Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2020

Course: Engineering Mechanics (MECH 2019) **Semester: III**

Program: B. Tech APE gas, CERP, Mechanical, Mechatronics, Electrical, Civil

Time: 3 Hours **Max. Marks: 100**

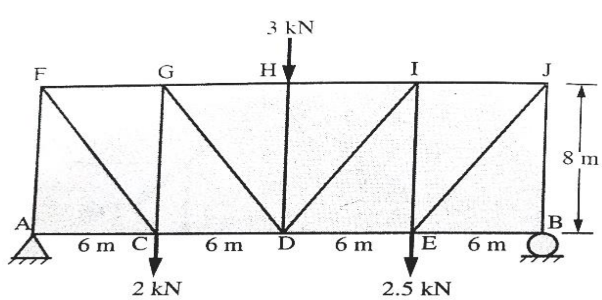
SECTION A

Note: For Q-1 to Q-4, Type the final answer only.

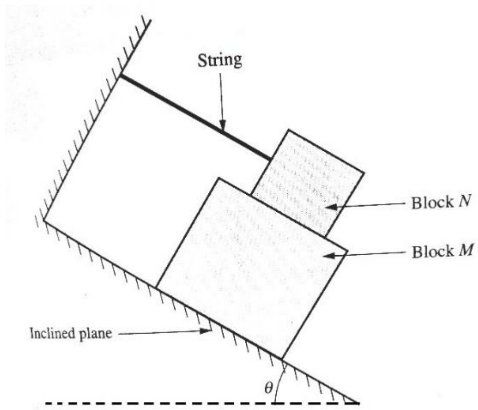
S. No.		**Marks**	**CO**
Q-1	Two forces P of same nature act at a point at angle α. If the square of their resultant is three times of their product, then what will be value of α?	**5**	**CO1**
Q-2	The force required to move a body up an inclined plane is 3 times the force required to lower it on the same inclined plane. If the coefficient of friction between body and inclined plane is 0.5, what will be the angle of inclination of inclined plane?	**5**	**CO1**
Q-3	Two balls thrown with identical velocities from same point at 60^0 and 30^0 respectively. What will be the relation between the attainments of height of both balls?	**5**	**CO1**
Q-4	To slide a heavy block over a rough floor by a rope with minimum force by a man, at what angle the rope should be inclined with the level of floor.	**5**	**CO1**
Q-5	Write the application of parallel axis theorem.	**5**	**CO1**
Q-6	Between method of joints and method of sections, which one is practically suitable and why?	**5**	**CO1**

SECTION B

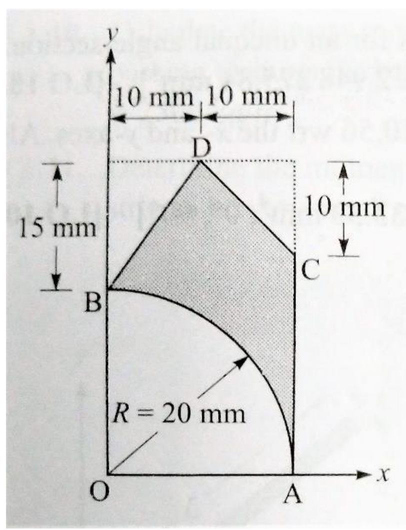
Q-7	Find the magnitude and nature of forces in the members CD, DG and GH of the truss shown in the figure below.	**10**	**CO2**



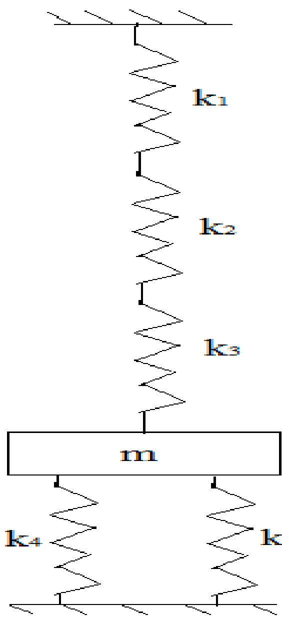
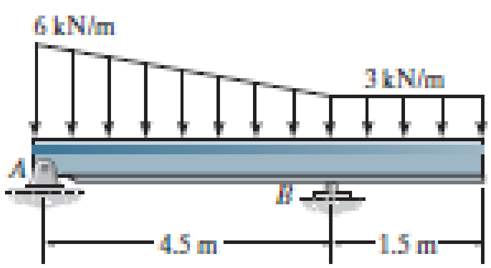
<table>
<tr>
<td>Q-8</td>
<td>Find the value of θ, if the block M is about to slide. The weight of the block N is 10 kN and that of the M is 30 kN, and the coefficient of friction for all surfaces of contact is 0.25.

