Register Number.....

# B.E. DEGREE EXAMINATIONS: APRIL / MAY 2009

Third Semester

## AERONAUTICAL ENGINEERING

## U07AR302 Solid Mechanics

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

**Answer ALL the Questions:-**

**PART A (20 x 1 = 20 Marks)**

1. Internal resistance of a body to deformation when it is subjected to external forces is called
   A. Stress B. Strain C. Elasticity D. Stiffness

2. The Stress corresponding to a load, up to which the strain totally disappear on the removal of load is called
   A. Yield Stress B. Elastic limit C. Endurance limit D. All the above

3. Modulus of elasticity is defined as the ratio of
   A. Shear stress to shear strain
   B. Linear strain to lateral strain
   C. Linear stress to linear strain
   D. Lateral strain to linear strain

4. When longitudinal force acting on a body, the change in length is given by
   A. PE / AL B. PA / EL C. AE / PL D. PL / AE

5. A stress induced when a bar is subjected to an increase of temperature and its deformation is prevented, is
   A. Tensile stress
   B. Shear stress
   C. Compressive stress
   D. All the above

6. A structural member which is acted upon by a system of external loads at right angles to the axis is called
   A. Beam B. Bar C. Truss D. Frame

7. Bending moment at supports of simply supported beams is always
   A. Equal to unity
   B. More than unity
   C. Less than unity
   D. Zero

8. The strength of the beam mainly depends on
   A. Bending moment
   B. Section modulus
   C. Weight
   D. All the above

9. If the bending moment is consistent, the shear stress induced in the beam is equal to
   A. Bending stress
   B. $3/4^{th}$ of the bending stress
   C. $1/4^{th}$ of the bending stress
   D. Zero

10. Circular beams of uniform strength can be made by varying diameter in such a way that
    A. $\sigma/y$ is constant
    B. E/R is constant
    C. M/Z is constant
    D. M/R is constant

11. The deflection at the free end of a cantilever beam of length L carrying a point load P a free end is
A. $3PL^3/EI$ B. $PL^3/3EI$ C. $2PL^3/3EI$ D. $3PL^3/2EI$ 21.(b)

12. Which of the method is convenient to find the deflection of a beam with varying fle rigidity
A. Conjugate beam method B. Double integration method
C. Macaulay's method D. All the above

13. The unit for torsional stiffness is
A. Nm/rad B. N/m C. N/m rad D. N/rad 22.(a)

14. When a solid circular shaft is subjected to a torque T, a shear stress induced at the cent the shaft is
A. Maximum B. Zero
C. Either of the above D. Both A & B

15. For the same material, length and given torque a hollow shaft weighs --------- a solid sh 22.(b)
A. Equal to B. More than C. Less than D. Either of B or C

16. If a closely coiled helical spring is subjected to a load W and the deflection produced the stiffness of the spring is given by
A. $W.\delta$ B. $\delta/W$ C. $W/\delta^2$ D. $W/\delta$ 23.(a)

17. Hoop stress in a thin cylindrical shell acts in a
A. Longitudinal direction B. Radial direction
C. Circumferential direction D. All the above

18. Longitudinal stress in a thin cylindrical shell is given by
A. Pd/4t B. Pd/2t C. 4Pd/3t D. 3Pd/2t 23.(b)

19. If $\sigma_1$ and $\sigma_2$ are two principal stresses, then the maximum shear stress is given by
A. $(\sigma_1-\sigma_2)/2$ B. $(\sigma_1+\sigma_2)/2$ C. $\sigma_1\sigma_2/2$ D. $\sigma_1\sigma_2/4$

20. Angle between the principal planes is
A. $90^o$ B. $45^o$ C. $60^o$ D. $120^o$

**PART B (5 x 16 = 80 Marks)**

21.(a) (i) A mild steel rod of 20mm diameter is enclosed centrally inside an aluminium tub 40mm external diameter and 20mm internal diameter. The composite bar is loaded compression by an axial load P. Find the stress in aluminium when the stress in steel is 70 $N/mm^2$. Also calculate the value of P. Take Young's modulus of steel 200 $KN/mm^2$ and that of aluminium as 70 $KN/mm^2$. (12 24. (a

(ii) A cast iron bar has internal diameter of 200mm. What should be the minim external diameter so that it may carry a load of 1.6 MN, without the stress exceed 90 $N/mm^2$? (4)

