B.E. DEGREE EXAMINATIONS: OCTOBER / NOVEMBER 2008

Third Semester

AERONAUTICAL ENGINEERING

U07AR302: Solid Mechanics

Time: Three Hours

Maximum Marks: 100

ANSWER ALL QUESTIONS

PART A (20 X 1 = 20 Marks)

1. Elasticity of a body is

    (a) The property by which a body returns to its original shape after removel of the load.
    (b) The ratio of stress to strain.
    (c) The resistance to the force acting .
    (d) Large deformability as in case of rubber.

2. For a given material, if E, N and 1/m are young's modulus, modulus of rigidity and poisson's ratio, then..

    (a) $E = 2N(1+1/m)$ (b) $E = 2N(1-1/m)$ (c) $E = \dfrac{2N}{(1+1/m)}$ (d) $E = \dfrac{3N}{(1+2/m)}$

3. The poisson's ratio is the ratio of

    (a) Lateral elongation to linear elongation
    (b) Lateral stress to linear stress
    (c) Lateral strain to longitudinal strain.
    (d) Young's modulus of modulus of rigidity.

4. In a composite bar the load distribution among different materials of which it is made based on the assumption that all the materials will have.

    (a) equal areas   (b) same young's modulus   (c) same strain   (d) same stress

5. A simply supported beam is subjected to a udl of intensity w/m throught the length of the span. The B.M. diagram will be

    (a) Trianglewith $wl^2/8$ max ordinate   (b) Rectangle with uniform ordinate $wl^2/8$
    (b) Parabola with $wl^2/8$ max ordinate   (d) Parabola with $wl/4$ max ordinate

6. The bending moment in a beam will be maximum where

    (a) The S.F is uniform   (b) The S.F is maximum
    (c) The S.F is Zero   (d) The S.F is Maximum

7. The ratio of maximum shear stress to average shear in the case of a rectangle section is

    (a) 4/3   (b) 3/2   (c) 1   (d) 2)

8. The maximum shear stress will always occur at

    (a) Netural axis   (b) The top extreme fibre
    (c) The bottom extreme fibre   (d) A fibre in the cross – section depending on the configuration

9. Taking sagging Moments as positive, the equation governing bending moment 'M' and curvature is given by.

    (a) $EI \dfrac{d^2y}{dx^2} = -M$ (b) $EI \dfrac{d^2y}{dx^2} = \dfrac{1}{M}$ (c) $EI \dfrac{d^2y}{dx^2} = M^2$ (d) $EI \dfrac{d^2y}{dx^2} = M$

10. Maximum deflection at the centre of a simply supported beam carrying a point load at the centre, is given by

(a) $\dfrac{WL^3}{48EI}$ (b) $\dfrac{WL^3}{84EI}$ (c) $\dfrac{WL^3}{8EI}$ (d) $\dfrac{WL^3}{2EI}$

11. Maximum deflection at free end of a cantilever of span 'l' under a concentrated load at the free end in given by

(a) $\dfrac{WL^3}{8EI}$ (b) $\dfrac{WL^3}{2EI}$ (c) $\dfrac{WL^3}{3EI}$ (d) $\dfrac{WL^3}{4EI}$

12. Slope of a simply supported beam of length L and carrying a uniformly distributed load of W per unit length over the entire length are given by

(a) $\dfrac{WL^2}{24EI}$ (b) $\dfrac{WL^3}{48EI}$ (c) $\dfrac{5}{384}\dfrac{WL^3}{EI}$ (d) $\dfrac{WL^3}{384EI}$

13. What are the units of torque ?

(a) NM (b) N (c) N/M (d) N/M^2

14. The stiffness of a spring is

(a) The load required for breaking the spring
(b) Load required to compress the spring up to shearing proportional limit
(c) Load required to produce unit deflection
(d) Load per coil of the spring

15. Twristing moment is a moment applied in the plane of cross_section acting about

(a) Longitudinal axis (b) Neutral axis (c) YY axis (d) XX axis

16. When a close coiled helical spring with n coils, with mean radius R and wire diameter d is subjected to axial load, the compression in the spring is given by

(a) $\dfrac{64\,WR^3 n}{Cd^3}$ (b) $\dfrac{64WR^3 n}{Cd^4}$ (c) $\dfrac{CWR^3 N}{32d^4}$ (d) $\dfrac{32WR^3 n}{Cd^4}$

17. A Thin cylinder is the one in which

(a) The variation is hoop stress along the thickness can be neglected
(b) The hoop stress can be neglected
(c) The thickness is less than 20mm
(d) Only internal fluid pressure acts.

