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

II B. Tech I Semester Regular Examinations, October/November - 2017
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) Draw typical stress-strain diagram for mild steel. (2M)
b) Draw the shapes of shear force and bending moment diagrams for a cantilever beam of length L carrying an end point load (3M)
c) State Mohr's theorem? (2M)
d) Find an expression for section modulus of a rectangular section of a beam (2M)
e) Which ratio decides whether cylinder is thin or thick (3M)
f) Derive the equation of maximum torque transmitted by a circular solid shaft. (2M)

PART -B

2. a) Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50cm apart. Diameters and lengths of each rod are 2cm and 4cm respectively. A cross bar fixed to the rods at the lower ends Carries a load of 5000N such that the cross bar remains horizontal even after loading. Find the stress in each rod and position of the load on the bar. Take *E*s= 2.x 10^5N/mm^2, *E*c= 1x 10^5N/mm^2 (7M)
b) A round bar of length L and diameter D is subjected to an axial pull *P*. Find the change in volume of the bar. Poisson's ratio = *1/m*, young's modulus = *E.* (7M)

3. a) A simply supported overhanging beam is load as shown in the Figure 5. Draw the shear force and bending moment diagrams. (7M)

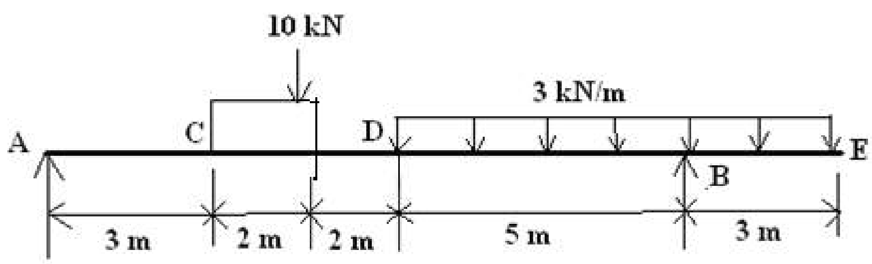

Figure 5

b) A beam of 10 m long is simply supported and carries a load of uniformly varying from 50kN/m at the left end to 150 kN/m at the right end. Draw the shear force and bending moment diagrams. (7M)
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Code No: R1621032 **R16** SET - 1

4. Derive bending stresses for i) Solid rectangular cross section and ii) Hollow circular cross section (14M)

5. a) a) A cantilever beam AB of length 4m carries a point load of 100kN at free end and another point load 100kN at 2m from the free end. If E = 10^5 N/$mm^2$and I=10^8 $mm^4$for the cantilever then determine the slope and deflection at the free end byMoment area method. (7M)
   b) Write in brief about double integration method. (7M)

6. a) Show that in the case of a thin cylindrical shell subjected to an internal fluid pressure, the tendency to burst length wise is twice as great as a transverse section. (7M)
   b) Determine change in dimensions of a thin spherical shell due to an internal pressure. (7M)

7. Derive the expression for the crippling load by Rankine's method. (14M)

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PART –A

1. a) Define the terms: a) Bulk modulus b) Resilience (2M)

b) Derive the relation between the shear force and bending moment in a beam (3M)

c) A beam 4m long, simply supported at its ends, carries a point load W at its center. If the slope at the beam is not to exceed 1^0, find the deflection at the center of the beam. (2M)

d) Define the terms a) neutral axis b) moment of resistance (2M)

e) Differentiate hoop & longitudinal stress. (3M)

f) What are the limitations of Euler's formula. (2M)

PART -B

2. a) A piece of material is subjected to three mutually perpendicular tensile tresses and the strains in the three directions are in the ratio 3:4:5. If the value of Poisson's ratio is0.2857, find the ratio of the stresses and their values when the greatest stress is $90N/mm^2$. (7M)

b) Draw Mohr's circle when the component is subjected to state of pure shear. (7M)

3. a) A beam of 12 m long is supported at 2 m and 10 m from the left end. It carries uniformly distributed loads of 15 kN/m over both overhanging lengths along with a clockwise couple load of 220 kN-m at mid-span. Draw the shear force and bending moment diagrams for the beam. Find the position and magnitudes of maximum bending moment and the position of the point of contra flexure. (7M)

b) Derive the relation between loading, shear force and bending moment. (7M)

