Code No: R1621032 **R16** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2019
MECHANICS OF SOLIDS
(Com to ME, AE & AME)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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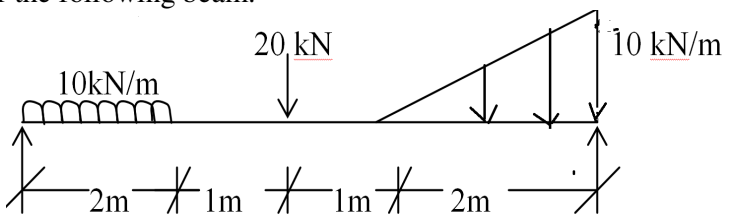
PART –A

1. a) State the Hooke's Law? (2M)
   b) Define the terms strain energy and toughness? (2M)
   c) Draw the SFD and BMD of a CB with UDL throughout its span? (3M)
   d) Derive the formula for section modulus? (3M)
   e) State the Mohr's theorem-I? (2M)
   f) Write the torsion formula? Describe the each quantity present in the formula. (2M)

PART -B

2. a) Express Poisson's ratio in terms of shear and Bulk modulii. (7M)
   b) A mild steel bar of 200mm long and 50mmx50mm cross section is subjected to an axial compressive load of 200 KN. Taking 1/m =0.3 and E = 210 KN/mm^2, calculate the changes in length, width and volume of the bar. Also calculate the values of shear and bulk modulii of the material of the bar (7M)

3. a) Derive the expression to show the relationship between shears force and bending moment. (7M)
   b) Sketch the shear force and bending moment diagrams and given all the salient values for the following beam. (7M)



4. a) Show that for a rectangular section, the distribution of shearing stress is parabolic. (7M)
   b) An I section beam consists of two flanges 150 mm X 20 mm and a web of 310 X 10 mm. Find the magnitude of maximum shear stress when it is subjected to a shear force of 40 kN. (7M)

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5. a) A cantilever of length L and constant flexural rigidity EI carries a uniformly distributed load of intensity w/unit length on the middle half of its length. Determine the ratio of the slope and the ratio of the deflection at the centre and free end of the cantilever. (7M)

   b) A simple beam with a span of 6 meters carries a point load of 40 kN at 2 meters from the left support. If, for the section I_{XX} = 73.3 x 10^{-6} m^4 and E = 200 GN/m^2, Find: The deflection under the load and the position and amount of maximum deflection. (7M)

6. a) Derive the expressions for longitudinal and hoop stress in a thin cylinder subjected to fluid pressure internally. (7M)

   b) A cylindrical shell, 3m long, 1000mm in diameter, thickness of metal 12mm is subjected to an internal pressure of 1.5 N/mm^2. Calculate the max intensity of shear stress induced and also the changes in the dimensions of the shell. Given E = $2x10^5$ N/mm^2 and 1/m = 0.3. (7M)

7. a) Derive an expression for the Euler's critical buckling load of a column with Clamped- Free ends. (7M)

   b) A hollow shaft with diameter ratio 3/5 is required to transmit 450kW at 120rpm with uniform twisting moment. The shear stress in the shaft must not exceed 60N/mm^2 and the twist in a length of 2.5m must not exceed 1^0. Calculate the maximum external diameter of the shaft satisfying these conditions. Take the modulus of rigidity C = 8 x $10^4$$N/mm^2$ (7M)

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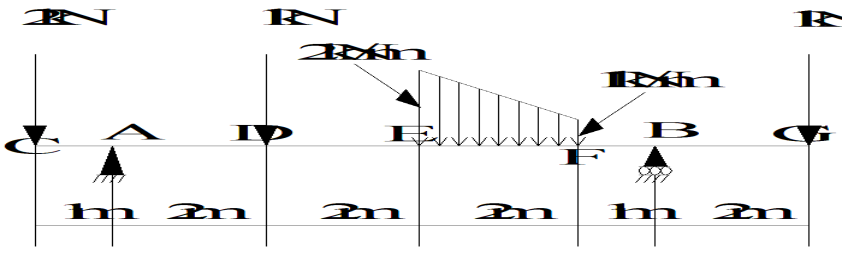
PART –A

1. a) Define the terms factor of safety and margin of safety. (2M)
   b) What is a principal stress? How many principal stresses present in a structure? (2M)
   c) Draw the SFD and BMD of an OHB with free end point loads? (3M)
   d) Derive the formula for section modulus of a beam with square cross-section? (3M)
   e) State the Mohr's theorem-II? (2M)
   f) Write the Rankine's Formula for short column? (2M)

