Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous College Affiliated to University of Mumbai)

End Semester Examination

August 2021

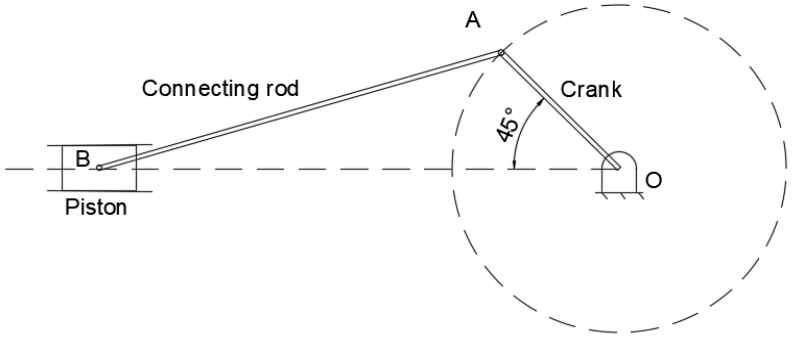
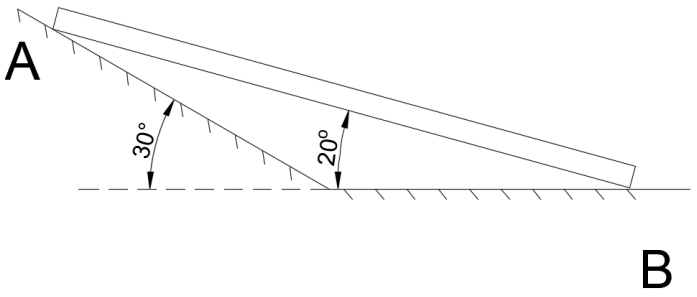
Max. Marks: 60 **Duration: 120 Minutes**
Class: F.E. **Semester: I/II**
Course Code: AS105 **Branch: All**
Name of the Course: Engineering Mechanics

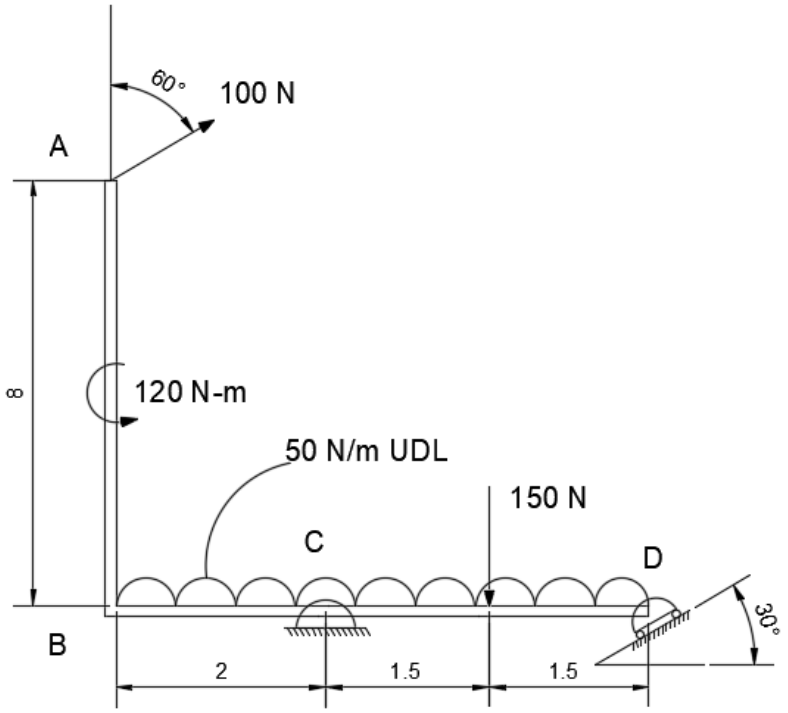
Instrucions:

