Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2018

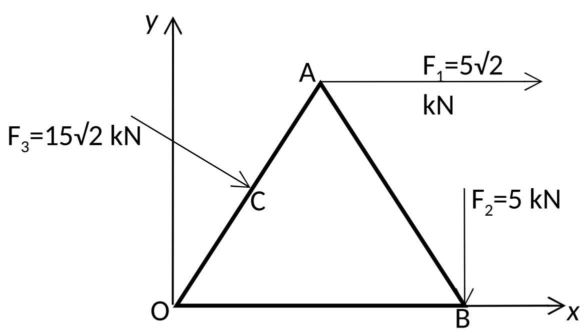
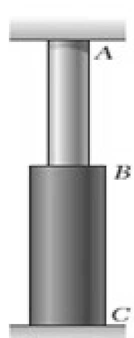
Course: Mechanics and Mechanism **Semester: I**

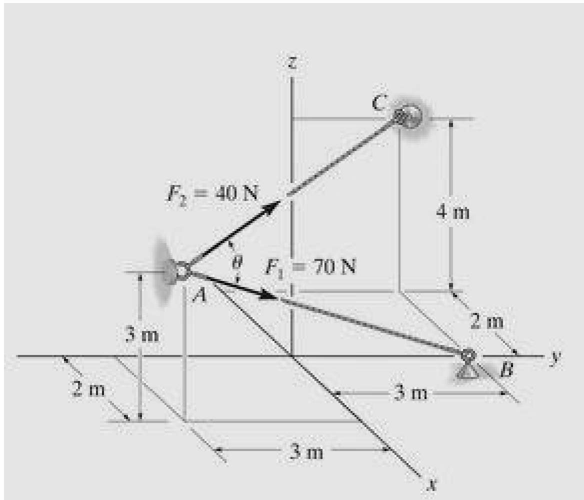
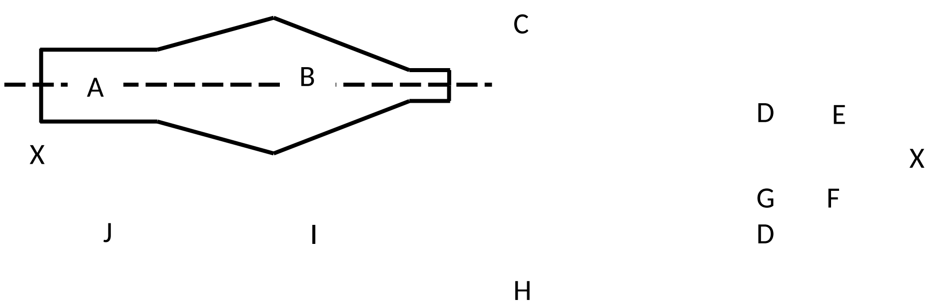
Programme: M. Tech. (A&RE)

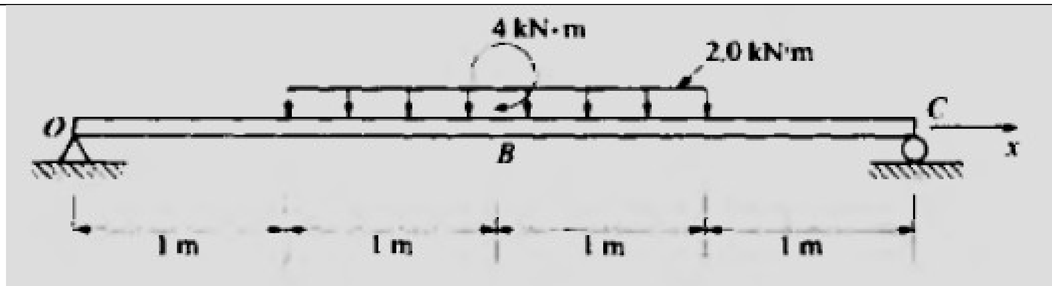
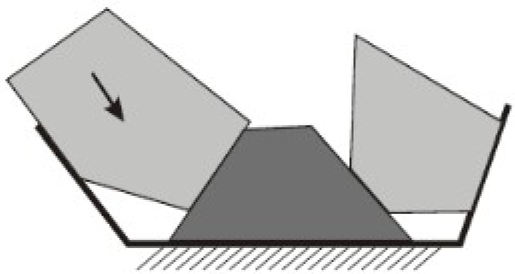
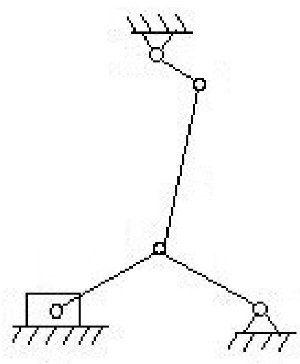
Time: 03 hrs. **Max. Marks: 100**

