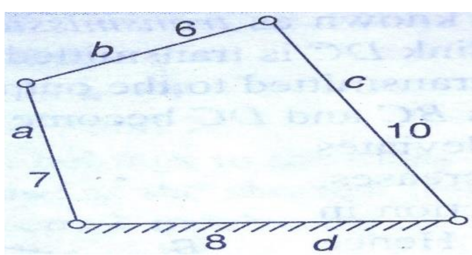
Name: Enrolment No:	

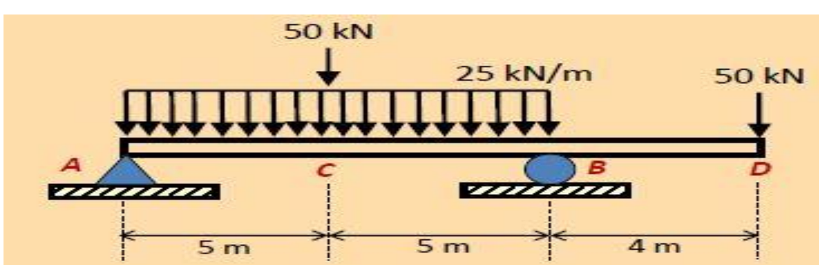
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, January 2021

Course: Mechanics and Mechanism (MECH 7002) **Semester: I**
Program: M. Tech. Robotics and Automation Engineering
Time: 3 Hours **Max. Marks: 100**

SECTION A

S. No.		**Marks**	**CO**
Q-1	Two forces P of same nature act at a point at an angle α. If the square of their resultant is three times of their product, then what will be value of α? Write only the final answer.	**5**	**CO1**
Q-2	Write the two important applications of dot product or scalar product of two vectors in mechanics. Give brief answer.	**5**	**CO1**
Q-3	A force **F** = 2**i** – 3**j** + 6**k** acts at point A having coordinates as (3, - 4, 2). Determine the moment of same force **F** about axis BC, if the coordinates of points B and C are (0, 2, 0) and (1, 4, 2) respectively. Write only the final answer.	**5**	**CO1**
Q-4	What is a kinematic chain? How can you decide whether given kinematic chain is either structure or mechanism? Give brief answer.	**5**	**CO5**
Q-5	Write the application of parallel axis theorem. What will be the moment of inertia of a rectangle of base b and height h about an axis parallel to base and passing at a height of h/3 from its base? Write only the answer in terms of b and h.	**5**	**CO2**
Q-6	Define transmission angle of a mechanism. Determine the minimum transmission angle for the mechanism having dimensions as shown in figure below. Write only the final answer. 	**5**	**CO5**

SECTION B

Q-7	Draw the shear force and bending moment diagrams for the loaded beam shown in the figure below. Determine maximum bending moment and location of point of contra-flexure, if any. 	**10**	**CO3**

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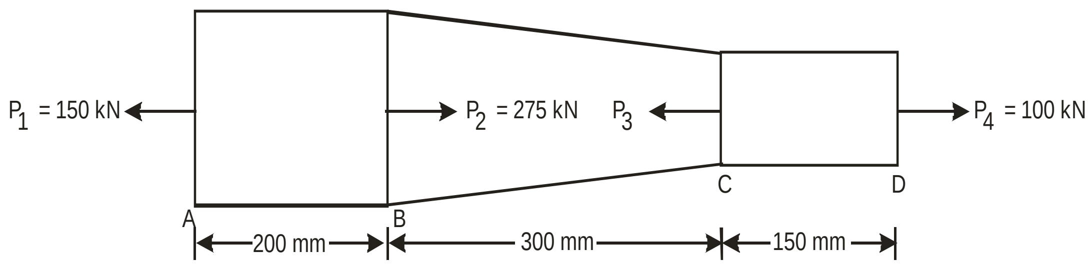
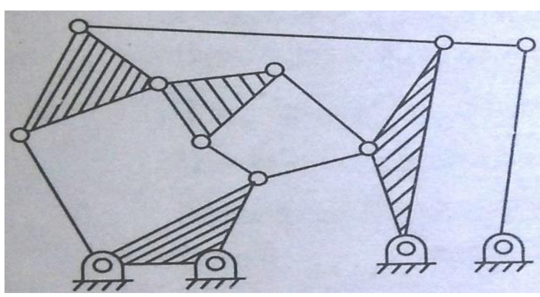
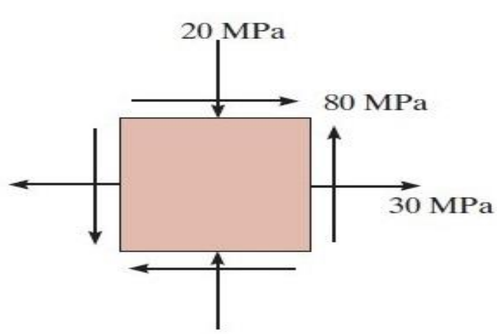
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Q-8</td><td>Two bars one of steel and other of copper, are having same lengths and same cross sectional area. These bars are rigidly joined at both the ends by keeping one over the other (parallel combination) to form a compound bar at 15 ^{o}C. When the temperature is raised to 315^{o}C, the length of compound bar increases by 0.15 cm. Determine the original length of the bars and stresses in the bars. Take E_s= 210 GPa, E_c= 100 GPa, α_s= 12 x 10^{-6} /^{o}C and α_c= 17.2 x 10^{-6} /^{o}C. Subscripts s and c in symbols stand for steel and copper respectively.