**(OR)**

21.(b) (i) For a given material, Young's modulus is 110 GN/m$^2$ and Shear modulus is 42 GN/m$^2$. Find the Bulk modulus and lateral contraction of a circular bar of 37.5 mm diameter and 2.4 m long when stretched by 2.5mm under the action of the external force. (12)

(ii) A steel rod of 2 m long is heated through a temperature of 100°C. Find the stresses induced in the rod, if coefficient of linear expansion is $12\times10^{-6}$/°C. Take Young's modulus E =200 GPa. (4)

22.(a) A simply supported beam of 6 m spam carries a uniformly distributed load of 2 N/m over the middle 2 m length and point loads of 1 N and 4 N at a distance of 1 m and 5 m from left end. Draw shear force diagram and bending moment diagram and also determine the magnitude and position of maximum bending moment.

**(OR)**

22.(b) A beam of T section is used as a cantilever with the flange uppermost. The flange is 12 cm wide and 2 cm deep and the web is 1.5 cm wide and 12 cm deep while the cantilever is 2 m long. Determine the maximum possible load which may be suspended from the free end of the cantilever if the limiting stresses in tension and compression are 90 MN/m$^2$ and 150 MN/m$^2$ respectively.

23.(a) A beam of 14 m long is simple supported at its ends. It carries concentrated loads of 120 KN and 80 KN at two points 3 m and 4.5 m from the two ends respectively. Calculate the deflection of the beam at two points under the load and the maximum deflection. Take Young's modulus E=$210\times10^6$ KN/m$^2$ and moment of inertia I=$16\times10^{-4}$ m$^4$.

**(OR)**

23.(b) Using conjugate beam method find out the slope of the support A and the vertical deflection at point B in terms of EI for the section AC shown in Fig.1

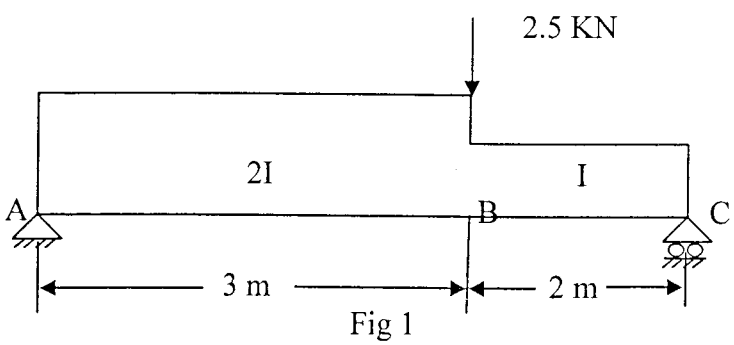


Fig 1

24. (a) A hollow steel shaft has to transmit 6000 KW at 110 rpm. If the allowable shear stress is 60 N/mm$^2$ and inside diameter is 3/5$^{th}$ of the outside diameter, find the dimensions of the shaft. Also find the angle of twist in a 3 m length. Take Shear modulus G=80 KN/mm$^2$.

**(OR)**

24.(b) A helical spring in which the mean diameter of the coil is 12 times the wire dia and is to be designed to absorb 300 Nm of energy with the extension of 150 mm. maximum shear stress is not to exceed 140 $MN/m^2$. Determine the mean diame the spring, diameter of the wire and the number of turns. Also find the load with w an extension of 50 mm could be produced in the spring. Take Shear modulus ( $GN/m^2$.

25.(a) A bar 100 mm x 75 mm x 250 mm is subjected to a tensile load of 900 KN on the mm x 75 mm face and compressive load of 1000 KN on the 250 mm x mm face and tensile load of 480 KN on the 100 mm x 75 mm face. Determin change in volume. Take Young's modulus E=200 GPa and Poisson's ratio $\nu$=0.25.

**(OR)**

25.(b) At a point in an elastic material under strain, there are normal tensile stresses o $MN/m^2$ and 30 $MN/m^2$ respectively at right angles to each other with a shearing s of 25 $MN/m^2$. Find the principle stresses and maximum shear stress and also find normal and tangential stress on a plane inclined at an angle $50^o$ with the vertical axi

**Time**

1.

2.

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3.

4.

5.

6.