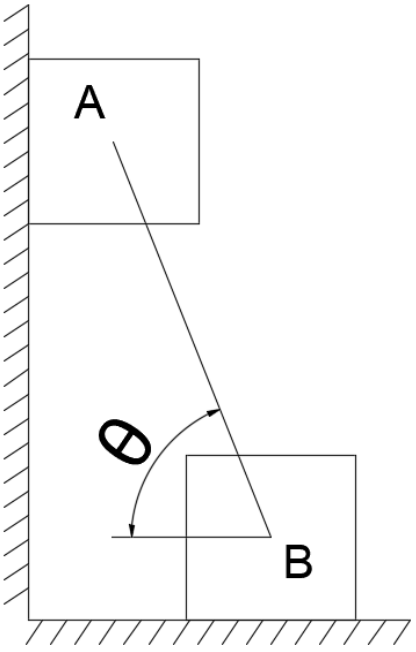
(1) All questions are compulsory.
(2) Draw neat diagrams.
(3) Assume suitable data if necessary.
(4) Solutions without a question number will not be evaluated.
(5) For Q1(a) to Q1(j), write down the correct option number in your answer sheet along with the statement for that option. Repeating the question statement is not required. You may provide additional details if required. Answers without the question number, the option number, and the statement of that option will not be evaluated.

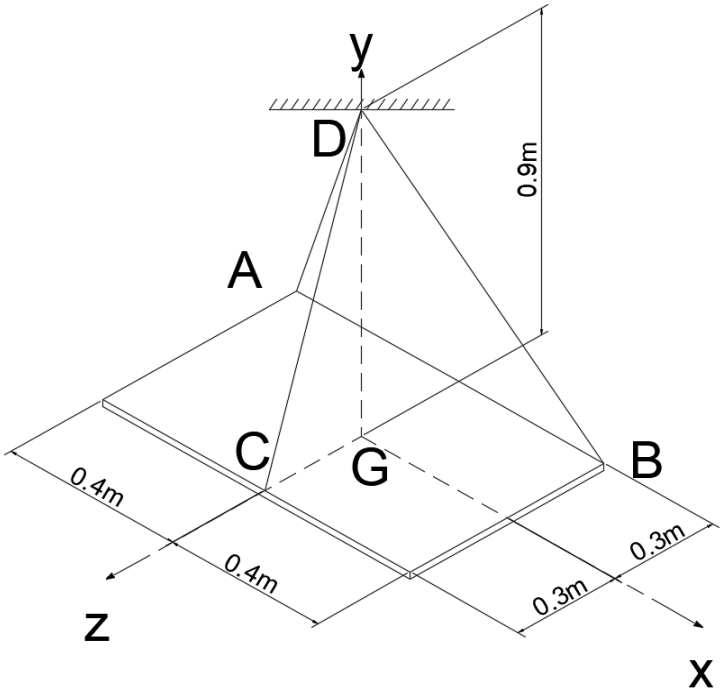
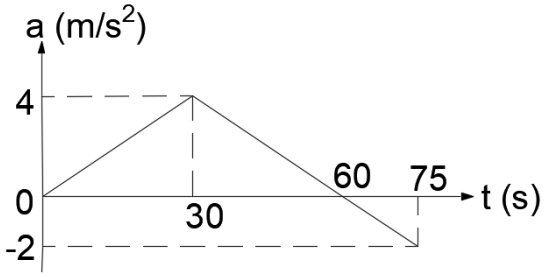
Question No.		Max. Marks	CO	BL
Q1 (a)	Two parallel forces can only be in equilibrium if: i. They are simply equal in magnitude. ii. They are non-coplanar. iii. They satisfy one condition, which is _____ iv. They satisfy multiple conditions, which are _____ _____	1	1	3
Q1 (b)	If Lami's theorem is applicable to a system, the system must be: i. A parallel force system in equilibrium. ii. A three force system in equilibrium. iii. A concurrent force system in equilibrium. iv. None of the above.	1	1	3
Q1 (c)	A body in impending motion will become static again if the external load producing impending motion is removed. i. The above statement is completely true. ii. The above statement is completely false. iii. The above statement is dependant on various system parameters, such as _____ iv. The above statement is only true for wedges.	1	2	3
Q1 (d)	For a parallel, non-coplanar force system, Varignon's theorem is not applicable. i. The above statement is true. ii. The above statement is false. iii. Varignon's theorem cannot be used for non-coplanar force systems.	1	3	3

