

B.E. DEGREE EXAMINATIONS: NOV/DEC 2010

Third Semester

AERONAUTICAL ENGINEERING

MEC109: Strength of Materials

Time: Three Hours

Maximum Marks: 100

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. The materials having same elastic properties in all directions are called
a) ideal materials b) uniform materials c) isotropic materials d) elastic materials
2. The value of Poisson's ratio for steel is between
a) 0.01 – 0.1 b) 0.23 – 0.27 c) 0.25 – 0.33 d) 0.4 – 0.6
3. A composite bar made of steel and copper is heated up. The stresses developed in steel and copper will be
a) compressive and tensile b) compressive and bending
c) bending and tensile d) tensile and compressive
4. The section modulus Z is expressed as
a) I/Y b) EI c) Y/I d) E/I
5. The moment diagram for a cantilever beam subjected to bending moment at end of beam will be
a) rectangle b) triangle c) parabola d) elliptical
6. The ratio of deflection of two identical beams subjected to a central load W, but one fixed at both ends and other supported freely will be
a) $1/2$ b) $1/3$ c) $1/4$ d) $1/8$
7. Maximum deflection in a beam supported freely at both ends due to a central load P at middle is
a) $PL^3 / 48EI$ b) $PL^3 / 32EI$ c) $PL^3 / 96EI$ d) $PL^3 / 128EI$
8. Torsional rigidity of a solid circular shaft of diameter 'd' is proportional to
a) d b) d^2 c) d^3 d) d^4
9. For biaxial stress the maximum shear stress occurs on plane inclined at following angle to the principal normal plane
a) 90° b) 45° c) 145° d) 135°
10. The ratio of hoop stress to longitudinal stress in thin walled cylinder is
a) 1 b) $1/2$ c) 2 d) $1/4$

PART B (10 x 2 = 20 Marks)

11. State Hooke's law.

12. A 2m solid steel bar of diameter 100mm is subjected to a pull of 100kN. Find the increase in length of bar. Take $E = 200\text{kN/mm}^2$.
13. Draw the S.F. and B.M. diagrams for a cantilever of length L carrying a point load W at the free end.
14. What do you mean by point of contraflexure?
15. What is the relationship between slope, deflection, B.M. and S.F.?
16. Define conjugate beam.
17. The shearing stress in a solid shaft is not to exceed 40N/mm^2 when the torque transmitted is $20,000\text{Nm}$. Determine the minimum diameter of the shaft.
18. A solid shaft of 150mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced to the shaft is 45N/mm^2 .
19. Define the terms: principal planes and principal stresses.
20. A cylindrical pipe of diameter 2m and thickness 2cm is subjected to an internal fluid pressure of 1.5N/mm^2 . Determine the longitudinal stress developed in the pipe.

PART C (5 x 14 = 70 Marks)

21. a) A tensile load of 40kN is acting on a rod of diameter 40mm and of length 4m. A bore of diameter 20mm is made centrally on the rod. To what length the rod should be bored so that the total extension will increase 30% under the same tensile load. Take $E = 2 \times 10^5 \text{N/mm}^2$.

(OR)

- b) A steel tube of 30mm external diameter and 20mm internal diameter encloses a copper rod of 15mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C . Take E for steel and copper as $2.1 \times 10^5 \text{N/mm}^2$ and $1 \times 10^5 \text{N/mm}^2$ respectively. The value of co-efficient of linear expansion for steel and copper is given as 11×10^{-6} per $^\circ\text{C}$ and 18×10^{-6} per $^\circ\text{C}$ respectively.

22. a) A cantilever of length 2m carries a uniformly distributed load of 1.5kN/m run over the whole length and a point load of 2kN at a distance of 0.5m from the free end. Draw the S.F. and B.M. diagrams for the cantilever.

(OR)

- b) A timber beam of rectangular section is to support a load of 20kN uniformly distributed over a span of 3.6m when beam is simply supported. If the depth of section is to be twice the breadth, and the stress in the timber is not to exceed

7N/mm^2 , find the dimensions of the cross-section. How would you modify the cross-section of the beam, if it carries a concentrated load of 20kN placed at the center with the same ratio of breadth to depth?

23. a) A cantilever of length 2m carries a uniformly distributed load of 2kN/m over a length of 1m from the free end, and a point load of 1kN at the free end. Find the slope and deflection at the free end if $E = 2.1 \times 10^5 \text{N/mm}^2$ and $I = 6.667 \times 10^7 \text{mm}^4$.

(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 $E = 2 \times 10^5 \text{N/mm}^2$ and $I = 10^8 \text{N/mm}^4$, determine the slope at the left support and deflection under the point load using conjugate beam method.

24. a) A solid circular shaft and a hollow circular shaft whose inside diameter is $(3/4)$ of the outside diameter, are of the same material, of equal lengths and are required to transmit a given torque. Compare the weights of these two shafts if the maximum shear stress developed in the two shafts are equal.

(OR)

- b) The stiffness of a close-coiled helical spring is 1.5N/mm of compression under a maximum load of 60N . The maximum shearing stress produced in the wire of the spring is 125N/mm^2 . The solid length of spring is given as 5cm . Find:

(i) diameter of wire

(ii) mean diameter of the coils and

(iii) number of coils required. Take $C = 4.5 \times 10^4 \text{N/mm}^2$.

25. a) Direct stresses of 120N/mm^2 (tensile) and 90N/mm^2 (compressive) exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the planes. The greatest principal stress at the point due to these is 150N/mm^2 .

(i) What must be the magnitude of the shearing stresses on the two planes?

(ii) What will be the maximum shearing stress at the point?

(OR)

- b) A boiler is subjected to an internal steam pressure of 2N/mm^2 . The thickness of boiler plate is 2.6cm and permissible tensile stress is 120N/mm^2 . Find out the maximum diameter, when efficiency of longitudinal joint is 90% and that of circumferential joint is 40% .
