B.E DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Third Semester

AERONAUTICAL ENGINEERING

MEC109: Strength of Materials

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. If the Poisson's ratio of a metal is 0.3 and the linear strain is 0.18, the lateral strain is
   a) 0.054   b) 0.6
   c) 1.333   d) 0.06

2. The strain energy stored in a bar when 50 kN load gradually applied to the bar causes an
   extension of 10 mm is
   a) 0.5kJ   b) 0.25kJ
   c) 125 kJ   d) 25 kJ

3. The neutral axis of a beam is subjected to ------------------ stress.
   a) Maximum tensile   b) Maximum compressive
   c) zero   d) Minimum compressive

4. A beam which is fixed at one end and free at the other is called
   a) Simply supported beam   b) Fixed beam
   c) Overhanging beam   d) Cantilever beam

5. The load required to produce unit deflection in a spring is called
   a) Flexural rigidity   b) Torsional rigidity
   c) Rigidity modulus   d) Stiffness

6. When a helical compression spring is subjected to an axial compressive load, the stress induced in the
   wire is
   a) Tensile stress   b) Shear stress
   c) Compressive stress   d) Bending stress

7. A column of length, l, with one end fixed and other end free may be considered as equivalent to a column
   of length ------------------ with both ends hinged.
   a) l   b) $l/\sqrt{2}$
   c) 2l   d) l/2

8. The ratio of length of column to least radius of gyration is known as
   a) Poisson's ratio   b) Long column
   c) Short column   d) Slenderness ratio

9. If the maximum principal stress is 80 MPa and minimum principal stress is – 40 MPa, the maximum shear
   stress is
   a) 40 MPa   b) 20 MPa
   c) 120 MPa   d) 60 MPa

10. When a thin cylindrical shell subjected to an internal pressure, the tensile stress acting in a direction
    tangential to the circumference is called
    a) Hoop stress   b) Longitudinal stress
    c) Radial stress   d) Axial stress

PART B (10 x 2 = 20 Marks)

11. Distinguish between a rigid body and a deformable body.

12. Define thermal stresses.

13. Sketch the bending moment diagram for cantilever beam of length L subjected to a concentrated load P at
    the free end.

14. List any four assumptions made in the simple theory of bending.

15. Write the equation which relates the torque and the torsional shear stress.

16. Mention the use of Wahl factor in the design of helical coil spring.

17. Distinguish between the failures of long column and short column.

18. List the factors influencing the maximum deflection when a cantilever is subjected to a concentrated load
    at its free end.

19. Draw the Mohr's circle for the state of stress: $\sigma_x = 0$; $\sigma_y = 0$; $\tau_{xy} = 10$ MPa.

20. Define principal stress

PART C (5 x 14 = 70 Marks)

21. a)   A steel bar of cross-section 500 mm^2 is subjected to the axial forces shown in Fig.1.
          Determine load P for equilibrium. Find the net total elongation of the bar. For steel E=210
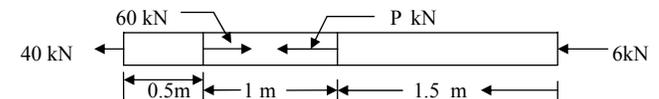   GPa.

Figure.1.

(OR)

b) A 12.5 mm-diameter tensile specimen has a 200 mm gage length. The load corresponding to yield is 30.5 kN. The elastic limit is 18 kN with an elongation of 0.12 mm. Maximum load is 54 kN. Length of the specimen after fracture is 244 mm. Fracture occurs at 44 kN. .Diameter at the neck = 9.0 mm.
Determine: i) Young's modulus of elasticity ii) yield stress iii) ultimate stress iv)Nominal breaking stress. v) true stress at breaking point vi) percentage elongation

22. a) A beam AB is subjected to a concentrated load of 8.4 kN at C together with a with distributed load of 0.6 kN/m for length of 4 m as indicated in Fig.2. Plot the shear force and bending moment diagrams. Locate the point of contra flexure if any.
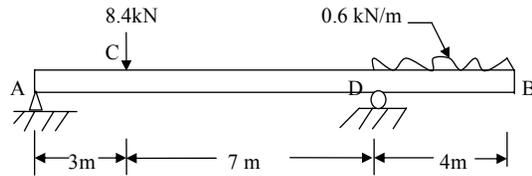

Fig.2

(OR)

b) i) A beam is 50mm wide and 75 mm deep. The bending moment at each end is equal to (7) 5×10^6 Nmm. Find the value of the bending stress.

ii) Draw the shear force diagram for the beam ABC shown in Figure.3.Mark the values of (7) principal ordinates.
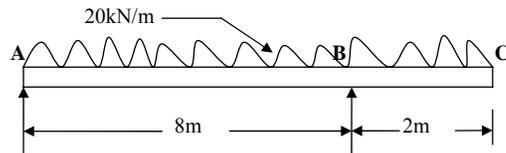

Fig.3

23. a) i) It is specified that the angular deformation in a circular shaft should not exceed 1° in a (7) length of 1800 mm. The permissible shearing stress is 83 MPa. Find the diameter of the shaft. Take G=77GPa

ii) A solid round shaft is replaced by a hollow one , the external diameter of which is twice (7) the internal diameter. Find the ratio of the values of torque that can be transmitted by both the shafts of same material of equal weights over the same lengths.

(OR)

b) i) A hollow shaft must transmit a power of 330 kW at 120 rpm. The shearing stress should (7) not exceed 80 MPa. The inside diameter is to be 0.6 of the outside diameter. Find the value of the outside diameter.

ii) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 (7) mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN /mm^2 , find the axial load which the spring can carry.(consider the effect of curvature)

24. a) Derive the equation by double integration method for the deflection y for values of x located between the supports for the beam shown in figure.3
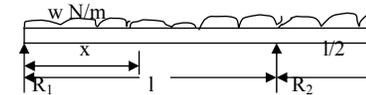
(OR)

b) i) A solid circular column steel column with hinged ends is 1m long and 66 mm (7) diameter.Find the Euler's load. Take E = 210GPa

ii) A 4m cantilever beam fixed at one has a uniform load of 3 kN/m on its entire span.E =200 (7) GPa; I==10x10^{-6}m^4. Compute the angle of slope and deflection at free end.

25. a) A material is subjected to two mutually perpendicular direct stresses of 80 MPa compressive and 50 MPa tensile, together with a shear stress couple of +30 MPa. Calculate

i) the magnitude and nature of principal stresses (8)

ii) the direction of the planes on which principal stresses act. (2)

iii) verify the answers by drawing Mohr's circle (4)

(OR)

b) A thin cylindrical shell three meter long, one meter in diameter has a metal thickness of 10 mm. If it is subjected to an internal pressure of 3MPa, determine the changes in length, diameter and volume. E= 210GPa; Poisson's ratio = 0.30

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