

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), Nov.-Dec. 2017

B. Tech in Civil Engineering, Semester IIIrd

Roll No.....

COURSE CODE: CE-305

Time: 3 hours

Max. Marks: 100

COURSE TITLE: Structure Analysis-I

Instructions to students:

1. Do not write anything other than your roll number on question paper.
 2. Assume suitable data wherever required and mention it clearly.
 3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
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Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. The neutral axis of the cross-section a beam is that axis at which the bending stress is:
(a) zero (b) minimum (c) maximum (d) infinity
- ii. A body is subjected to a tensile stress of 1200 MPa on one plane and another tensile stress of 600 MPa on a plane at right angles to the former. It is also subjected to a shear stress of 400 MPa on the same planes. The maximum normal stress in MPa will be:
(a) 400 (b) 500 (c) 900 (d) 1400
- iii. Two shafts 'A' and 'B' transmit the same power. The speed of shaft 'A' is 250 r.p.m. and that of shaft 'B' is 300 r.p.m. The shaft 'B' has the greater diameter.
(a) True
(b) False
- iv. The simply supported beam 'A' of length l carries a central point load W . Another beam 'B' is loaded with a uniformly distributed load such that the total load on the beam is W . The ratio of maximum deflections between beams A and B is
(a) $5/8$ (b) $8/5$ (c) $5/4$ (d) $4/5$
- v. Two shafts 'A' and 'B' are made of same material. The shaft 'A' is solid and has diameter D . The shaft 'B' is hollow with outer diameter D and inner diameter $D/2$. The strength of hollow shaft in torsion is _____ as that of solid shaft.
(a) $1/16$ (b) $1/8$ (c) $14/15$ (d) $15/16$
- vi. The property of a material by virtue of which it can be beaten or rolled into plates is called:
(a) malleability (b) ductility (c) plasticity (d) elasticity
- vii. A solid circular shaft of 60 mm diameter transmits a torque of 1600 N.m. The value of maximum shear stress developed is:
(a) 37.72 MPa (b) 47.72 MPa (c) 57.72 MPa (d) 67.72 MPa
- viii. The diameter of shaft A is twice the diameter of shaft B and both are made of the same material. Assuming both the shafts to rotate at the same speed, the maximum power transmitted by B is:

- (a) The same as that of A (b) Half of A (c) 1/8th of A (d) 1/4th of A
- ix. Angle of twist of a shaft of diameter d is inversely proportional to:
 (a) d (b) d^2 (c) d^3 (d) d^4
- x. For the two shafts connected in parallel, find which statement is true?
 (a) Torque in each shaft is the same
 (b) Shear stress in each shaft is the same
 (c) Angle of twist of each shaft is the same
 (d) Torsional stiffness of each shaft is the same

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- (i) Define stress and strain. Draw neat and clean diagram of stress-strain curve of steel.
- (ii) Define Hook's law. Discuss about four elastic constants (elastic moduli).
- (iii) A rectangular column of width 200 mm and of thickness 150 mm carries point load of 240 kN at an eccentricity of 10 mm as shown in the figure. Determine minimum and maximum stresses on the section.

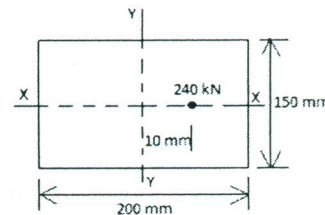


Figure : Top View of Column

- (iv) Write the basic assumptions in deriving Torsion Formula.

Q.3A Define: (i) Shear Force (ii) Bending Moment 05

Q.3B Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 25 mm and of length 1.2 m if the longitudinal strain in a bar during a tensile test is four times the lateral strain. Find the change in volume when the bar is subjected to a pressure of 120 N/mm². Take $E = 1.2 \times 10^5$ N/mm² 05

Q.4A Write the assumptions of theory of simple bending. 05

Q.4B A beam 6 m long, simply supported at its ends, carries a point load 50 kN at its center. Given Moment of Inertia = 78×10^6 mm⁴, $E = 2.1 \times 10^5$ N/mm². Calculate: 05
 (i) deflection at the center of the beam
 (ii) slope at the supports

Q.5A A wooden beam 100 mm wide and 150 mm deep is simply supported over a span of 4 m. If shear force at a section of the beam is 4500 N, find the shear stress at a distance of 25 mm above N.A. 05

Q.5B A cantilever of length 3 m is carrying a point load of 25 kN at the free end. Given Moment of Inertia = 10^8 mm⁴ and $E = 2.1 \times 10^5$ N/mm². Find: 05
 (i) Slope of cantilever at the free end
 (ii) deflection at the free end.

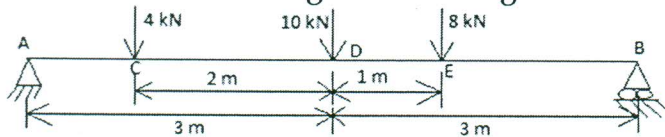
Q.6A Draw shear stress distribution of rectangular beam of width b and depth d . 05

- Q.6B At a point in a piece of elastic material, there are three mutually perpendicular planes on which the stresses are as follows: on one plane 50 N/mm^2 (tensile) and other plane 35 N/mm^2 (compressive) and shear stress 40 N/mm^2 (+). Find: 05
 (i) Principal stresses and the position of the planes on which they act
 (ii) Maximum shear stress.
 Draw neat and clean Mohr circle also.

OR

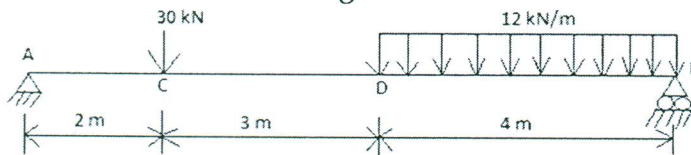
- Q.6B At a point in an elastic material under strain, there are normal stresses of 60 N/mm^2 and 40 N/mm^2 (both tensile) respectively at right angles to each other, with positive shearing stress of 20 N/mm^2 . Find: 05
 (i) Principal Stresses and the position of the planes on which they act
 (ii) Maximum Shear stress
 Draw neat and clean Mohr Circle also.

- Q.7A A cantilever of length 2 m fails when a load of 2 kN is applied at the free end. If the section of the beam is $40 \text{ mm} \times 60 \text{ mm}$, find the stress at the failure. 05
 Q.7B Draw shear force and bending moment diagram: 05



OR

- Q.7B Draw shear force and bending moment: 05



- Q.8A A simply supported beam of length 4 m carries a point load of 3 kN at a distance of 1 m from each end. If $I = 10^8 \text{ mm}^4$ and $E = 2 \times 10^5 \text{ N/mm}^2$ for the beam, then using conjugate beam method determine: 10
 (i) slope at each end
 (ii) deflection at center

- Q.9A A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 r.p.m. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 60 N/mm^2 . 10
 Q.9B A solid shaft of 250 mm diameter has the cross-section area as hollow shaft of the same material with inside diameter of 200 mm. (i) Find the ratio of power transmitted by two shafts for the same angular velocity (ii) Compare the angles of twist in the equal lengths of these shafts, when stressed to same intensity. 10

OR

- Q.9B A beam is simply supported and carries a UDL of 40 kN/m run over the whole span. The section of the beam is rectangular having depth as 500 mm. If the maximum stress in the material of the beam is 120 N/mm^2 and moment of inertia (I) = $7 \times 10^8 \text{ mm}^4$, find the span of the beam. 10