18. A thin cylinder is subjected to an external fluid pressure. The hoop stress will be

(a) Compressive (b)Tensile (c) bending stress (d) Zero

19. A block is subjected to normal stresses σ_x and σ_y and shear stresses τ along two planes at right angles on an inclined plane making angle 0 with σ_x axis, the shear stress $\tau\theta$ will be

(a) $\tau\theta = \dfrac{(\sigma_x - \sigma_y)\ \sin 2\theta}{2} + \tau \cos 2\theta$

(b) $\tau\theta = \dfrac{(\sigma_x + \sigma_y)\ \sin 2\theta}{2} + \tau \cos 2\theta$

(c) $\tau\theta = \dfrac{(\sigma_x - \sigma_y)\ \cos 2\theta}{2} + \tau \sin 2\theta$

(d) $\tau\theta = \dfrac{(\sigma_x - \sigma_y)\ \cos 2\theta}{2} + \tau \sin 2\theta$

20. If a block is subjected to pure shear τ shear stress on an inclined plane making angle 0 with the normal to normal cross – section will be

(a) $\tau \sin^2 \theta$ (b) $\tau \cos 2\theta$ (c) $\tau \sin 2\theta$ (d) $\tau \cos^2 \theta$

PART B (5 X 16 = 80 Marks)

21. (a) (i) Find the young's modulus of a brass rod of diameter 25mm and of length 250mm which is subjected to a tensile load of 50 kN, when extension of the rod is equal to 0.3mm   (10)

(ii) A rod which tapers uniformly from 40mm diameter to 20mm diameter in a length of 400mm is subjected to an axial load of 5000N. if $E = 2.1 \times 10^5$ N/mm². Find the extension of the rod.   (6)

(OR)

(b) A compound tube consists of a steel tube 140mm internal diameter and 160mm external diameter and an outer brass tube 160mm internal diameter and 180mm external diameter. The two tubes are of same length. The compound tube carries an axial load of 900KN. Find the stresses and the load carried by each tube and the amount it shortens. Length of each tub is 140mm. Take E for steel as 2×10^5 N/mm² and E for brass as 1×10^5 N/mm².

22. (a) A simply supported beam of length 6m carries point loads of 3KN and 6KN at a distance of 2m and 4m from the left end. Draw the S.F and B.M. diagram for the beam.

(OR)

(b) The cross section of the beam is I section has the following dimensions.

Width of the top flange	=	200mm
Thickness of the top flange	=	20mm
Depth of web	=	360mm
Thickness of web	=	10mm
Width of the bottom flange	=	200mm
Thickness of bottom flange	=	20mm

This beam of I section carries a u dl of 40KN/m run on a span of 10m. Calculate the maximum stress produced due to bending.

23. (a) A beam of length 6m is simply supported at its end and carries two point loads of 48KN and 40KN at a distance of 1m and 3m respectively from left support.
Find

(i) deflection under each load

(ii) Maximum deflection and

(iii) The point at which maximum deflection occurs. By macaulay's method

Given $E = 2 \times 10^5$ N/mm^2 and $I = 85 \times 10^6$ mm^4

(OR)

(b) A simply supported beam of length 5m carries a point load of 5KN at a distance of 3m from the left end. If $E = 2 \times 10^5$ N/mm^2 and $I = 10^8$ mm^4, determine the slope at the left support and deflection under the point load using conjugate beam method.

24. (a) A solid circular shaft tramsmits 75kW power at 200rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed $1°$ in 2m length of shaft and shear stress is limited to 50N/mm^2 take $C = 1 \times 10^5$ N/mm^2.

(OR)

(b) A closely coiled helical spring of round steel wire 10mm in diameter having 10 complete turns with a mean diameter of 12cm is subjected to an axial load of 200N. Determine.

(i) The deflection of the spring

(ii) Maximum shear stress in the wire

(iii) stiffness of the spring take $C = 8 \times 10^4$ N/mm^2

25. (a) A cylindrical vessel is 1.5m diameter and 4m long is closed at ends by rigid plates. It is subjected to an internal pressure of 3 N/mm^2 if the maximum principal stress is not to exceed 150 N/mm^2, Find the thickness of the shell. Assume $E = 2 \times 10^5$ N/mm^2 and poisson's ratio $= 0.25$. Find the changes in diameter, length and volume of the shell.

(OR)

(b) A rectangular block of material is subjected to a tensile stress of 110 N/mm^2 on one plane and a tensile stress of 47 N/mm^2 on the plane at rightangles to the former. Each of the above stresses is accompanied by a shear stress of 63 N/mm^2 and that associated with the former tensile stress tends to rotate the block anticlockwise.
Find

(i) The direction and magnitude of each of the principal stress and

(ii) Magnitude of the greatest shear stress.

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