4. a) A 3 m long rectangular beam of section 100 mm x 200 mm is loaded with a point load of30000 N distant 1 m from the right-hand support. Find the maximum shear stress in the beam Also find the shearing stress at a layer 20 mm below the top of the beam at a section 1 m to the right of the left-hand support. (7M)

b) Derive the equation M/I = f/y = E/R (7M)

5. a) A cantilever beam AB of length 4m carries a point load of 100kN at free end and another point load 100kN at 2m from the free end. If E = 10^5 $N/mm^2$and I $=10^8$ $mm^4$for the cantilever then determine the slope and deflection at the free end by moment area method (7M)

b) Write in brief about double integration method. (7M)
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6. a) A shell 3.25m long, 1m in diameter is subjected to an internal pressure of $1 N/mm^2$. If thickness of the shell is 10mm, find the circumferential and longitudinal stresses. And also find the maximum shell stress and the changes in the dimensions of the shell. Take $E = 2\times10^5$ N/mm^2, $1/m = 0.3$. (7M)
   b) A riveted boiler 2.25m in diameter has to sustain and internal pressure of 0.56 N/mm^2. The efficiency of the riveted joints is 70% and a safe stress of $60 N/mm^2$ is allowed in a material. Find the thickness of the shell and the necessary pitch of rivets for the longitudinal joints, which is a single riveted butt joint. Take diameter of rivet =6 t and where t is thickness of the plate (7M)

7. a) A solid cylindrical shaft is to transmit 300kW power at 100 r.p.m. If the shear stress is not to exceed $80 N/ mm^2$, find its diameter. (7M)
   b) Derive the expression for the crippling load when both ends of the column are hinged. (7M)

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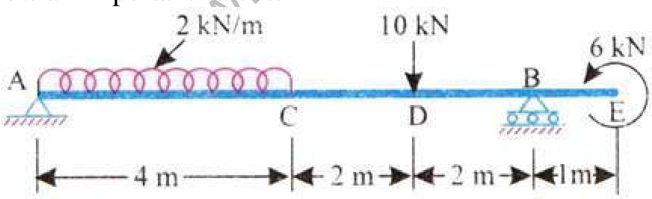
PART –A

1. a) Define the terms: principal planes and principal stresses. (2M)
b) Draw the B.M.D of simply supported beam with uniformly varying load with zero at free ends and w per metre run at the centre. (3M)
c) Write the methods of determining Slope and Deflection at a section in a loaded beam (2M)
d) Write the Assumptions for theory of Simple Bending. (2M)
e) Draw the Shear stress diagram for I- section (3M)
f) What are the limitations of Euler's formula. (2M)

PART -B

2. a) Define the following (7M)
i) Poisson's ratio ii) shear modulus iii) Volumetric strain
b) A steel rod is 2.2 m long and must not stretch more than 1.2 mm when a 8.5kN load is applied to it. Knowing that E = 200GPa, determine (i) the smallest diameter rod that should be used, (ii) the corresponding normal stress caused by the load. (7M)

3. a) Draw shear force and bending moment diagrams for the beam shown in Figure. Show all important values. (14M)



4. a) A rectangular beam 300mm deep is simply supported over a span of 4m. Determine the U.D.L per meter which the beam may carry, if the bending stress should not exceed 120 N/mm^2 Take $I = 8 \times 10^6$mm^4 (7M)
b) An I-section beam 350mm×150mm has a web thickness of 10mm and a flange thickness of20mm. If the shear force acting on the section is 40kN, find the maximum shear stress developed in the section. Sketch the shear stress distribution across the section. Also calculate the total shear force carried by the web. (7M)
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Code No: R1621032 **R16** SET - 3

5. a) Derive the relationship between slope, deflection and radius of Curvature of a simply supported beam. (7M)
   b) A 300 mm long cantilever of rectangular section 48 mm wide and 36 mm deep carries a uniformly distributed load. Calculate the value of load *w* if the maximum deflection in the cantilever is not to exceed 1.5 mm. Take E = $70X10^9 GN/m^2$. (7M)

