Name of Examination (Please tick, symbol is given)	:	**MID**		**END**		**SUPPLE**	
Name of the College (Please tick, symbol is given)	:	**COES**		**CMES**		**COLS**	
Program/Course	:	**B. TECH. ASE and B. TECH. ASE + AVIONICS**					
Semester	:	**III**					
Name of the Subject	:	**STRENGTH OF MATERIALS**					
Subject Code	:	**GNEG 217**					
Name of Question Paper Setter	:	**DR. RAJNISH GARG**					
Employee Code	:	**40000547**					
Mobile & Extension	:	**+91 9897370667 / 1345**					

Note: Please mention additional Stationery to be provided, during examination such as Table/Graph Sheet etc. else mention "NOT APPLICABLE":

GRAPH PAPER

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Date of Examination	:	
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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination – December, 2017

Program/course: B. Tech. ASE and ASE + AVIONICS **Semester : III**
Subject: Strength of Materials **Max. Marks : 100**
Code : GNEG 217 **No. of Pages: 05** **Duration : 3 Hrs**

NOTE: This question paper has 3 sections; Section A, section B and Section C. Make use sketches/plots to elaborate your answers. Assume any **MISSING** data appropriately. Brief and to the point answers are expected.

SECTION-A (5X 4 = 20 MARKS)

Attempt all Questions

Q1. A steel bar of 25 mm diameter was tested on a gauge length of 250 mm for tension and for torsion. A tensile load of 50 kN produced an extension of 0.13 mm and a torque of 200 N-m produced 1° of twist in the bar. Determine (i) Modulus of Elasticity (ii) Modulus of Rigidity (iii) Poisson's Ratio (iv) Bulk Modulus.

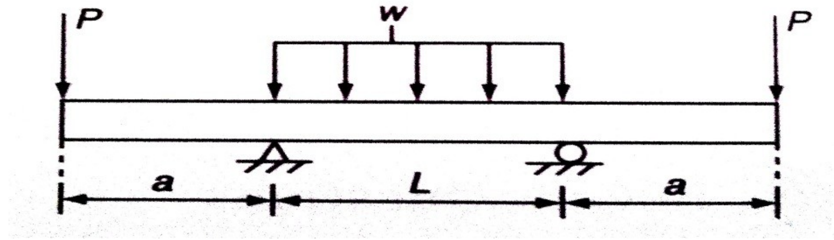
OR

Q1. A vertical rod of length 'L' and diameter 'D' is fixed at its upper end and carries an axial load 'W' at its lower end. The extension of the rod due to axial load is 'δ'. If a torque 'T' is applied in a horizontal plane at the lower end of the rod which produces an angle of twist 'θ' radians, show that the Poisson's ratio is given by $v = -1 + (WD^2\theta) / (16T\delta)$.

Q2. A thin spherical shell has internal diameter of 400 mm and unknown wall thickness. At a point in the material, three mutually perpendicular direct stresses are acting due to an internal pressure of 5 N/mm^2. The material has Poisson's ratio 0.3 and yield strength of 265 MPa. Determine the thickness of shell with a factor of safety 3.0 according to Maximum strain energy per unit volume theory.

Q3. An equal double overhanging uniform beam of length 'L' is simply supported on a span 'l' i.e. L > l. Find the ratio of L / l so that the upward deflection at each end equals the downward deflection at middle point, if a point load acts at the middle point of the beam.

Q4. A simply supported with overhanging ends carries two point loads of magnitude 'P' Newton at each end and UDL of intensity 'W' N/m between the supports. The length of overhung is 'a' on both sides and distance between the supports is 'L' as shown in figure below. If WL = P, what is the ratio of a / L for which the bending moment at the mid-point of the beam will be zero.



Q5. A circular rod is tapered from larger diameter 'D' to smaller diameter 'd' over a length 'L'. The rod is subjected to a torque T. Derive an expression for the strain energy stored in the rod.

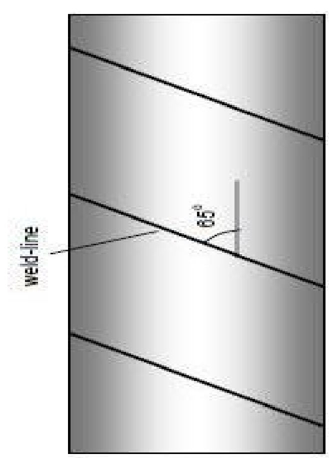
SECTION-B (5 X 8 = 40 MARKS)

Attempt all Questions

Q6. A steel column of 4.0 cm diameter is fixed at both the ends. Initially column is 10.0 m long at room temperature. The modulus of elasticity, crushing strength and coefficient of linear thermal expansion for the material of column are respectively 200 GPa, 330 MPa and 12×10^{-6} / °C. Determine the minimum rise in temperature to just buckle the column. Take Rankine's constant as 1/7500.

