S.E. (SEM - III) (CBSGS) (MECHANICAL ENGG.)
STRENGTH OF MATERIALS

24th May. 2016
3.00 pm to 6.00 pm

QP Code : 30642

Time: 3 hours **Maximum Marks: 80**

- Q1 is compulsory. Answer any three out of remaining five questions.
- Assume any suitable data wherever required, but justify the same. Assumptions made should be clearly stated.
- Illustrate answers with sketches wherever required.
- Answers to questions should be grouped and written together. That is, all answers to sub-questions of individual questions like Q1, Q2, Q3, etc. should be answered one below the other.
- Use a blue/ black ink pen to write answers. Use of pencil should be done only to draw diagrams and graphs.
- Figures to the right indicate marks

1 Answer any four from the following: **20**

a. A uniformly tapering rod of length **l** and diameters d_1 and d_2 is subjected to an axial pull **P**. Prove that the total extension of the rod is *[05]*

$$\delta l = \frac{4Pl}{\pi E d_1 d_2}$$

b. Write the assumptions in simple bending and hence derive the bending formula, *[05]*

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

c. Draw the shear force and bending moment diagram for a simply supported beam of length **l**, subtended to a clockwise couple **M** at the centre of the beam. *[05]*

d. Derive an expression for the maximum and the minimum stresses at the base of a column of rectangular section, when it is subjected to a load which is eccentric to both axes. *[05]*

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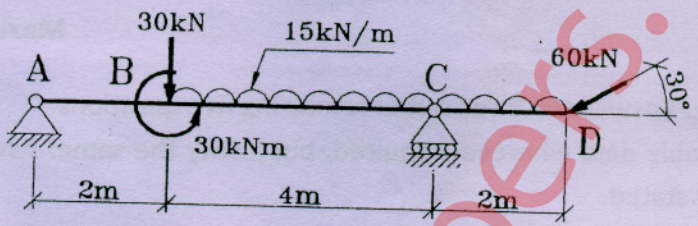
e. In a hollow circular shaft, the outer and inner diameters are 200 mm and 100 mm respectively. If the shear stress is not to exceed 40 N/mm^2, find the maximum torque, which the safely can safely transmit. **[05]**

f. What is equivalent length of a column? Give the ratio of equivalent length and actual length of columns, with various end conditions. Also, write the expression for crippling load, P for various end conditions. **[05]**

IIa. Draw axial force, shear force and bending moment diagrams for the beam loaded as shown in the figure. Also, determine the points of contra-flexure and maximum moments. **[10]**



b. A point load of 10 kN applied to a simply supported beam at mid-span, produces a deflection of 6 mm and a maximum bending stress of 20 N/mm^2. Calculate the maximum value of the momentary stress produced, when a weight of 5 kN is allowed to fall through a height of 18 mm on the beam at the middle of the span. **[10]**

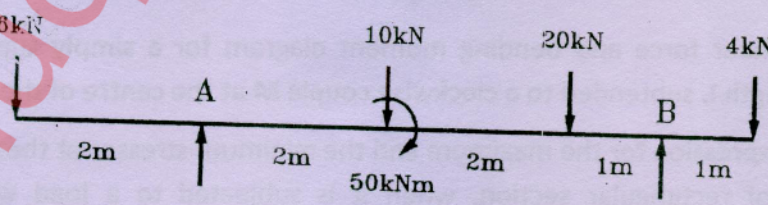
IIIa. A short column of rectangular cross section 80 mm x 60 mm carries a load of 40 kN at a point 20 mm from longer side and 35 mm from the shorter side. Determine the maximum compression and tensile stresses in the section. **[10]**

b. Find the Euler Crushing load for a hollow cylindrical cast iron column 200 mm external diameter and 25 mm thick, if it is 6 m long and hinged at both ends. **[10]**

Take, E= 1.2 x 10^6 N/mm^2

Compare the load with the crushing load as given by Rankine formula, taking f_c= 550 N/mm^2 and $\alpha = 1/1600$.

IVa. Determine the position and the amount of maximum deflection for the beam shown in the figure. Take, EI = 1.8 × 10^4 kNm^2. **[10]**



b A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 rpm. Determine the maximum internal diameter, if maximum stress in the shaft is not to exceed 60 N/mm^2. **[10]**

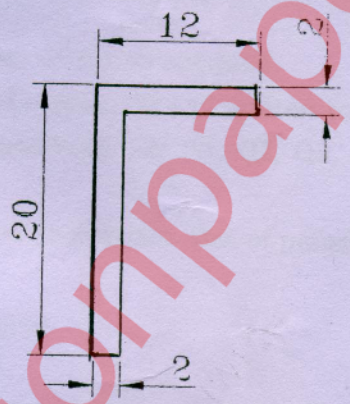
TURN OVER

Va. A closed cylindrical vessel, made of steel plates 4 mm thick with plane ends carries fluid under a pressure of 3 N/mm^2. The diameter of the cylinder is 250 mm and length is 750 mm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine changes in diameter, length and volume of the cylinder. *[10]*

Take, if $E = 2.1 \times 10^5$ N/mm^2, $1/m = 0.286$

b. A simply supported beam, with a span of 1.3 m and a rectangular cross section of 150 mm wide and 250 mm deep, carries a concentrated load of **W** at the centre. If the allowable stresses are 7 N/mm^2 for bending and 1 N/mm^2 for shear, what is the value of the safe load **W**? Also draw bending stress and shear stress distribution diagrams *[10]*

VIa. Find the principal moments of inertia and directions of principal axes for the angle section shown below. *[10]*



b. A flitched beam consists of a wooden joint 100 mm wide and 200 mm deep, strengthened by two steel plates 10 mm thick and 200 mm deep as shown in figure. If the maximum stress in the wooden joint is 7 N/mm^2, find the corresponding maximum stress attained in steel. Find also moment of resistance of composite section. *[10]*

Take, $E_s = 2 \times 10^5$ N/mm^2 and $E_w = 1 \times 10^4$ N/mm^2.