Please check that this question paper contains 09 questions and 03 printed pages within first ten minutes.

[Total No. of Questions : 09] [Total No. of Pages : 03]

University Roll No. : .....

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0 4 JAN 2023

Program: B.Tech. (Batch 2018 onwards)
Semester: 3
Name of Subject: Solid Mechanics
Subject Code: PCCE - 102
Paper ID: 16021
Scientific Calculator is Allowed.

Time Allowed : 03 hours **Max. Marks : 60**

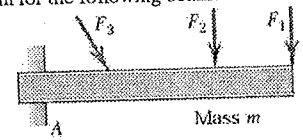
NOTE :

1) Parts A and B are compulsory.
2) Part-C has Two Questions Q8 and Q9. Both are compulsory, but with internal choice.
3) Any missing data may be assumed appropriately.

Part – A **[Marks: 02 each]**

Q1.

a) How are 'Loading Rate', 'Shear Force' and 'Bending Moment' correlated?
b) A circular shaft is subjected to a twisting moment, "T", and a bending moment, "M". Determine the ratio of maximum bending stress to maximum shear stress.
c) Draw a free body diagram for the following beam?



d) Compare any "4" different materials with steel with regard to stress-strain curve.
e) Evaluate the poisson's ratio for an incompressible material.
f) A beam simply supported at both the ends of length "l", carries two equal unlike couples, "M", at the two ends. If the flexural rigidity, "EI", is constant, then, compute the central deflection of the given beam.

Part – B **[Marks: 04 each]**

Q2. A tapering circular bar having diameter 'D' at the left end and '$2D$' at the right end is subjected to axial force 'P'. Find the % $error$, expected to occur, if the deflection is computed by assuming average diameter '$1.5\ D$', using formula of Prismatic Bar.

Q3. Enlist the effective lengths of columns for various end conditions. Further mention the Euler's Buckling loads for each end condition (with regard to respective effective lengths).

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Q4. Enlist and elucidate the conditions required to be satisfied for the static equilibrium of any structure {Two – dimensional}.

Q5. A simply supported beam, A, carries a point load at its mid-span. Another identical beam, B, carries the same magnitude of load, but it is uniformly distributed over the entire span. Compute the ratio of (a) Maximum slopes of beams A and B, and, (b) Maximum deflections of beams A and B.

Q6. Determine the diameter of a solid circular shaft to transmit $50\ kW$ power rotating at $120\ rpm$. Maximum torque is likely to exceed by 30%. Maximum permissible shear stress is $60\ MPa$. Also calculate the angle of twist for a length of $1800\ mm$. Take Modulus of Rigidity as $80\ GPa$.

Q7. A simply supported beam of rectangular cross-section is loaded with a uniformly distributed load of "$w\ kN/m$" over the entire span of "$2.5\ m$". If the permissible stresses in bending and shear are "$150\ MPa$" and "$15\ MPa$", respectively, evaluate the depth of a beam when both bending and shear stresses reach to their allowable limits simultaneously.

Part – C **[Marks: 12 each]**

Q8.

A) At a point on the surface of a generator shaft, the stresses are $\sigma_x = 50\ MPa\ \{Compressive\}$ and $\sigma_y = 10\ MPa\ \{Tensile\}$. Using an analytical method of stress transformation, determine the following quantities :
   a) Stresses acting on an element inclined at an angle of 45°,
   b) Principal Stresses, and,
   c) Maximum Shear Stresses.
   Show all results on sketches of properly oriented elements.
B) Verify the above evaluated data using a graphical method of stress transformation.

OR

A) A rectangular cross-section bar in which width is varying from b_1 to b_2 with constant thickness and external load 'P' is applied. If self - weight of the bar is negligible, derive the formula for elongation in the bar.
B) A stress element is under a state of pure shear. Using a graphical method of stress transformation, evaluate the principal stresses and maximum shear stresses.
C) A circular bar of diameter $50\ mm$ is subjected to a pull of $50\ kN$. The elongation in length was recorded $0.090\ mm$ and the reduction in diameter $0.006\ mm$. Compute Poisson's ratio and values of the three moduli. Take length of specimen $250\ mm$.

Q9. Draw the shear force and bending moment diagrams for the following overhanging beam. Also, compute and locate the points of contraflexure (if any).

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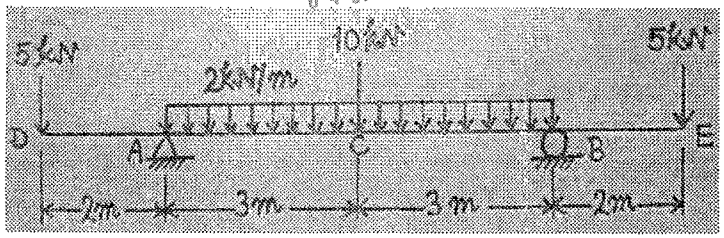
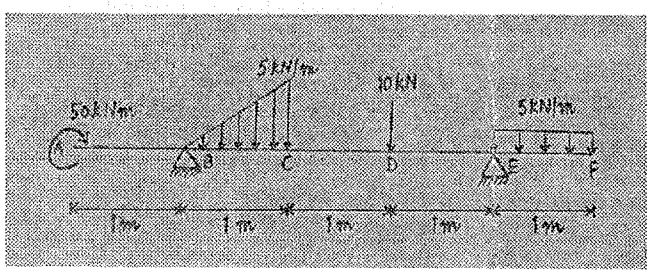


OR

Draw the shear force and bending moment diagrams for the following overhanging beam. Also, compute and locate the points of contraflexure (if any).



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