Register Number.....

B.E. DEGREE EXAMINATIONS: APRIL / MAY 2009

Fourth Semester

MECHANICAL ENGINEERING

U07ME401 Strength of Materials

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

Answer ALL the Questions:-

PART A (20 x 1 = 20 Marks)

1. When a bar is subjected to a change of temperature and its deformation is prevented, which of the following stresses is induced?
   (a) Thermal stress (b) Shear stress
   (c) Tensile stress (d) Compressive stress

2. Relation between E, K and C is given by
   (a) $E=\frac{9KC}{3K+C}$ (b) $E=\frac{3K+C}{6KC}$
   (c) $E=\frac{6KC}{K+3C}$ (d) $E=\frac{3KC}{3K+C}$

3. The ratio of lateral strain to linear strain known as
   (a) modulus of elasticity (b) modulus of rigidity
   (c) Poisson's ratio (d) elastic limit

4. A localized compressive stress at the area of contact between two members is known as ..... stress.
   (a) shear (b) crushing
   (c) bending (d) tensile

5. In a cantilever with uniformly distributed load the shearing force varies following a
   (a) linear law (b) parabolic law
   (c) exponential law (d) logarithmic law

6. Bending moment at supports in case of simply supported beams is always
   (a) less than unity (b) more than unity
   (c) zero (d) equal to unity

7. The point of contra-flexure is also called
   (a) the point of inflexion (b) a virtual hinge
   (c) either of the above (d) a point of intersection

8. The most common way of keeping the beam of uniform strength is by
   (a) keeping the width uniform and varying the depth
   (b) keeping the depth uniform and varying the width
   (c) varying both width and depth
   (d) keeping both width and depth constant

9. The slope and deflection at a section in a loaded beam can be found out by which of the following methods?
   (a) Double integration method (b) Moment area method
   (c) Macaulay's method (d) Any of the above

10. A simply supported beam of spam l is carrying point load W at the mid span. What is the deflection at the centre of the beam?

(a) $\frac{Wl^2}{48EI}$ (b) $\frac{Wl^3}{48EI}$

(c) $\frac{5Wl^2}{348EI}$ (d) $\frac{11}{120}\cdot\frac{Wl^3}{EI}$

11. If a slenderness ratio of a column is more than 120 it is termed as

(a) short column (b) medium column

(c) long column (d) infinite column

12. Rankine formula takes into account which of the following?

(a) The effect of slenderness ratio (b) The initial curvature of the column

(c) The eccentricity of loading (d) The effect of direct compressive stress

13. Longitudinal stresses act..... to the longitudinal axis of the shell.

(a) parallel (b) perpendicular

(c) inclined (d) oblique

14. The principal stresses σ_1, σ_2 and σ_3 at a point respectively are 80 MPa, 30 MPa and -40 MPa. The maximum shear stress is

(a) 25 MPa (b) 35 MPa

(c) 55 MPa (d) 60 MPa

15. A shell with wall thickness small compared to internal diameter $\left(\frac{d}{t} \geq 20\right)$ is called...

(a) thin shell (b) thick shell

(c) pipe (d) either of the above

16. The strength of a hollow shaft for the same length, material and weight is ..... a solid shaft.

(a) less than (b) more than

(c) equal to (d) any of the above

17. The angle of twist is ..... proportional to the twisting moment.

(a) directly (b) inversely

(c) exponentially (d) either (a) or (b)

18. If a close-coiled helical spring is subjected to load W and the deflection produced is d, then stiffness of the spring is given by

(a) W/d (b) W.d

(c) d/W (d) W^2.d

19. In case of a laminated spring, the load at which the plates become straight is called

(a) working load (b) safe load

(c) proof load (d) crippling load

20. Proof resilience is the mechanical property of materials which indicates their capacity to bear

(a) static tensile loads (b) static compressive loads

(c) shocks (d) crushing loads

PART B (5 x 16 = 80 Marks)

21. a. A.C.I.flat, 300 mm long and of 30 mm × 50 mm uniform section, is acted upon by the following forces uniformly distributed over the respective cross-section; 25 kN in the direction of length (tensile); 350 kN in the direction of the width (compressive); and 200 kN in the direction of thickness (tensile). Determine the change in volume of the flat.

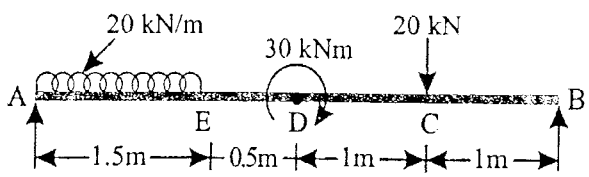
Take E = 140 GN/m^2, and m = 4.

(OR)

21. b. A copper rod of 40 mm diameter is surrounded tightly by a cast-iron tube of 80 mm external diameter, the ends being firmly fastened together. When put to a compressive load of 30 kN, what load will be shared by each? Also determine the amount by which the compound bar shortens if it is 2 m long.

Take : $E_{C.I}$ = 175 GN/m^2,
and E_{copper} = 75 GN/m^2.

22. a. Figure shows a beam AB of length 4 m acted upon by the forces and moments. Draw the B.M. and S.F. diagrams.



(OR)

22. b. Two wooden planks 150 mm × 50 mm each are connected to form a T-section of a beam. If a moment of 3.4 kNm is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the stresses at the extreme fibres of the cross-section. Also calculate the total tensile force on the cross-section.

23. a. A steel girder of 6 m length acting as a beam carries a uniformly distributed load w N/m run throughout its length. If I = 30 × 10^{-6} m^4 and depth 270 mm, calculate:

i) The magnitude of w so that the maximum stress developed in the beam section does not exceed 72 MN/m^2.

ii) The slope and deflection (under this load) in the beam at a distance of 1.8 m from one end.

Take : E = 200 GN/m^2.

(OR)

23. b. A 1.5 m long C.I. column has a circular cross-section of 5 cm diameter. One end of the column is fixed in direction and position and the other is free. Taking factor of safety as 3, calculate the safe load, using:

i) Rankine-Gordon formula; take yield stress 560 MN/m^2, and a = $\frac{1}{1600}$ for pinned ends.

ii) Euler's formula.

Young's modulus for C.I. = 120 GN/m^2.

24. a. A cylindrical water tank of height 25 m, inside diameter 2.2 m, having vertical axis is open at the top. The tank is made of steel having yield stress of 210 MN/m^2. Determine the thickness of steel used when the tank is full of water.
Given: Efficiency of the longitudinal joint = 70%; Factor of safety = 3.

(OR)

b. Two mutually perpendicular planes of an element of material are subjected to direct stresses of 10.5 MN/m^2 (tensile) and 3.5 MN/m^2 (comp.) and shear stress of 7 MN/m^2.
Find graphically or otherwise :

i) The magnitude and direction of principal stresses, and

ii) Magnitude of the normal and shear stresses on a plane on which the shear stress is maximum.

25. a. Two shafts of the same material and same length are subjected to the same torque. If the first shaft is of a solid circular section, and the second shaft is of a hollow circular section, whose internal diameter is 2/3 of the outside diameter and maximum shear stress developed in each shaft is the same, compare the weights of the two shafts.

(OR)

25. b. A close-coiled helical spring is to have a stiffness of 100 N/m in compression, with a maximum load of 45 N and a maximum shearing stress of 120 N/mm^2. The solid length of the spring (i.e. coils touching) is 45 mm. Find:

i) The wire diameter,

ii) The mean coil radius, and

iii) The number of coils.

Take modulus of rigidity of material of the spring = 0.4×10^5 N/mm^2.

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