Name: **Enrolment No:**	

UPES

End Semester Examination, December 2024

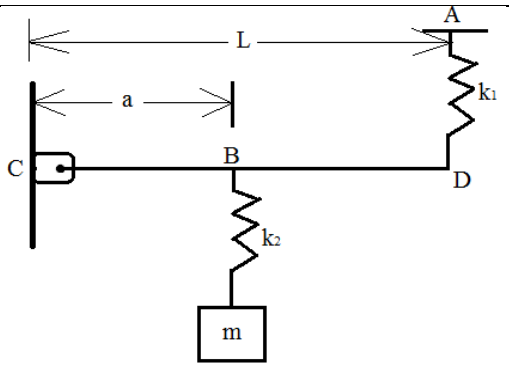
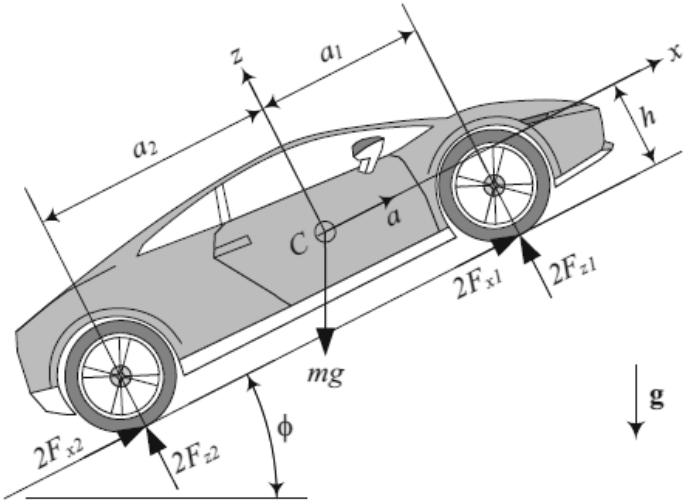
Program Name: B. Tech ADE **Semester : V**
Course Name: Vehicle dynamics **Time : 3 hrs**
Course Code: MEAD 3021 **Max. Marks : 100**
Nos. of page(s): 3
Instructions: Attempt all the questions. Assume any missing data if required.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Justify the statement, "Though not many systems belong to single degree of freedom system, the analysis of 1 DOF system helps us in understanding quite a few facets of the vibratory motion".	**4**	**CO1**
Q 2	Discuss the source of vibration in Automobiles.	**4**	**CO1**
Q 3	Enlist the various information printed on the side wall of a tire.	**4**	**CO1**
Q 4	Discuss the significance of various forces and moments acts on an automobile.	**4**	**CO1**
Q 5	Discuss the composition of tire material.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Discuss the dynamics of steering for low speed and high-speed cornering.	**10**	**CO2**
Q 7	A car with mass = 2000 kg, wheelbase = 2.8 m has 55% of weight distribution on front tires. Lateral stiffness of front and rear tires is $C_f = 40\ kN/rad$ and $C_r = 35\ kN/rad$. Calculate the understeer coefficient and critical speed or characteristic speed as applicable.	**10**	**CO2**
Q 8	Derive the expression of natural frequency for the system shown in. Assume the bar CD to be weightless and rigid.	**10**	**CO2**

			
Q 9	Illustrate the tire coordinate frame and tire force system with a clear and precise diagram. Additionally, explain how camber angle and slip angle impact tire performance. OR Discuss the factors that contribute to rolling resistance in tires and explain the mechanism by which rolling resistance affects tire dynamics. Additionally, describe different types of rolling resistance and suggest methods to reduce it.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	Derive an expression for the normal force under each of the front and rear wheels, Fz1 & Fz2, when a car is accelerating on an inclined pavement with angle ϕ as shown in figure below. Also explain the change in dynamics when Front-wheel-drive car, accelerating on inclined road and Rear-wheel-drive car, accelerating on inclined road. Also discuss the maximum acceleration on inclined road. 	**20**	**CO4**
Q 11	The springs of an automobile trailer are compressed 0.15 m under its own weight. Find the critical speed when the trailer is travelling over the road with a	**20**	**CO4**

	profile approximated by a sine wave of amplitude 0.1 m and length 16 meters. Also, find the amplitude of vibration at 60 km/hr. OR Write down the equation of motion for the 2 DOF system. Also, find the two natural frequencies of vibration and establish the principal modes and mode shape.