December 2017

MECHANICS OF STRUCTURE

Time Allowed: 3 Hours *Full Marks: 70*

Answer to Question No.1 is compulsory and to be answered first.
This answer is to be made in separate loose script(s) provided for the purpose.
Maximum time allowed is 45 minutes, after which the loose answer scripts will be collected and fresh answer scripts for answering the remaining part of the question will be provided.
On early submission of answer scripts of Question No.1,
a student will get the remaining script earlier.

Answer any five questions from the rest.

1. Answer any twenty questions from the followings: 1x20=20

i) Modulus of rigidity is defined as the ratio of – (a) Longitudinal stress to longitudinal strain (b) Shear stress to shear strain (c) Stress to strain (d) None of the above.

ii) The relationship between young's modulus of elasticity E, Bulk modulus K and Poisson's ratio μ is given by – (a) E= 2K (1-2μ) (b) E = 3K (1+μ) (c) E = 3K (1-2μ) (d) E = 2K (1+μ).

iii) If a bar is subjected to axial stress of 25N / mm^2 and Poisson's ratio is 0.3, Volumetric Strain is – (a) 25/5 (b) 17.5/5 (c) 10/E (d) None of the above.

iv) The unit of modulus of elasticity is same as those of – (a) Stress, Strain and Pressure (b) Stress, Pressure and modulus of rigidity (c) Stress, force and modulus of rigidity (d) None of the above.

v) If the shear stress on a plane has to be maximum, then the plane should be make an angle with the normal cross section which is – (a) 45° (b) 90° (c) 135° (d) None of the above.

vi) Principal plane is the plane carrying – (a) Zero normal stress but only shear stress (b) Zero shear stress but only normal stress (c) both shear and normal stress (d) none of the above.

vii) The inclination of maximum shear stress makes an angle 45° to the direction of principal plane.

viii) The point of contraflexture lies where – (a) shear force changes sign, (b) bending moment is zero or changes sign, (c) shear force is zero, (d) bending moment is maximum.

ix) If shear force is zero along a section, the bending moment at that section will be – (a) zero, (b) minimum, (c) maximum, (d) either minimum or maximum.

x) In a cantilever beam of spam L subjected to uniformly varying load of intensity zero at free end and W/unit length at fixed end, maximum shear force is $\frac{wL}{2}$.

xi) The variation of shear force due to a uniformly varying load is by – (a) cubic law, (b) parabolic law, (c) linear law, (d) uniform law.

xii) The moment of inertia of a rectangular lamina of side d and b about centroidal axis parallel to side d is – (a) bd^3/12 (b) bd^3/36 (c) b^{3}d/12 (d) b^{3}d/36.

xiii) Neutral axis in a beam carries zero bending stress.

xiv) Bending stress means – (a) tensile stress, (b) compressive stress, (c) Both tensile and compressive stress, (d) shear stress.

xv) The ratio of maximum shear stress and average shear stress in a circular beam is – (a) 3:2 (b) 4:3 (c) 2:1 (d) none of the above.

xvi) For a T section, Maximum shear stress occurs at Neutral axis. [True / False]

xvii) In a redundant frame the number of member is equal to (2J-3). [True / False]

xviii) A Truss can be solve by method joints when the number of unknowns at the joint is not more than two. [True / False]

xix) Maximum strain energy store per unit volume is called proof resilience. [True / False]

xx) In a short column bending stress occurs due to eccentric loading. [True / False]

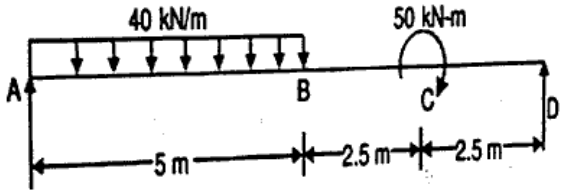
xxi) Moment area method used for determined deflection only. [True / False]

xxii) For a simply supported beam loaded with symmetrical loading maximum deflection occurs at mid spam [True / False]

xxiii) At fixed end deflection and slope are zero. [True / False]

2. a) Write down the assumptions in the theory of pure bending.
b) Stress at a point are 50 N/mm^2 tensile in x direction 20 N/ mm^2 compression in y direction 15 N/mm^2 in shear. Determine the principal stresses and location of principal plane. 4+6

3. Find the reaction and draw S.F and B.M diagram for the following beam. 2+2+6



4. a) A 8 m long CI pipe of 40 cm inside diameter and 2.8 cm wall thickness runs full of water and supported at its ends. Determine the maximum stress intensity in the material if density of CI is 7.2 gm/cm^3 and that of Water is 1gm/cm^3 respectively.
b) Defined pure bending? Explain the meaning of terms in the shear stress equation. 6+4

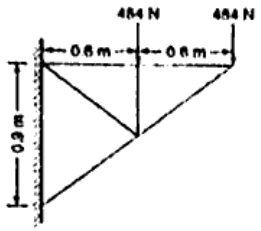
5. a) Prove that the stress induced in a member under sudden load is twice that of gradual loading.
b) A solid circular steel rod is of length 4m and diameter 200mm. If the allowable axial stress in the rod is 135N/mm^2, find the magnitude of maximum tensile force that can be applied on the rod suddenly. Consider suitable value for E as per the material given. Also calculate the strain energy absorbed by the rod at that force. (unit 5) 5+5

6. Write down expression of Carry Over Factor and Stiffness Factor for a Beam Simply Supported at One end and Fixed at the other end. 10

7. a) cantilever 2.5 m long carries a uniformly distributed load of 60 KN/m run at a length of 1.8 m from the free end. Draw the shear force and bending moment diagrams for the beam.
b) Calculate the strain energy in a bar 2.5 m long and 5 cm in diameter when it is subjected to a tensile load of 10000 kg. What will then be modulus of resilience of the material of the bar? Take E= 2.0 X 10^5 N/ mm^2. 6+4

8. a) A cantilever of length (L) 6 m carries a udl of 20 KN/m for a distance of (3/4)L from the fixed end. Using Moment area theorem, find the slop and deflection at the free end.
b) What do you mean by elastic curve? Write the differential equation of elastic curve. 8+2

9. Determine the forces in the various members of a pin jointed framework shown in figure below; tabulate the forces stating whether they are in tension or compression. 10



10. A timber cantilever 200 mm wide and 300 mm deep is 3 m long. It is loaded with a u.d.l. of 3 kN/m over the entire length. A point load of 2.7 kN is placed at the free end of the cantilever. Find the maximum bending stress produced. 10

11. a) Determine the force and elongation of the compound bar. if the maximum stress induced in it is 100 N/mm^2. Both sections are circular with dia of 20mm and 10mm respectively. Take E = 200GPa.

b) A beam has hollow rectangular cross section with external dimensions 70 mm × 120 mm. The uniform thickness of the section is 10 mm. Draw shear stress variation diagram if the section is subjected to a shear force of 70 kN. Also determine the ratio of maximum shear stress to average shear stress. 5+5

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