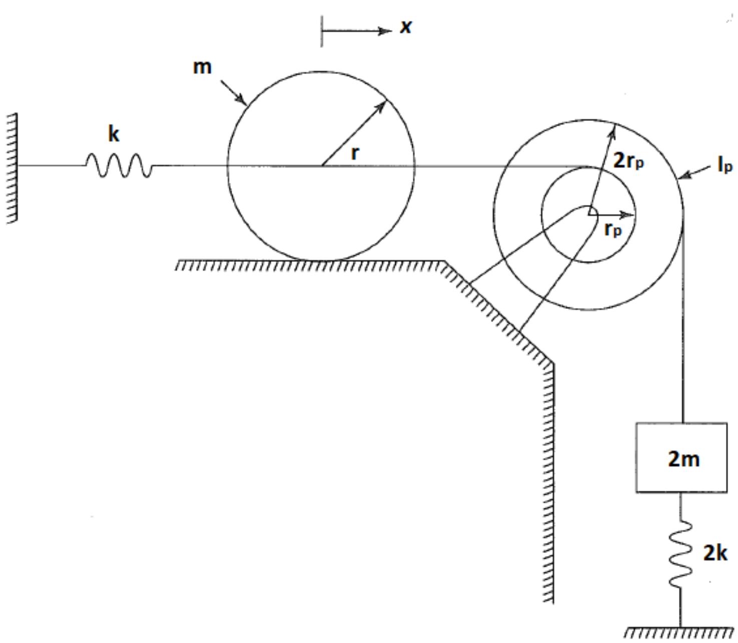
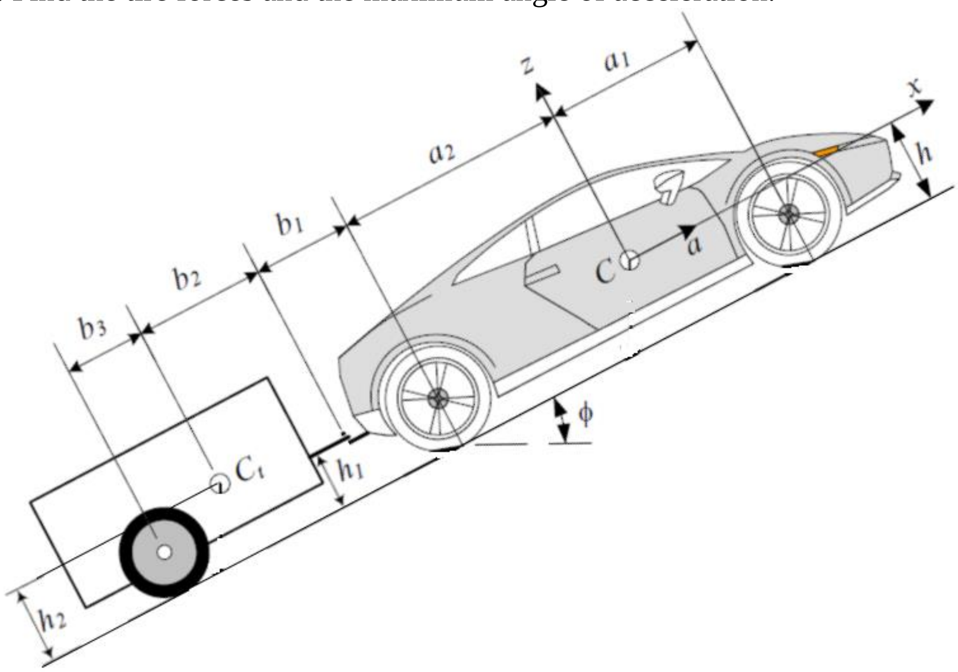
Name: Enrolment No:	UPES

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

Course: Vehicle Dynamics — **Semester: V**
Course Code: MEAD3001 — **Time: 03 hrs.**
Program: B.Tech-ADE — **Max. Marks: 100**

	SECTION A		
S. No.	**Question Statement**	**Marks**	**CO**
Q 1	Explain critical damping and give some examples where it is used.	**4**	**CO1**
Q 2	Differentiate between solid axle and independent suspension.	**4**	**CO2**
Q 3	Differentiate between radial-ply tires and bias-ply tires.	**4**	**CO3**
Q 4	Describe anti-lock braking system (ABS).	**4**	**CO2**
Q 5	Explain the Ackerman condition for low speed turning.	**4**	**CO4**
	SECTION B		
Q 6	Determine the equivalent stiffness and mass matrix of the system shown in Figure when *x*, the displacement of disc measured from equilibrium is used as generalized coordinates. Assume the disk is thin and rolls without slip.  	**10**	**CO1**
Q 7	Explain Anti-Dip and Anti-Squat suspension geometry.	**10**	**CO2**
	OR		

<table>
<tr><td></td><td>Explain Anti-Roll suspension geometry.</td><td></td><td></td></tr>
<tr><td>Q 8</td><td>Use the tire brush model to prove that for pure lateral slip, $= 1 - \theta_y \tan\alpha$.</td><td>10</td><td>CO3</td></tr>
<tr><td>Q 9</td><td>Determine the pitch and bounce frequencies of an automobile with the following data,
Mass (m) = 1000 kg
Radius of gyration (r) = 0.9 m
Distance between front axle and C.G. = 1.0 m
Distance between rear axle and C.G. = 1.5 m
Front spring stiffness (k_f) = 18 kN/m
Rear spring stiffness (k_r) = 22 kN/m</td><td>10</td><td>CO5</td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 10</td><td>For a rear-wheel-drive car pulling a trailer with the following characteristics:
l = 2272mm, w = 1457mm, h = 230mm, $a_1 = a_2$, h_1 = 310mm, b_1 = 680mm, b_2 = 610mm, b_3 = 120mm, h_2 = 560mm, m = 1500 kg, m_t = 150 kg, $\mu = 1$, φ = 10deg, a = 1m/s^2. Find the tire forces and the maximum angle of acceleration.

</td><td>20</td><td>CO6</td></tr>
<tr><td>Q 11</td><td>Derive the equations of motion of a car taking a corner using bicycle model. Also, discuss the stability of the car with following specifications taking a corner at 10 m/s,
Cornering stiffness of front tires = 500 N/deg
Cornering stiffness of rear tires = 400 N/deg
Mass of the car = 900 kg
Mass moment of inertia of yaw = 1128 kgm^2
Distance of CG from front wheel = 91 cm
Distance of CG from rear wheel = 164 cm
State whether the car is in understeer or oversteer condition.</td><td>20</td><td>CO4</td></tr>
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