* 3 5 0 3 *

C09–M–403

3503

BOARD DIPLOMA EXAMINATION, (C–09)

OCT/NOV—2016

DME—FOURTH SEMESTER EXAMINATION

STRENGTH OF MATERIALS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answer should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Define the following :

(a) Lateral strain

(b) Volumetric strain

(c) Strength

2. A material has a Young's modulus of 1 25 10^5 N/mm^2 and a Poisson's ratio of 0·25. Calculate *(a)* modulus of rigidity and *(b)* bulk modulus.

3. An axial pull of 150 kN is gradually applied on a circular steel rod 5 m long and 50 mm diameter. Find the strain energy that can be stored in the rod. Take E 2 10^5 N/mm^2.

4. What are meant by *(a)* shear force diagram and *(b)* bending moment diagram?

5. Draw shear force and bending moment diagrams for a simply supported beam which is loaded with a point load W at its mid-point. Take length of the beam L.

6. A steel wire 8 mm diameter is bent into a circular shape of 9 m radius. Determine the maximum stress induced in the wire. Take $E = 2 \times 10^5$ N/mm^2.

7. A cantilever of length 7 m is carrying a UDL of 16 kN/m. Calculate the deflection at the free end if moment of inertia, $I = 85 \times 10^7$ mm^4 and $E = 2 \times 10^5$ N/mm^2.

8. A circular shaft is required to transmit a torque of 6 kN-m. If the permissible angle of twist is 2 degrees over the length of 4 m, find the diameter of the shaft. Take $G = 8 \times 10^4$ N/mm^2.

9. Define *(a)* spring index and *(b)* spring stiffness.

10. A gas cylinder 2 m internal diameter is 15 mm thick. Find the allowable pressure of the gas if the tensile stress in the metal is not to exceed 120 N/mm^2 and efficiency of the joint is 80%.

PART—B

10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. A rectangular block 250 mm × 100 mm × 75 mm is subjected to axial loads as follows :

(a) 480 kN tensile load on the 100 mm × 75 mm face

(b) 1000 kN compressive load on the 250 mm × 100 mm face

(c) 900 kN tensile load on the 250 mm × 75 mm face

Assuming Poisson's ratio as 0·25 and $E = 2 \times 10^5$ N/mm^2, calculate the change in volume of the block due to application of loading specified above.

12. A steel bar is placed between two copper bars each having same area and length as the steel bar is at 15 °C. At this stage, they are rigidly connected together at both ends. When temperature is raised to 315 °C, the length of the bars increases by 1·5 mm. Determine the original length and final stresses in the bars. Take E_s 2 1 10^5 N/mm^2, E_{cu} 1 10^5 N/mm^2, $_s$ 12 10^{-6} per °C, $_{cu}$ 17 5 10^{-6} per °C.

13. A mild steel bar of length 2·5 m has a diameter of 55 mm, hangs vertically. A load of 25 kN falls on a collar attached to the lower end. Find the maximum stress when—

(a) height of fall is 150 mm;

(b) the load is applied suddenly without impact;

(c) the load is applied gradually.

Take E 2 10^5 N/mm^2.

14. A beam 5 m long supported at the ends carries point loads of 140 kN, 60 kN and 80 kN at a distance of 0·5 m, 2·5 m and 3·5 m respectively from the left end. Draw the shear force and bending moment diagrams.

15. A simply supported beam of span (length between supports) 4 m has an overhanging of 1 m on right-hand support. Point loads of 2 kN and 1 kN act at 5 m and 2 m respectively from the left-hand support and UDL of 2 kN/m over a length of 2 m from the left hand support. Draw the shear force and bending moment diagrams.

16. A wooden beam of rectangular cross section 125 mm wide 200 mm depth is simply supported at its ends and has a span of 5 m. If the maximum allowable bending stress is 7·5 N/mm^2, what is the maximum deflection? Take E 0 1 10^5 N / mm^2.

17. Find the diameter of a solid circular shaft to transmit 750 kW at 250 r.p.m. It is specified that the maximum shear stress must not exceed 40 N/mm^2 and the angle of twist must not exceed one degree in a length of 20 times the diameter. Take G 0 82 10^5 MN/m^2.

18. *(a)* A closed coiled helical spring is required to exert a force of 3·5 kN and to have stiffness of 75 kN/m. If the mean diameter of the coil is to be 100 mm and the working stress 200 N/mm^2, find the number of turns and diameter of spring wire with which it is made. Take G 0 8 10^5 N/mm^2.

(b) Derive the expression for hoop stress of a thin cylinder subjected to internal pressure.

★ ★ ★