Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–IV • EXAMINATION – WINTER 2013**

**Subject Code: 140201 Date: 23-12-2013**

**Subject Name: Mechanics of Deformable Bodies**

**Time: 02:30 pm to 05:00 pm Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Select most appropriate answer from the given option and rewrite the sentence. **05**

(1) For cantilever beam with point load at free end, the maximum deflection is _____

(a) $Wl^3 / 3EI$ (b) $Wl^4 / 8EI$ (c) $Wl^3 / 16EI$

(2) If the actual beam has both end fixed, then the ends of the conjugate beam will be _____

(a) Fixed at both ends (b) fixed at one end and free at other (c) free at both ends (d) either 'a' or 'c'.

(3) The water pressure per metre length on a vertical wall is _____

(a) wh (b) $wh^2 / 2$ (c) $wh / 2$ (d) $wh^2 / 4$

(4) In an eccentric riveted connection, if the magnitude of the load is increased it will effect _____

(a) Linear displacement (b) rotary displacement (c) both 'a' and 'b' (d) none of these

(5) Rankine formulae gives fairly correct results for _____

(a) Short columns only (b) long columns only (c) short to long columns (d) none of these

**(b)** (1) Differentiate between Truss and Frame **03**

(2) Define slenderness ratio. Discuss its significant. **03**

(3) Discuss strength and efficiency of riveted joints. **03**

**Q.2** **(a)** A rolled steel joist having cross section 250 X 152 mm shown in fig. (1) carries a single concentrated load of 20 KN at the right third point over a simply supported span of 9 m. If the value of Ixx for the beam is $51.316 \times 10^6$ $mm^4$ and the value of modulus of elasticity E for the material is 200 GPa, Calculate using conjugate beam method (i) deflection under the load and (ii) maximum deflection on the span. **07**

**(b)** A cantilever beam of length 3 m is carrying a uniformly distributed load of w KN/m. Assuming rectangular cross-section with depth(d) equal to twice the width(b), determine the dimensions of the beam, so that vertical deflection at the free end does not exceed 8 mm. Take maximum bending stress = 100 MPa and Modulus of elasticity E = 200 GPa. **07**

**OR**

**(b)** A curved beam of circular section of diameter 100 mm is subjected to pure bending moment of 11.5 KNm. The radius of curvature is 100 mm, Determine: (i) position of neutral axis and (ii) maximum and minimum stresses. **07**

**Q.3** **(a)** Determine the diameter of solid steel shaft which will transmit 90 KW at 160 r.p.m. Also determine the length of the shaft if the twist must not exceed 1° over the entire length. The maximum shear stress is limited to 60 $N/mm^2$. Take the value of modulus of rigidity = 8 x $10^4$ $N/mm^4$. **07**

**(b)** A concrete dam of trapezoidal section having water on vertical face is 16 m high. The base of the dam is 8 m wide and top 3 m wide. **07**

Find (a) resultant thrust on the base per metre length of the dam,

(b) point, where the resultant thrust cuts the base

(c) Intensities of maximum and minimum stresses across the base

Take weight of the concrete as 25 $KN/m^3$ and water level coinciding with the top of the dam.

**OR**

**Q.3** **(a)** A shaft is to be fitted with a flanged coupling having 8 bolts on a circle of diameter 150 mm. the shaft may be subjected to either a direct tensile load of 400 KN or a twisting moment of 18 KNm. If the maximum direct and shearing stresses permissible in the bolt material are 125 $N/mm^2$ and 55 $N/mm^2$ respectively, find the minimum diameter of the bolt required. Assume that each bolt takes an equal share of the load or torque. **07**

**(b)** Using standard notation derive the torsion formulae for solid shaft. **04**

**(c)** What is middle third rule? Derive expression for eccentricity for rectangular section. **03**

**Q.4** **(a)** A square chimney 24 m high, has an opening of 1.25 m x 1.25 m inside. The external dimensions are 2.5 m x 2.5 m. The horizontal intensity of wind pressure is 1.3 $KN/m^2$ and specific weight of masonry is 22 $KN/m^3$. Calculate the maximum and minimum stress intensities at the base of the chimney. **07**

**(b)** Explain the term: (i) Column and Strut (ii) Buckling load and Crushing load (iii) Long column and Short column **07**

**OR**

**Q.4** **(a)** Give the assumption made in Euler's theory of column. Derive the relation for Euler's crippling load for column of both ends hinged. **07**

**(b)** A 1.5 m long C.I. column has a circular cross-section of 5 cm diameter. One end of the column is fixed in direction and position and the other end is free. Taking factor of safety as 3, Calculate the safe load, using; **07**

(i) Rankine-Gordon formula; take yield stress 560 $MN/m^2$, and a=1/1600 for pinned ends.

(ii) Euler's formula where Young's modulus for C.I. = 120 $GN/m^2$.

**Q.5** **(a)** Discuss failure of riveted joint. With usual notation derive efficiency of a riveted joint. **07**

**(b)** A single riveted double cover butt joint is to be provided in a structure for connecting two plates of 12 mm thickness. Design the joints and find its efficiency. Take permissible stresses in shearing as 75 MPa, in crushing as 175 MPa and in tearing as 100 MPa respectively. **07**

**OR**

**Q.5** **(a)** A steel ring has a rectangular cross-section, 75 mm in the radial direction and 45 mm perpendicular to the radial direction. If the radius of the ring is 150 mm and maximum tensile stress is limited to 180 **07**

$MN/m^2$ calculate the tensile load the ring can carry.

**(b)** Distinguish between arch, cable, net, membrane, framed and grid structures. **07**

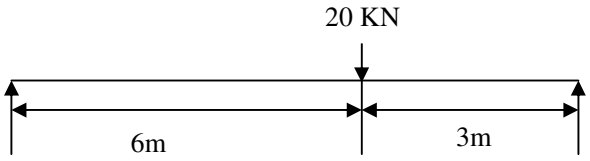


Fig. 1

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