PART -B

2. a) Define the terms (7M)
      i) Normal stress ii) Tangential stress
      iii) Ductility iv) Brittleness
   b) A flat steel plate is of trapezoidal form of uniform thickness 't'. Its width at one end is 'a' and at the other end is 'b'. If its length is 'L', determine its elongation under an axial pull. (7M)

3. a) Draw the shear force and bending moment distribution over rectangular and circular cross-sections of the beams. (4M)
   b) Draw the SFD and BMD for the beam loaded as shown in the Figure. (10M)



4. a) Find the dimensions of the strongest rectangular beam that can be cut out of a log of wood 2.6m diameter. (7M)
   b) A T-beam having flange 160mmX20mm and web 20mmX170mm is simply supported over a span of 6.5m. It carries an udl of 6kN/m including self weight over its entire span, together with a point load of 40kN at mid span. Find the maximum tensile and compressive stresses occurring in the beam section and sketch the stresses across the section. (7M)

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5. a) What are the different methods used to determine the deflection of beams? Explain the detailed streps followed in Macaulay's method. (7M)

   b) A beam of length 'ℓ' simply supported at the ends carries a point load 'W' at a distance 'a' from the left end. Find the deflection under the load. If ℓ = 10m, a = 4m, W = 100KN. Calculate the deflection under the load. Take E = 2 x 10^5 N/mm^2 and I = 1 x $10^9$$mm^4$. (7M)

6. a) Explain the effect of riveting in a thin cylindrical shell. How it is done? (4M)

   b) What thickness of metal would be required for cast-iron water pipe 90 cm in diameter under a head of 100m? Assume the permissible tensile stress for cast iron as 20 MN/ m^2. (10M)

7. a) Derive an expression for the Euler's critical buckling load of a column with Pinned-Pinned ends. (7M)

   b) A circular shaft supported in bearing 4m apart transmits 75 kW of power at 120 rpm. A pully provided at 1.5m from one bearing exerts a transverse load of 40 kN on the shaft. Determine the suitable diameter of the shaft if (i) The maximum direct stress is not to exceed 90 N/mm^2 and (ii) The maximum shear stress is not to exceed 45 N/mm^2. Take $\frac{1}{m}$=0.25. (7M)

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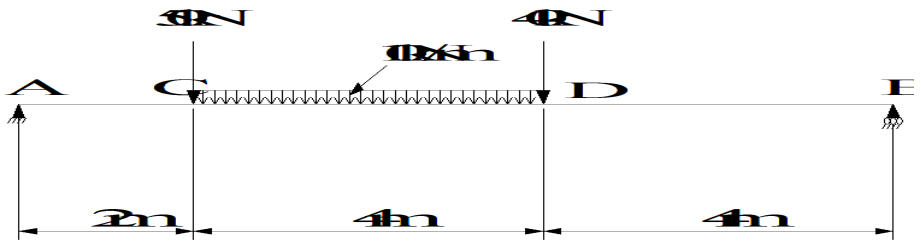
PART –A

1. a) Distinguish the Impact and Shock loading? (2M)
   b) Define the term Point of contra flexure? (2M)
   c) Draw the SFD and BMD of a CB with free end point load? (3M)
   d) Derive the formula for section modulus for a beam of rectangular cross-section? (3M)
   e) What is statically indeterminate beam? Give some examples (2M)
   f) Define the term slenderness ratio? (2M)

PART -B

2. a) Define the terms (7M)
   i) Proportional limit ii) Poisson's ratio
   iii) Proof stress iv) Strain energy.
   b) A compound bar 1 metre long is 40 mm diameter for 300 mm length, 30 mm diameter for the next 350 mm length. Determine the diameter of the remaining length so that its elongation under an axial load of 100 kN does not exceed 1mm. Take E = $2X10^5$ N/mm^2. (7M)

3. a) Define a beam and classify them. (4M)
   b) Draw the shear force and bending moment diagram of the beam loaded as shown in the Fig. below (10M)



4. a) Find the dimensions of the strongest rectangular beam that can be cut of a log of wood 1.8m diameter. (7M)
   b) A timber beam of rectangular section of length 8m is simply supported. The beam carries an udl of 12KN/m run over the entire length and a point load of 8 KN at 3m from the left support. If the depth is 2 times the width and the stress in the timber is not to exceed 8N/mm^2, find the suitable dimensions of the section. (7M)