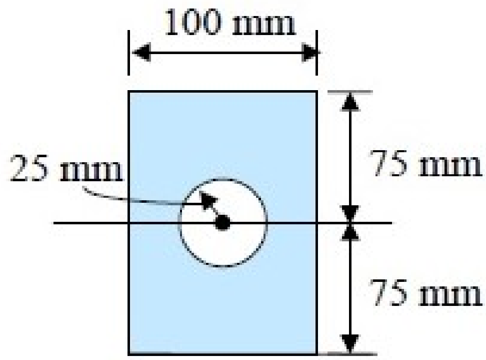
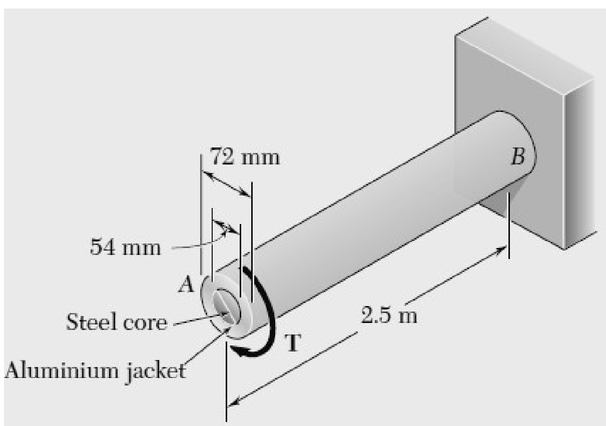
Instructions: *All questions are compulsory.*

SECTION A

S. No.		Marks	CO
Q.1	Three forces F_1, F_2 and F_3 are acting at points A, B and C as shown in figure below. ΔOAB is an equilateral triangle of 1 m side. Point C is the mid-point of OA. Find the simplest resultant of this force system at origin O. Force F_3 is perpendicular to OA. 	**05**	**CO1**
Q.2	Describe various types of joints with appropriate diagrams. Explain degree of freedom.	**05**	**CO5**
Q.3	A compound rod is made up of steel, AB portion, and aluminium, portion BC. Length of AB is1 m and of BC is 1.5 m. Diameters of AB and BC are 7.0 mm and 10.5 mm respectively. Modulus of Elasticity of aluminium and steel are 70 GPa and 210 GPa respectively. Linear thermal expansion coefficients of aluminium and steel are 23.0 µm/m°C and 11.5 µm/m°C respectively. At room temperature there are no forces in the rod. If heated by 50 °C above the room temperature then find the stresses in AB and BC. 	**05**	**CO4**

<table>
<tr><td>Q.4</td><td>For the figure shown below, find the resultant of F1 and F2 at A. Calculate the moment of this resultant force about a line that joins origin of the coordinate system to the point C.

</td><td>05</td><td>CO1</td></tr>
<tr><td colspan="4">SECTION B</td></tr>
<tr><td>Q.5</td><td>Determine the surface area and volume of the container shown in figure below using the theorem of Pappus & Guldinus. Diameters AJ and EF are 1 m and 0.5 m respectively. Lengths of AB, BC, CD and DE are 1.5 m, 2.0 m, 2.5 m and 0.5 m respectively. XX is the axis of rotation.

</td><td>10</td><td>CO2</td></tr>
<tr><td>Q.6</td><td>A 2 m long cantilever beam has cross section of 20X30 mm^2. 20 mm is the vertical side while 30 mm is the horizontal width. When a downward point load is applied at the free end then the deflection of the beam at its mid-point is observed to be 0.4 mm. Determine the magnitude of the downward load applied. Young's Modulus of the material of the beam is 200 GPa.</td><td>10</td><td>CO3</td></tr>
<tr><td>Q.7</td><td>Derive the relationship between Shear Force, Bending Moment and Loading.
OR
Plot SFD and BMD for the simply supported beam shown below.</td><td>10</td><td>CO3</td></tr>
</table>

			
Q.8	Find the degree of freedom for the mechanisms shown below, (A)  (B) 	**10**	**CO5**
SECTION-C			
Q.10	Determine the moments of inertia I_{xx}, I_{yy} and I_{xy} of the beam cross-sectional area shown below. The origin of the xy-coordinate system is at the center of the circular hole. If the axes are rotated by an angle of 30° then also determine these quantities. Also determine the principal plane.	**20**	**CO2**

			
Q.11	If state of stress at a point is given by $\sigma_x = 84\ MPa, \sigma_y = -30\ MPa, \tau_{xy} = -32\ MPa$. Determine principal stresses, principal plane and maximum shear stress. *OR* A 4 kNm torque T is applied at end *A* of the composite shaft shown. Knowing that the modulus of rigidity is 77 GPa for the steel and 27 GPa for the aluminum, determine (a) the maximum shearing stress in the steel core, (b) the maximum shearing stress in the aluminum jacket, (c) the angle of twist at *A*. 	**20**	**CO4**