	iv. Varignon's theorem is not legitimate.			
Q1 (e)	If a block placed on an inclined surface is under impending sliding motion, the surface's inclination with the horizontal is called the angle of repose. i. The above statement is completely true. ii. The above statement is completely false. iii. Exactly one other condition must be satisfied for the angle to be called angle of repose. The condition is: _____ iv. More than one other conditions must be satisfied for the angle to be called angle of repose. The conditions are: _____ _____	1	2	3
Q1 (f)	The area under an a-t diagram for rectilinear motion gives the: i. Acceleration of the particle. ii. Change in velocity of the particle. iii. Jerk. iv. Potential energy of the particle.	1	4	3
Q1 (g)	For kinematic analysis of projectile motion on the surface of a planet, we assume that motion in the horizontal direction has uniform velocity, because: i. Gravity is assumed to act uniformly and vertically downwards. ii. Air resistance is neglected. iii. Either i or ii, but not both at the same time. iv. Both i and ii.	1	4	3
Q1 (h)	The ICR of a rigid body system is: i. Not fixed with respect to time. ii. Independent of the arrangement of the members of the system in space. iii. A zero velocity point. iv. An imaginary point. Which of the above choices is incorrect? (If multiple, state them all.)	1	5	3
Q1 (i)	Under what conditions would you prefer using a ball-and-socket type support for a non-coplanar system instead of a fixed support? i. When we need to constrain translation. ii. When we need to constrain translation and rotation. iii. When the body must be freely suspended. iv. For total static equilibrium.	1	3	3
Q1 (j)	All motion can be considered to be pure rotation: i. If analysis is done instantaneously. ii. Only if studied at the microscopic level.	1	5	3

	iii. Only if studied at the macroscopic level. iv. If analysis is done on an infinite time scale.			
Q1 (k)	In the mechanism shown, find the velocity of the piston when the crank is at an angle of 45 degrees with the horizontal. The crank is rotating at 360rpm anticlockwise. The length of the crank is 400mm. The connecting rod's length is 1400mm. 	5	5	3
	OR			
Q1 (k)	A 4m long rod is kept on smooth planes as shown below. Locate the ICR and find the velocity of end B if the velocity of end A is 10m/s downwards along the inclined plane. 	5	5	3
Q2 (a)	Find the support reactions for the L shaped beam shown below. Assume the beam's self weight to be negligible, C to be a hinge support and D a roller support. All lengths are in meters.	9	1	3

				
Q2 (b)	For the beam system given in Q2 (a): Keep the same external load system, the same dimensions of the beam and use the value of Rd (net reaction at D) that you computed from the previous solution. How will the support reactions at C change if you change the inclination of Rd with the horizontal? Choose any single value of inclination (Θ) with the horizontal between 20-40 degrees (excluding the original value of 30 degrees) for the plane on which support D rests and show whether support C's components increase or decrease with an increase or decrease in that inclination compared to the original inclination of 30 degrees. Comment on the observed behavior. (Hint: since the external load system does not change, the equations formed in the previous solution for translatory equilibrium, ΣFx and ΣFy, will not change in terms of the net external loads represented in them.) OR If the UDL is replaced with a UVL increasing over the same span length of the beam from 0 N/m at B to a maximum value at D, with the same net magnitude as the net magnitude of the UDL, will the system change in any way? Qualify your statement by removing all other loads acting on the beam except the UDL and computing its net effect on the beam versus a linearly increasing load's (0N/m at B and maximum at D) net	3	1	3

	effect in terms of equilibrium equations. (You need not compute support reactions for this comparison. Only compare the effect of the two arrangements of UDL versus linearly increasing loading in the absence of all other loads and state whether there is an increase, decrease or no change to the system's load structure.)			
Q2(c)	Briefly state (any two): i. The Principle of Transmissibility of a force. ii. Lami's Theorem. iii. The concept of a Couple. iv. The method for transferring a force to another point on a body using force-couple approach.	3	1	3
Q3 (a)	A link connects two blocks (each having weight 40kN). Take μ at all contact surfaces as 0.5, neglect the weight of the link, and find the value of angle **Θ** for impending motion of the system. Additionally, if the weight of the link is considered to be a non-zero value, how will it affect **Θ**? 	8	2	3
Q3 (b)	Three cables joined at D keep a 0.6mx0.8m plate weighing 240N suspended as shown. If point D is directly above the center of the plate, determine the tension in each cable.	7	3	3

				
Q4 (a)	The a-t diagram for a particle's rectilinear motion is shown below. Plot v-t and x-t diagrams and find the maximum speed from the diagrams obtained. Assume initial displacement x0 = 20m. 	8	4	3
Q4 (b)	A cricket ball hit from point A (with a velocity vo) just crosses a high wall at the top of its trajectory at B and lands into the clearing on the other side of the wall at C. Find initial velocity vo, height h of the wall, and total range of the projectile.	7	4	3

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