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5. a) A beam AB of span l carries a distributed load of varying intensity from zero at A to w per unit length at B. Measuring x from the end A, establish the equation for the deflection curve of the beam. (7M)
   b) A 3.5 meters long cantilever carries a uniformly distributed load over the entire length. If the slope at the free end is one degree, what is the deflection at the free end? (7M)

6. a) Show that in the case of a thin cylindrical shell subjected to a internal fluid pressure, the tendency to burst length wise is twice as great as a transverse. (7M)
   b) A vertical cylindrical gasoline storage tank made of 20mm thick mild steel plate has to withstand maximum pressure of 1.5 MN/m^2. Calculate the diameter of the tank if stress if 240 MN/ m^2, factor of Safety 3 and joint efficiency 85%. (7M)

7. a) Derive an expression for the Euler's critical buckling load of a column with Pinned-clamped ends. (7M)
   b) A solid shaft running at 160 rpm has to transmit 100 KW of power. The material must not be stressed beyond 60 N/mm^2 and the shaft must not twist more than 1^o in a length of 3 metres. Select a suitable diameter for the shaft. (7M)

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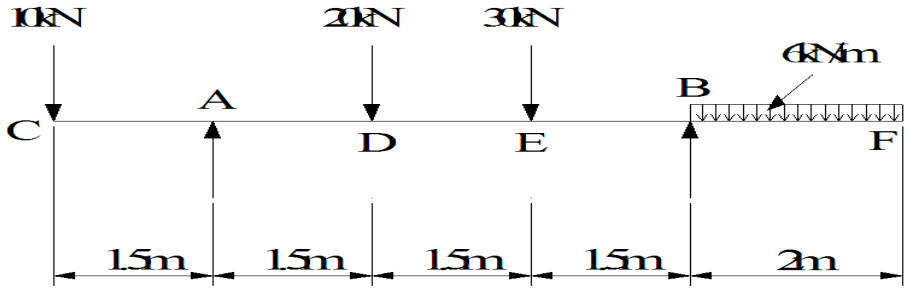
PART–A

1. a) Draw the stress – strain diagram for Brittle and Ductile materials with suitable examples? (2M)
   b) List the assumptions in simple bending theory? (2M)
   c) Draw the SFD and BMD of a SSB with central point load? (3M)
   d) Derive the formula for section modulus for a beam of circular cross-section? (3M)
   e) What is statically determinate beam? Give some examples (2M)
   f) According to theory of buckling distinguish long and short columns. (2M)

PART-B

2. a) Derive the relationship between E, N and μ of an elastic body. (4M)
   b) A steel wire 600 m long and 6mm in diameter operates a railway signal. A displacement of 150 mm is required at the signal end of the wire, and the operating force at this end is 2 kN. Find the displacement required at the other end of the wire. The wire does not sag between rollers, and the friction between wires and the roller is negligible. E for wire material is $2X10^5$ N/mm^2. (10M)

3. a) Define point of contra flexure and explain its significance (4M)
   b) Draw the SFD and BMD for the overhanging beam as shown in the Fig. (10M)



4. a) Show that the maximum shear stress in a rectangular section is 1.5 times the average stress. (7M)
   b) Sketch the shear stress distribution across an I-section consisting of two flanges 200mmx10mm and a web 10mmx180mm. Take F=20 KN (7M)

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5. a) Derive an expression for slope and deflection at the free end of a Cantilever beam AB of span *l* and stiffness EI when it is subjected to a triangular Load zero at the free end to w per unit length at the fixed end. (7M)

   b) A uniform section beam of length L is simply supported at its ends and carries a single concentrated load *W* at a distance of L/3 from one end. Working from fundamental beam theory, derive formula for the deflection (7M)
   i) under the load ii) at the centre iii) at the point of maximum deflection.

6. a) Derive a relation for the change of diameter and length of a thin cylindrical shell, when subjected to an internal pressure. (7M)

   b) A gas cylinder of internal diameter 1.5 meters is 30mm thick. Find the allowable pressure of the gas inside the cylinder if the tensile stress in the material is not to exceed 100 MN/ m^2. (7M)

7. a) Derive an expression for the Euler's critical buckling load of a column with Clamped- Clamped ends. (7M)

   b) Two shafts of the same material are subjected to the same torque. If the first shaft is of solid circular section and the second shaft is of hollow section whose internal diameter is $^2/_3$ rd of the external diameter, compare the weights of the two shafts. (7M)

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