OR

A machine component is subjected to point loads as shown in the figure below. The segments AB and CD have a uniform diameter of 60 mm and 30 mm respectively. Determine load P_3 for equilibrium and net change in the length of the component. Take modulus of elasticity of the material as E = 200 GPa.


</td><td>10</td><td>CO4</td></tr>
<tr><td>Q-9</td><td>Differentiate between mechanism and machine. What do you mean by inversion? What are different inversions of Four Bar Chain? Determine the degree of freedom for following mechanism.

</td><td>10</td><td>CO5</td></tr>
<tr><td>Q-10</td><td>The state of stress for a steel component is shown in figure below. Determine the magnitudes of principal stresses, maximum shear stress and position of principal planes.



If the yield strength of the material is found to be 350 MPa, determine the factor of safety with respect to yielding according to maximum distortion energy criterion.</td><td>10</td><td>CO4</td></tr>
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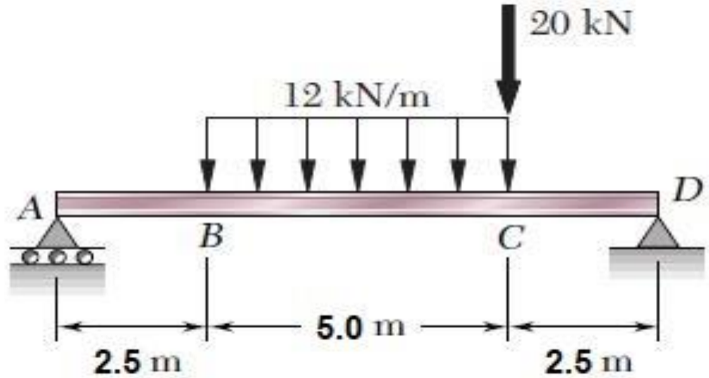
<td>Q-11</td>
<td>For the beam and loading shown in figure below, determine the deflection of the mid-point of the loaded beam. Take EI = 5.3×10^5 Nm^2.

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<td>10</td>
<td>CO3</td>
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<tr>
<td colspan="4">SECTION C</td>
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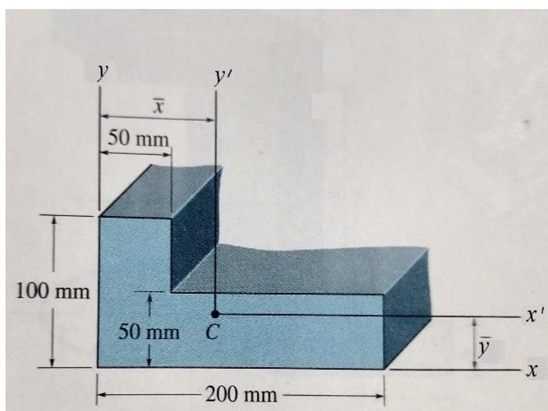
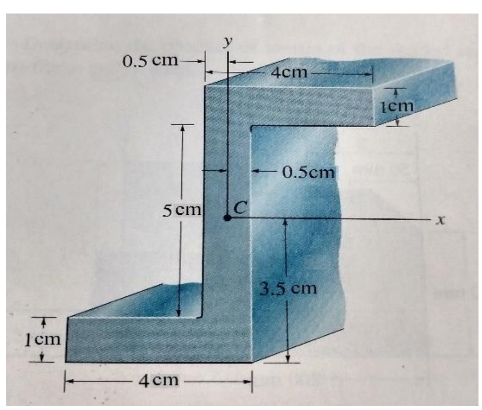
<td>Q 12</td>
<td>Determine moment of inertia about centroidal x' and y ' axes, product of inertia about centroid C, and principal moments of inertia for the section shown in the figure below.


OR
Determine moment of inertia about centroidal x and y axes, product of inertia about centroid C, and principal moments of inertia or the section shown in the figure below.

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<td>20</td>
<td>CO2</td>
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