)**

(ii) Direct stresses of 140N/mm$^2$ tensile and 100N/mm$^2$ compression exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the planes. The greatest principal stress at the point due to these is 160 N/mm$^2$. **(8)**

(1) What must be the magnitude of the shear stresses on the two planes ?

(2) What will be the maximum shear stress at the point ?

12. (a) Draw SFD and BMD and indicates the salient features of beam loaded Fig. Q. 12. (a) **(16)**

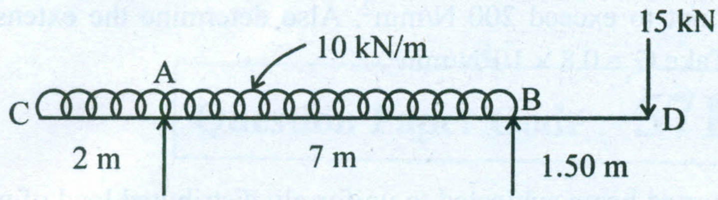


**Fig. Q. 12. (a)**

**OR**

(b) (i) Find the dimensions of a timber joist, span 4 m to carry a brick wall 230 mm thick and 3m high if the unit weight of brickwork is 20 kN/$m^3$. Permissible bending stress in timber is 10 N/$mm^2$. The depth of the joist is twice the width. **(8)**

(ii) A flitched beam shown in Fig. Q. 12. (b) (ii) is used as a load carrying member. Find the moment of resistance of the combined section and bending stress in steel, if $E_s = 2 \times 10^5$ N/$mm^2$, $E_w = 1.25 \times 10^5$ N/$mm^2$. **(8)**

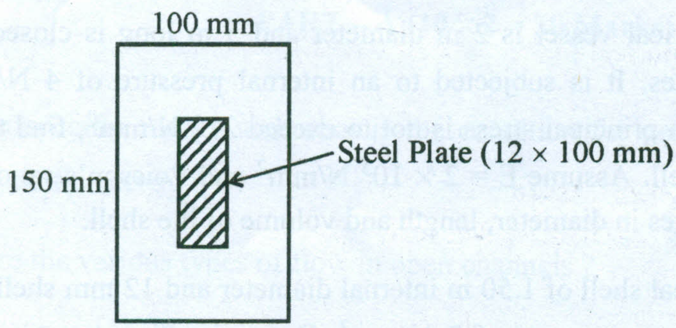


**Fig. Q. 12. (b) (ii)**

13. (a) A solid circular shaft 200mm in diameter is to be replaced by a hollow shaft the ratio of external diameter to internal diameter being 5:3. Determine the size of the hollow shaft if maximum shear stress is to be the same as that of a solid shaft. Also find the percentage savings in mass. **(16)**

**OR**

(b) (i) A closely coiled helical spring made from round steel rod is required to carry a load of 1000 Newton for a stress of 400 MN/$m^2$, the spring stiffness being 20 N/mm. The diameter of the helix is 100mm and G for the material is 80 GN/$m^2$. Calculate (1) the diameter of the wire and (2) the number of turns required for the spring. **(8)**

(ii) A spiral spring is made of 10 mm diameter wire has 20 close coils, each 100 mm mean diameter. Find the axial load the spring will carry if the stress is not to exceed 200 $N/mm^2$. Also determine the extension of the spring. Take $G = 0.8 \times 10^5 N/mm^2$. **(8)**

14. (a) A simply supported beam subjected to uniformly distributed load of w kN/m for the entire span. Calculate the maximum deflection by double integration method. **(16)**

**OR**

(b) A simply supported beam AB of span 5m carries a point of 40 kN at its centre. The value of moment of inertia for the left half is $2 \times 10^8$ $mm^4$ and for the right half portion is $4 \times 10^8$ $mm^4$. Find the slopes at the two supports and deflection under the load. Take E = 200 $GN/m^2$. **(16)**

15. (a) (i) A cylindrical vessel is 2 m diameter and 5 m long is closed at ends by rigid plates. It is subjected to an internal pressure of 4 $N/mm^2$. If the maximum principal stress is not to exceed 210 $N/mm^2$, find the thickness of the shell. Assume $E = 2 \times 10^5$ $N/mm^2$ and Poisson's ratio = 0.3. Find the changes in diameter, length and volume of the shell. **(12)**

(ii) A spherical shell of 1.50 m internal diameter and 12 mm shell thickness is subjected to pressure of 2 $N/mm^2$. Determine the stress induced in the material of the shell. **(4)**

**OR**

(b) (i) A spherical shell of internal diameter 1.2 m and of thickness 12 mm is subjected to an internal pressure of 4 $N/mm^2$. Determine the increase in diameter and increase in volume. Take $E = 2 \times 10^5$ $N/mm^2$ and $\mu = 0.33$. **(8)**

(ii) A steel cylinder of 300 mm external diameter is to be shrunk to another steel cylinder of 150 mm internal diameter. After shrinking the diameter at the junction is 250 mm and radial pressure at the common junction is 40 $N/mm^2$. Find the original difference in radii at the junction.

Take $E = 2 \times 10^5$ $N/mm^2$. **(8)**

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