

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination November 2018

B. Tech Civil /Mechanical Engineering , Semester III

Roll No.....

CE305/ME 306: Structural Analysis -I/Strength of Material

Time: 3 hours

Max. Marks: 80

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.
-

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. The shape of the bending moment diagram over the length of a beam, having no external load, is always
 - a) linear
 - b) parabolic
 - c) cubical
 - d) Circular
- ii. Which one of the following materials is highly elastic?
 - (a) Rubber
 - (b) Brass
 - (c) Steel
 - (d) Glass
- iii. When a shaft, is subjected to torsion, the shear stress induced in the shaft varies from
 - A. minimum at the centre to maximum at the circumference
 - B. maximum at the centre to minimum at the circumference
 - C. zero at the centre to maximum at the circumference
 - D. maximum at the centre to zero at the circumference
- iv. The maximum bending moment for a simply supported beam with a gradually varying load from zero at both ends and w per metre at the centre, lies at the centre of a beam.
 - A. Agree
 - B. Disagree
- v. Shear modulus (G), Elastic modulus (E) and Poisson ratio (μ) are related as
 - $G = \frac{E}{2(1+\mu)}$
 - b) $E = \frac{G}{2(1+\mu)}$
 - c) $G = \frac{E}{2(1-\mu)}$
 - d) $G = \frac{E}{2(\mu-1)}$
- vi. 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 shear stress will be
 - A. 400 MPa
 - B. 500 MPa
 - C. 900 MPa
 - D. 1400 MPa
- vii. The ratio of shear modulus to the modulus of elasticity for a Poisson's ratio of 0.4 will be
 - A. 5/7

- B. $7/5$
- C. $5/14$
- D. $14/5$

- viii. The ratio of the moment of inertia of a circular plate and that of a square plate for equal depth, is
- A. less than one
 - B. equal to one
 - C. more than one
 - D. equal to $3\pi/16$
 - E. none of these.
- ix. A three-hinged arch is said to be :
- a) statically determinate structure b) statically indeterminate structure
 - c) A bent beam d) none of these.
- x. A member subjected to couple produces rotational motion about its longitudinal axis called as ____.
- (a) Torsion (b) twisting moment (c) both a. and b. (d) none of the above

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

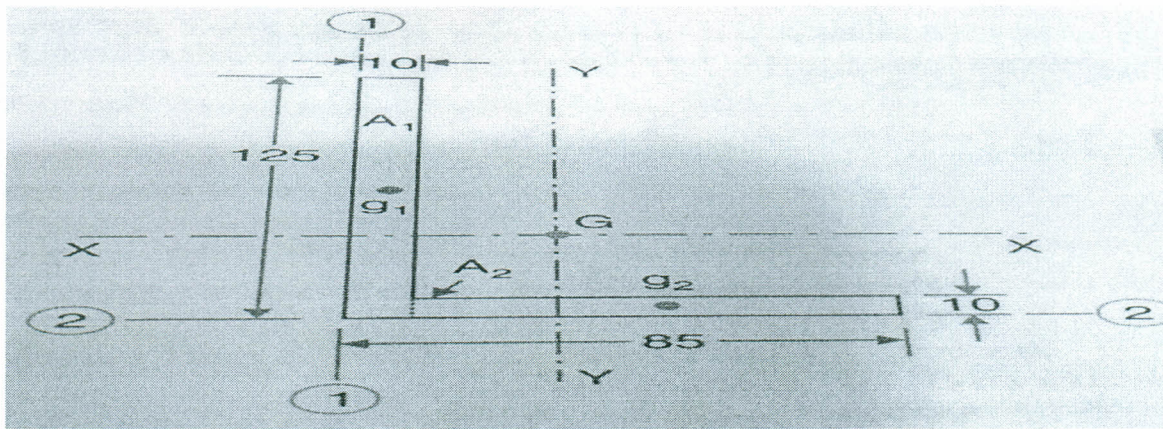
10

- i. A cylindrical bar of 20mm diameter and 1m length is subjected to a tensile test. Its longitudinal strain is 4 times that of its lateral strain. If modulus of Elasticity (E) is 2×10^5 , then its modulus of rigidity will be?
- ii. A weight falls on a plunger fitted in a container filled with oil there by producing a pressure of 1.5 N/mm^2 in the oil. The Bulk Modulus of oil is 2800 N/mm^2 . Determine the volumetric compressive strain produced in the oil?

