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**

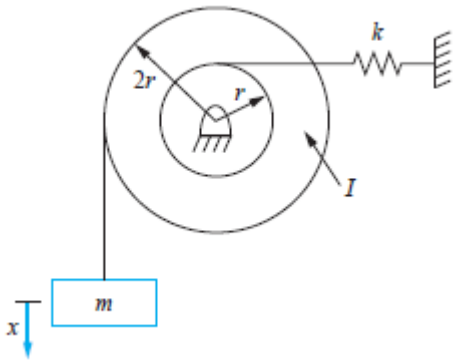
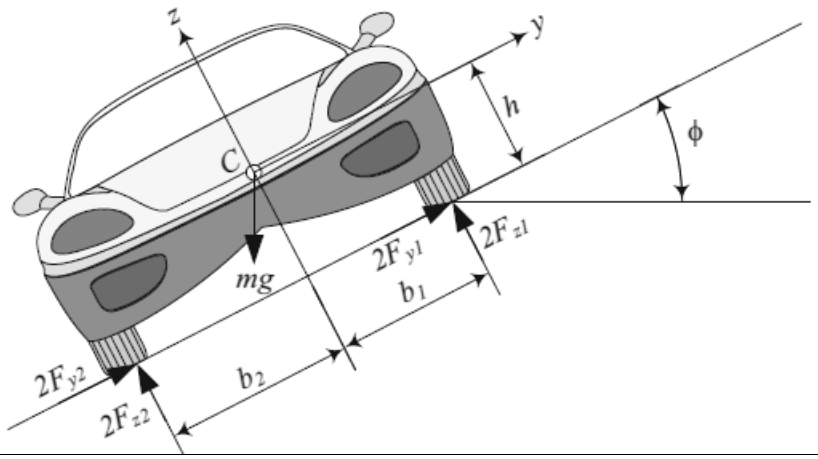
Instructions: Attempt all the questions. Assume any missing data if required.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	For a two degree of freedom, discuss principal mode of vibration and mode shape.	**4**	**CO1**
Q 2	Discuss the source of noise in Automobiles.	**4**	**CO1**
Q 3	Decode P 215\60 R 15 96 H which is printed on a side wall of a tire.	**4**	**CO1**
Q 4	Discuss the method to find the location of CG in a longitudinal direction.	**4**	**CO1**
Q 5	Discuss the effect of aspect ratio on the performance of a tire.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Analyze the behavior of an oversteer and understeer vehicle by plotting ‘steer angle vs speed’ curve for both. Analyze how the steer angle should be changed for each while negotiating a constant radius curve if the driver also accelerates during the turn.	**10**	**CO2**
Q 7	Discuss the kinematic condition for steering and prove that to have all wheels turning freely on a curved road, all the tire axes must intersect at a common point.	**10**	**CO2**
Q 8	Find the natural frequency of the system showm in figure.Consider the system as one DOF system.	**10**	**CO2**

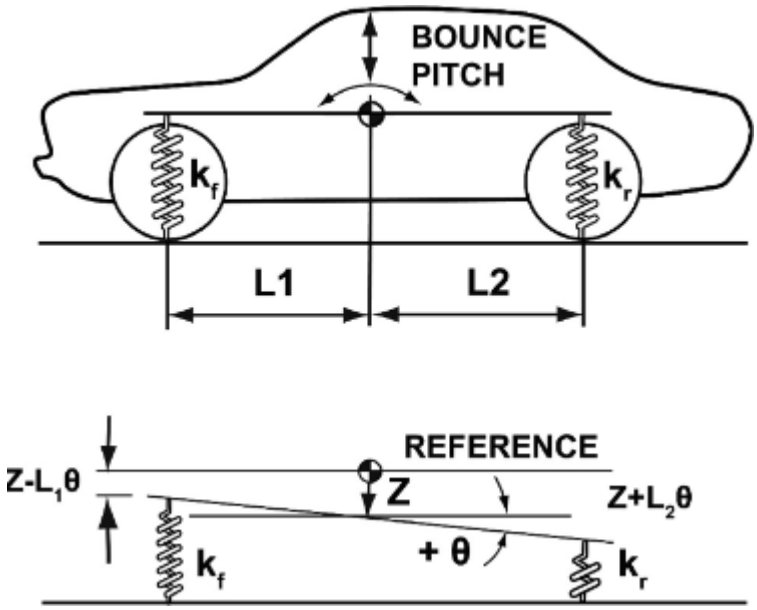
			
Q 9	Enumerate the main differences in performance, durability, and efficiency between radial and non-radial tires, and explain how these differences should influence a buyer's choice depending on vehicle type and usage. OR Analyze the relationship between contact patch dynamics and tire wear and discuss how factors like camber angle and side slip affect this relationship.	**10**	**CO2**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	Derive an expression for the normal force under each of the front and rear wheels, F_{z1} & F_{z2}, when a car is parked on banked road. Also, illustrate of the force ratio F_{z1}/F_{z2} as a function of road bank angle φ by a neat & clean diagram. 	**20**	**CO4**
Q 11	An engine of an automobile weighing 200 kg is mounted on spring having stiffness k=10790 N/cm. A piston within the engine weighing 2.2 Kg has a reciprocating motion with a stroke of 7.5 cm and a speed of 6000 rpm. Assuming the motion to be simple harmonic, determine; (a) The amplitude of vibration of the machine and	**20**	**CO4**

(b) The transmissibility and force transmitted to the ground.

Take the damping ratio as 0.2.

OR

A vehicle is modeled using the pitch & bounce model as shown in figure below.



The relevant data is the following –
Sprung mass, $m_s = 1900\ kg$
Radius of gyration, $r_y = 1.2\ m$
Distance from front axle to CG l_1 = 1.3 m
Distance from rear axle to CG l_2 = 1.45 m
Front spring stiffness, $k_f = 37\ kN/m$
Rear spring stiffness, $k_r = 42\ kN/m$

Determine/Do
(a) Derive the equations of motion for the 2 DOF system
(b) Determine the natural frequencies and mode shapes