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

Question Paper Code: 1033430

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024
Third Semester
Civil Engineering
U20CE301 – STRENGTH OF MATERIALS I
(Regulation 2020)

Time: Three Hours | Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. Define Poisson's ratio.

2. If a material has a Young's modulus of elasticity of 1.25×10^5 N/mm^2 and a Poisson's ratio of 0.34, what is the modulus of rigidity of the material?

3. What is meant by principal stress?

4. What are the stress invariants in a three-dimensional state of stress?

5. Define term point of contra flexure.

6. Differentiate between hogging and sagging bending moment.

7. Why called as Flitched Beams?

8. Differentiate between bonding stress and shear stress.

9. Write the formula for the equivalent bending moment under combined action of bending moment M and torque T.

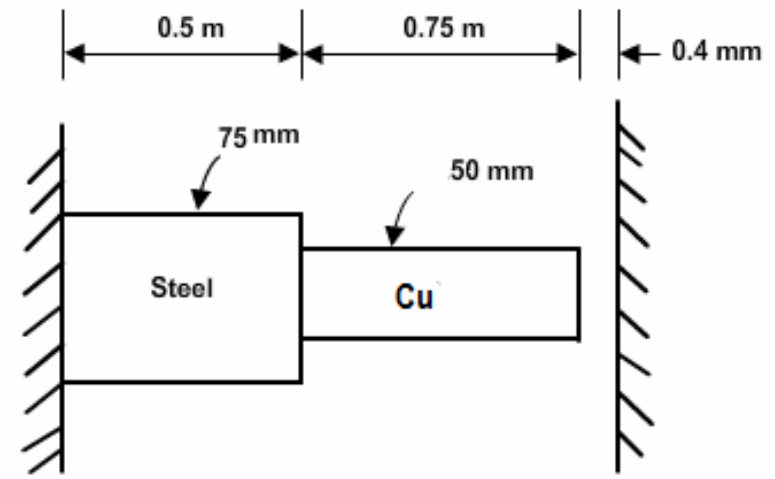
10. What is a spring? Name the two important types of springs.

PART – B (5 x 16 = 80 Marks)

11. (a) A 10 mm diameter tensile specimen has a 50 mm gauge length. The load corresponding to the 0.2% offset is 55 kN and the maximum load is 70 kN. Fracture occurs at 60 kN. The diameter after fracture is 8 mm and the gauge length at fracture is 65 mm. Calculate the following properties of the material from the tension test.
(i) % Elongation
(ii) Reduction of Area (RA) %
(iii) Tensile strength or ultimate tensile strength (UTS)
(iv) Yield strength
(v) Fracture strength
(vi) If E = 200 GPa, the elastic recoverable strain at maximum load
(vii) If the elongation at maximum load (the uniform elongation) is 20%, what is the plastic strain at maximum load? (16)

(OR)

(b) A rod consists of two parts that are made of steel and copper as shown in figure below. The elastic modulus and coefficient of thermal expansion for steel are 200 GPa and 11.7 × 10-6per °C respectively and for copper 70 GPa and 21.6 × 10-6 per °C respectively. If the temperature of the rod is raised by 50°C, determine the forces and stresses acting on the rod. (16)



12. (a) At a point in a crank shaft the stresses on two mutually perpendicular planes are 30 MPa (tensile) and 15 MPa (tensile). The shear stress across these planes is 10 MPa. Find the normal and shear stress on a plane making an angle 30^0 with the plane of first stress. Find also magnitude and direction of resultant stress on the plane. (16)

(OR)

(b) Two planes AB and BC which are at right angles are acted upon by tensile stress of 140 N/mm2 and a compressive stress of 70 N/mm^2 respectively and also by stress 35 N/mm^2. Determine the principal stresses and principal planes. Find also the maximum shear stress and planes on which they act. Sketch the Mohr circle and mark the relevant data. (16)

13. (a) A cantilever 1.5 m long is loaded with a uniformly distributed load of 2kN/m run over a length of 1.25m from the free end. It also carries a point load of 3kN at a distance of 0.25 m from the free end. Draw the shear force and bending moment diagrams of the cantilever. (16)

(OR)

(b) An overhanging beam ABC of length 8 m is simply supported at B and C over a span of 6 m and the portion AB overhangs by 2 m. Draw the shearing force and bending moment diagrams and determine the point of contra-flexure if it is subjected to uniformly distributed loads of 3kN/m over the portion AB and 4kN/m over the portion BC. (16)

14. (a) A Simply supported beam AB of span length 4 m supports a uniformly distributed load of intensity q = 4 kN/m spread over the entire span and a concentrated load P = 2 kN placed at a distance of 1.5 m from left end A. The beam is constructed of a rectangular cross-section with width b = 10 cm and depth d = 20 cm. Determine the maximum tensile and compressive stresses developed in the beam to bending. (16)

(OR)

(b) A T-beam of flange size 250x 30 mm (thickness), web 280 × 40 mm (thickness) is subjects to shear force of 20 kN. Sketch the shear stress distribution. (16)

15. (a) A hollow shaft and a solid shaft construction of the same material have the same length and the same outside radius. The inside radius of the hollow shaft is 0.6 times of the outside radius. Both the shafts are subjected to the same torque.
(i) What is the ratio of maximum shear stress in the hollow shaft to that of solid shaft?
(ii) What is the ratio of angle of twist in the hollow shaft to that of solid shaft? (16)

(OR)

(b) Derive the expression for the maximum shear stress induced in a closed coiled helical spring and also its stiffness. (16)

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