Write down relations between shear force and

- iii. Load distribution
- iv. Bending moment in case of beam subjected to continuous loading.

- Q.3A A hollow shaft of diameter ratio $3/5$ is required to transmit 800 kW at 110 r.p.m, the maximum torque being 20% greater than the mean. The shear stress is not to exceed 63 Mpa and the twist in a length of 3 m is not to exceed 1.4 degree. Calculate the minimum external diameter satisfying these conditions. $G = 84 \text{ GPa}$. 05
- Q.3B A horizontal beam of uniform section and length L rests on supports at its ends. It carries a uniformly distributed load of w per unit run for a distance a from the right end. Calculate the value of a value of which the maximum deflection will occur at the left end of uniformly distributed load. 05
- Q.4A Derive the relation between bulk modulus and Young's modulus in terms of Poisson's ratio. 05
- Q.4B Define the term : (a)polar moment (b) Torsional rigidity (c) Bending stress & combined stress. 05
- Q.5A Determine the moment of inertia of L - section shown in figure about its centroidal axes parallel to the legs. 05



Q.5B In a tensile test a test piece of 25 mm diameter is tested over a length of 125mm. The elongation over the length is 0.0875mm under a pull of 68725 N. In a torsion test a test piece was made of same material and of same diameter and it twisted 0.025 rad. Over a length of 250 mm.at a torque of 0.3068 KNm. Find poisson ratio and three elastic modulus of test piece material. 05

Q.6A A cantilever beam with circular cross-section of radius 100mm is subjected to a uniformly distributed load over the whole length. It is given that the deflected shape of the beam has max. Curvature of 1.0189×10^{-6} and max shear force of 1KN.find the intensity of loading on the beam and its length. Take $E = 2 \times 10^5$ MPa. 05

Q.6B A girder of uniform section and constant depth is freely supported over a span of 3 meters. If the point load at the mid span is 30 kN and $I_{xx} = 15.614 \times 10^{-6} \text{ m}^4$ calculate: 05

- (i) The central deflection.
- (ii) the slops at the ends of the beam

Take: $E = 200 \text{ GN/m}^2$.

OR

Q.6B A steel girder of 6 m length acting as a beam carries a uniformly distributed load $w \text{ N/m}$ run throughout its length. If $I = 30 \times 10^{-6} \text{ m}^4$ and depth 270 mm, Calculate 05

- (i) The magnitude of w so that the maximum stress developed in the beam section does not exceed 72 MN/m^2 .
- (ii) The slope and deflection (under this load) in the beam at a distance of 1.8 m from one end.

Take: $E = 200 \text{ GN/m}^2$.

Q.7 A solid shaft of mild steel 200 mm in diameter is to be replaced by hollow shaft of alloy steel for which the allowable shear stress is 22 percent grater. If the power to be transmitted is to be increased by 20 percent and the speed of rotation increased by 6 percent determine the maximum internal diameter of the hollow shaft. The external diameter of the hollow shaft is to be 200 mm. 10

Q.8 A steel girder of uniform section, 14 meter long is simply supported at its ends. It carries concentrated loads of 90 kN and 60 kN at two points 3 meters and 4.5 meters from the two ends respectively. Calculate : 10

- (i) The deflection of the girder at the points under the two loads.

(ii) The maximum deflection.

Take: $I = 64 \times 10^{-6} \text{ m}^4$ and $E = 210 \times 10^6 \text{ kN/m}^2$.

OR

Q.8 Derive the relation for circular shaft when subjected to torsion as given below

10

$$\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{L}$$

Where T = torque transmitted, J = polar moment,

τ = Max. shear stress R = Radius of shaft,

C = modules of rigidity, θ = angle of twist L = length of shaft