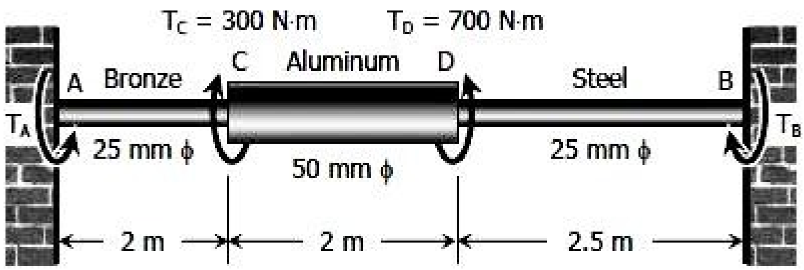
Q7. A cylindrical pressure vessel is fabricated by welding a rolled 10.0 mm thick sheet of mild steel along a spiral which has an angle of 65° to the pipe axis. The inner diameter of the pipe is 280 mm. The vessel is subjected to a torque of 64.0 kN-m. In order for the weld not to fail under an internal pressure of 2.5 MPa, calculate the maximum normal stress and shear stress respectively normal to the weld line and along the weld line. **05M**

Draw the Mohr's stress circle for the plane stress condition for the material and confirm your results. **03M**



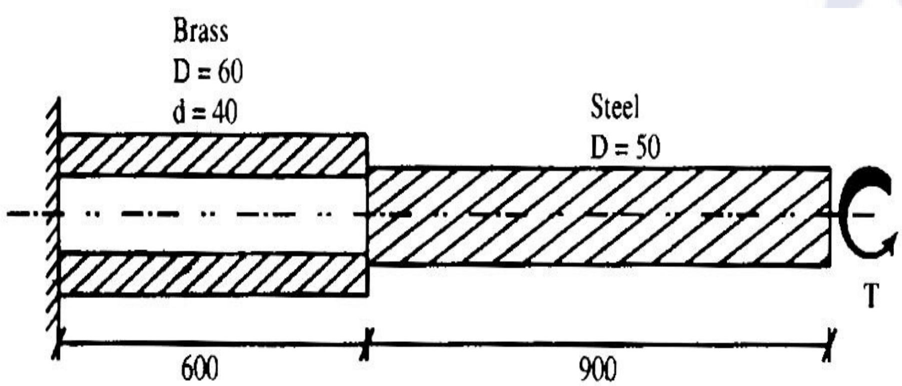
Q8. A solid steel rod of 5 m length and 10 mm diameter is subjected to an axial load of 5 kN. Find the stress induced in the rod if the load is applied (a) gradually, (b) suddenly and (c) impact after falling from a height of 150 mm. Also find the strain energy stored and the instantaneous deformation in the rod under given conditions. Take E= 200 kN/ mm^2.

Q9. A shaft composed of segments AC, CD, and DB is fastened to rigid supports and loaded as shown below. For bronze, G = 35 GPa, for aluminum, G = 28 GPa, and for steel, G = 83 GPa. Determine T_A and T_B and the maximum shearing stress developed in each segment.



OR

Q9. A compound shaft consists of brass and steel components coaxially attached; fixed at one end and subjected to torque T at free end as shown in figure (All Dimesions in mm). Find the safe torque T at free end satisfying the following conditions simultaneously: (i) $\tau_{brass} \leq$ 40 MPa (ii) $\tau_{steel} \leq$ 60 MPa (iii) $\theta \leq$ 2.5°. Assume G_s = 80 GPa and G_b = 35 GPa. Also find actual stresses developed in each part.

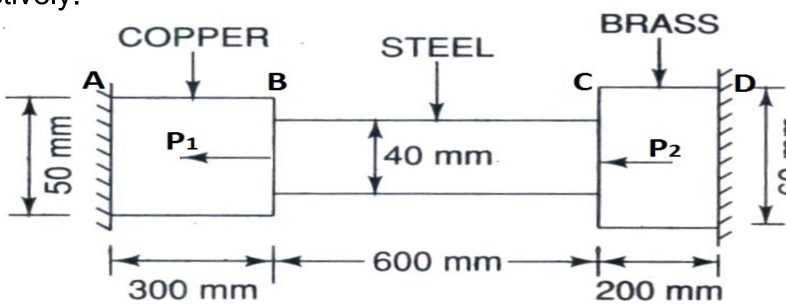


Q10. A simply supported beam of T cross-section of dimensions 100 mm wide and 150 mm deep with web and flange thickness of 20 mm carries a load P at its mid-point of span 2.5 m. The load line is inclined to 30° to the vertical and passes through the centroid of the cross-section. If the maximum compressive and maximum tensile stresses are not to exceed 75 MPa and 35 MPa respectively, calculate the safe load P that beam can carry.