6. a) A cylindrical vessel whose ends are closed by means of rigid flange plates is made of steel plate 3 mm thick. The internal length and diameter of vessel are 50 cm and 25 cm respectively. Determine the longitudinal and circumferential stresses in the cylindrical shell due to an internal fluid pressure of 3 MN/m^2 Also calculate increase in length, diameter and volume of the vessel. Take: E = 200 GN/m^2, and 1/m = 0.3 (7M)
   b) Derive the expression of hoop stress for thin spherical shell. (7M)

7. a) A solid round bar 6 cm in diameter and 2.5 m long is used as a strut. One end of the strut isfixed while its other end is hinged. Find the safe compressive load for this strut using Euler's formula. Assume E = 200 GPa and factor of safety = 3. (7M)
   b) Derive the equivalent length of column fixed at one end and hinged at other. (7M)

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PART –A

1. a) State the Hooke's law. (2M)
   b) Write about different types of beams and different loadings (3M)
   c) Define Section modulus (2M)
   d) What are statically indeterminate beams. (2M)
   e) Draw the Shear stress diagram for I- section (3M)
   f) Define torsional rigidity & power transmitted by shaft. (2M)

PART -B

2. A compound bar consists of a central steel strip 25 mm wide and 6.4 mm thick placed between two strips of brass each 25 mm wide and x mm thick. The strips are firmly fixed together to form a compound bar of rectangular section 25 mm wide and ($2x$ + 6.4) mm thick. Determine: (14M)
   i) The thickness of the brass strips which will make the apparent modulus of elasticity of compound bar 157 GN/m^2.
   ii) The maximum axial pull the bar can then carry if the stress is not to exceed 157 MN/m2, in either the brass or the steel. Take Es= 207 GN/m2 and Eb= 114 GN/m2.

3. a) Define point of contra flexure. (7M)
   b) Draw the Shear force and bending moment diagram for the loaded beam as shown in Figure 1. (7M)

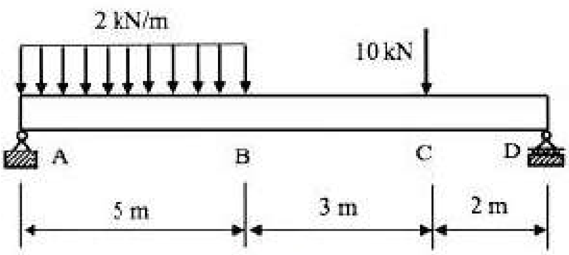

Figure 1
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4. a) A beam of triangular cross-section with a base of 120 mm and 150 mm, the lower surface being horizontal. If the shear force on a section is 30 kN, draw the distribution of shear stress in the beam. (7M)

   b) A beam is of T-section, flanges 135mm x 12mm and web 120mm x 15mm. It is subjected to a sheer force of 29kN. Draw shear stress distribution across thedepth marking values at salient points. What percentage of the shearing force a any section is carried by the web? (7M)

5. a) Define Macaulay's method? And find out Deflection of a simply supported beam with an Eccentric point load (7M)

   b) A horizontal beam AB is simply supported at A and B, 6m apart. The beam is subjected to a clockwise couple of 300kNm at a distance of 4m from the left end. If E=2×10^{5}N/mm^{2}and I=2×10^{8}mm^4. Determine (i) Deflection at the point where couple is acting(ii) the maximum deflection. (7M)

6. a) Derive expression for circumferential strain, volumetric strain for thin spherical shell. (7M)

   b) Determine change in dimensions of a thin spherical shell due to an internal pressure. (7M)

7. a) Two shafts of same material and same lengths are subjected to same torque, if the first shaft is a solid circular section and the second shaft is hallow circular section whose internal diameter is 2/3 of the outside diameter. And the maximum shear stress developed in each shaft is the same, compare the weights of the shafts. (7M)

   b) A simply supported beam of length 4m is subjected to a uniformly distributed load of 30 kN/m over the whole span and deflects 15mm at the center. Determine the Crippling loads when this beam is used as a column with the following conditions. (7M)
      (i) One end fixed and other end hinged (ii) both the ends pin jointed