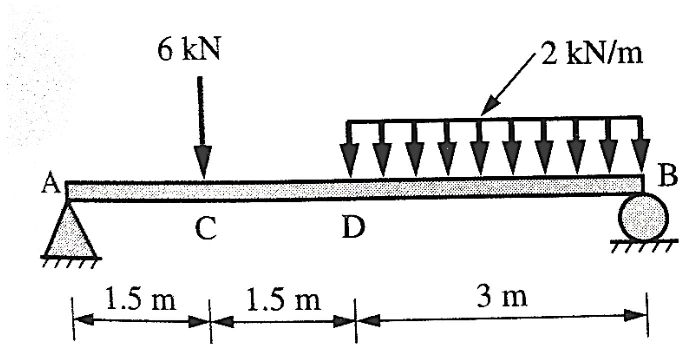
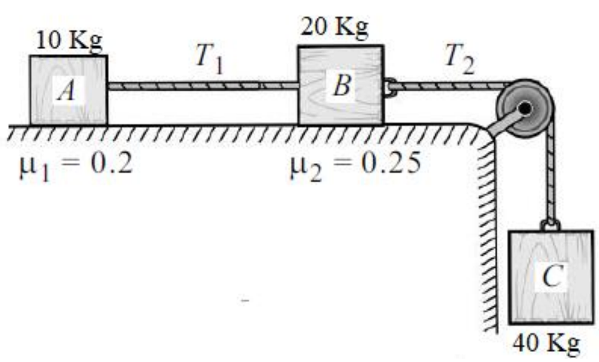


</td>
<td>10</td>
<td>CO2</td>
</tr>
<tr>
<td>Q-9</td>
<td>Locate the coordinates of the centroid of the plane area shown in the figure below with respect to origin O. Also, determine the moment of inertia of the plane area about its centroidal axis parallel to x-axis.



</td>
<td>10</td>
<td>CO2</td>
</tr>
<tr>
<td>Q-10</td>
<td>A body moves along a straight line, its acceleration a, which varies with time t is given by a = 2 – 3t. After 5 seconds, from start of observations, its velocity is observed to be 20 m/s. After 10 seconds, from start of observation, the body was at 85 metres away from the origin.
Determine
(a) Its acceleration and velocity at the time of start.
(b) Distance from the origin at the start of observations.
OR</td>
<td>10</td>
<td>CO3</td>
</tr>
</table>

	(a) A body is subjected to two harmonic motions as given below: $$x_1 = 15sin\left(\omega t + \frac{\pi}{6}\right)$$ $$x_2 = 8cos\left(\omega t + \frac{\pi}{3}\right)$$ Find the extra harmonic motion, which should be given to the body to bring it to static equilibrium. (b) For the system shown in Figure below, k_1 = 3000 N/m, k_2 = 1500 N/m, k_3 = 4000 N/m and k_4 = k_5 = 100 N/m. Find 'm' such that the system has a natural frequency of 25 Hz.  		
Q-11	For the single over hanging beam shown in figure, find the reactions at the supports A and B.  **OR**	**10**	**CO2**

<table>
<tr><td></td><td>A simply supported beam AB of span 6 m is loaded as shown in figure below. Determine the manitude of reactions using Virtual Work.

</td><td></td><td></td></tr>
<tr><td colspan="4">SECTION C</td></tr>
<tr><td>Q 12</td><td>Three blocks A, B and C are connected to each other as shown in the figure below. Find the acceleration of masses and tensions in the string AB and BC. What will be the values of accelerations and tensions if the position of A and B exchanged with each other?


OR
A) A box released from a helicopter moving horizontally with constant velocity 'u' from a certain height 'h' from the ground takes 5 seconds to reach the ground hitting it at an angle of 75º, as shown in the figure below. Determine (i) the horizontal distance 'x', (ii) the height 'h' and (iii) the velocity 'u' and v.</td><td>20</td><td>CO3</td></tr>
</table>

	B) If the helicopter will fly in the horizontal direction at the half of the previous height and the box will hit at the same point then determine (i) time required to hit the ground (ii) angle with which it will hit the ground (iii) velocities u and v