.SECTION-C (2 X 20 = 40 MARKS)

Attempt all Questions

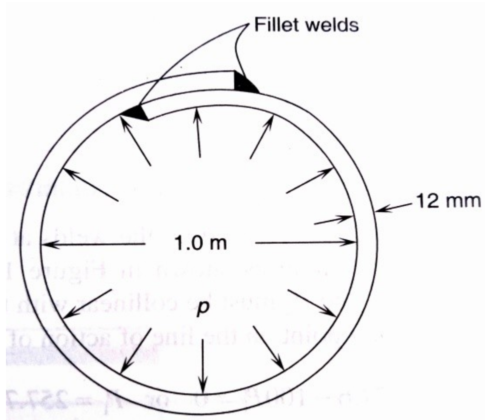
Q11. (a) A composite bar ABCD made up of copper steel and brass is rigidly attached to the end supports and subjected to two forces P1 and P2 at cross-section B and C as shown in figure below. Determine the stresses in three portions of bar when P1 = 150 kN & P2 = 90 kN and the temperature of composite system is raised by 70 °C. Assume the supports are rigid. Take E_c= 100 GPa, E_s= 205 GPa, E_b= 95 GPa and Take α_c= 18x $10^{-6}/^0C$, α_s= 11x $10^{-6}/^0C$, α_b= 19x $10^{-6}/^0C$. Where E and α are modulus of elasticity and linear coefficient of thermal expansion respectively. Subscripts c, b and s denote copper, brass and steel respectively. **10M**



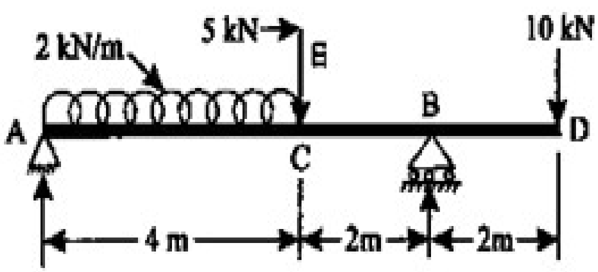
Q11. (b) A cylindrical pressure vessel 5.0 m internal diameter is fabricated of 16.0 mm thick steel plates. The longitudinal joint of the vessel is double riveted lap joint with chain arrangement of rivets. The permissible stresses are 140 MPa in tension, 110 MPa in shear and 240 MPa in bearing. Determine (i) the nominal diameter of the rivets (ii) pitch of the rivets in the joint (iii) efficiency of the joint and (iv) safe pressure in the vessel. **10M**

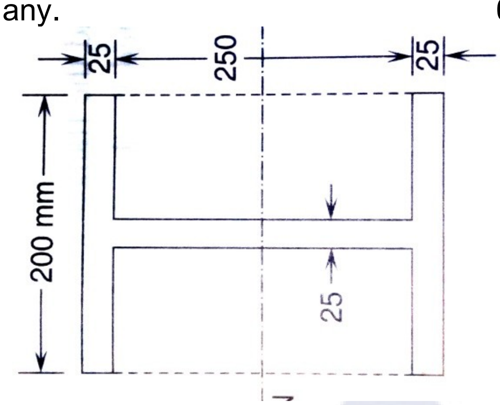
OR

(b) A cylindrical shell of 1.0 m diameter is fabricated from 12 mm thick plate by lapping over and securing it by double transverse fillet welds as shown in figure below. Determine the minimum size of the fillet weld for an internal pressure of 3.0 MPa, if the permissible stress through the throat of the weld is 110 MPa. Also determine the safe pressure for maximum size of the weld and the factor of safety for the shell against this pressure, if the permissible tensile stress in the plate is 160 MPa. **10M**



Q12. Draw the shear force and bending moment diagram of the beam hinged at A and roller supported at B as shown in figure below. Also find the maximum value of the bending moment. Locate the points of contra-flexure if any. **06M**





Beam has H cross-section as shown in adjacent figure where dimensions are in mm. Draw the shear stress distribution diagram for a cross-section located at 3.0 m from the left support. Show minimum four stress values between neutral axis and top or bottom surfaces. **06M**

Also determine the slope and deflection at mid-point C. Take E = 200 GPa. **08M**