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C14–C–302

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BOARD DIPLOMA EXAMINATION, (C–14)

MARCH/APRIL—2017

DCE—THIRD SEMESTER EXAMINATION

MECHANICS OF SOLIDS

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

PART—A 3×10=30

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

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

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

1. Define the terms *(a)* shear force, *(b)* bending moment and *(c)* point of contraflexure.

2. Write the three equilibrium equations.

3. Draw the shear force and bending moment diagrams for a simply-supported beam of span L meters and is loaded with a uniformly distributed load of W kN/meter on its entire span.

4. State any three assumptions made in the theory of simple bending.

5. A hollow circular beam of 80 mm internal diameter and 160 mm external diameter is subjected to a maximum bending moment of 400 kNm. Find the bending stress developed at the inner surface of the section.

6. A rectangular beam 100 mm wide is subjected to a maximum shear force of 40 kN and the corresponding maximum shear stress being 3 N/mm^2. Find the depth of the beam.

7. Differentiate the strength criteria and stiffness criteria for the design of beams.

8. An aluminium cantilever of rectangular section 48 mm wide and 36 mm deep of length 250 mm carries a udl. Find the maximum value of rate of udl, if the maximum deflection in the cantilever is not to exceed 1 mm. E for aluminium is 70 10^3 N/mm^2.

9. A timber beam 120 mm wide and 240 mm deep is used as simply-supported beam to carry a udl of 8 kN/m. If the central deflection is limited to 15 mm, determine the maximum permissible span for which the beam is suitable. Take E 10 kN/sq. mm.

10. A cantilever beam of span 3 m carries a point load of 20 kN at its free end. Calculate the slope and deflection at the free end, using moment-area method. Take EI 4000 kNm^2.

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)* State the location and magnitude of the maximum shear force developed for the following : 3

(i) Cantilever beam of length L meters and is loaded with a point load of W kN placed at the free end.

(ii) A simply-supported beam of span L meters and is loaded with a central point load of W kN.

(iii) A simply supported beam of span L meters and is loaded with a udl of W kN/m on its entire span.

(b) A cantilever beam of span 4 meters is loaded with a udl of 5 kN/m in a length of 2 meters from the fixed end and also a point load of 3 kN placed at its free end. Draw the shear force and bending moment diagrams indicating the values at salient points. 7

12. A beam of length 13 meters is supported at one meter from the left end and 2 meters from the right end. A concentrated load of 2 kN is acting at the left end and another load of 3 kN is acting at the right end. It is also subjected to a concentrated load of 20 kN placed at 5 meters from the left support. Draw the shear force and bending moment diagrams indicating the values at salient points. Also locate the points of contraflexure.

13. Two ISLC 225 channels are placed back-to-back at a distance of 100 mm and are connected by plates 275 mm wide and 15 mm thick, one at top and one at bottom to form a simply-supported beam of span 6 m. What udl the beam can carry safely without exceeding a bending stress of 100 MN/m^2? For each channel, I_{xx} 26 946 10^6 mm^4, area = 3301 mm^2.

14. A beam of I—section, 150 mm deep and 80 mm wide has flanges 6·8 mm thick and web 4·8 mm thick is simply-supported and carries a udl of 20 kN/m over its entire span. Find the maximum permissible span without exceeding the shear stress of 60 N/mm^2. Take I_{xx} 688 20 10^4 mm^4 and A = 1808 mm^2.

15. Derive the relation between curvature, slope and deflection of a loaded beam.

16. A timber beam of rectangular section has a span of 4·8 m and is simply-supported at its ends. It is required to carry a total load of 48 kN uniformly distributed over the whole length. Find the maximum value for the breadth and depth of the beam, if the maximum bending stress is not to exceed 7 N/mm^2 and the maximum deflection is limited to 9·5 mm. Take E for timber as 10500 N/mm^2.

17. A vertical thin walled stand pipe 3·2 m diameter is of height 30 m. If the allowable working stress in tension is 120 N/mm^2, what is the required thickness? Assume that the pipe is filled with water of specific weight 10 kN/m^3.

18. *(a)* List out any four assumptions made in the theory of pure torsion. 4

(b) Calculate the dimensions of a hollow steel shaft to transmit 800 HP at a speed of 120 RPM. The maximum torque being 1·12 times the mean. The internal diameter of the shaft is 60% of outer diameter and greatest intensity of shear stress in the steel is limited to 280 kg/cm. 6

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