Name: **Enrolment No:**	

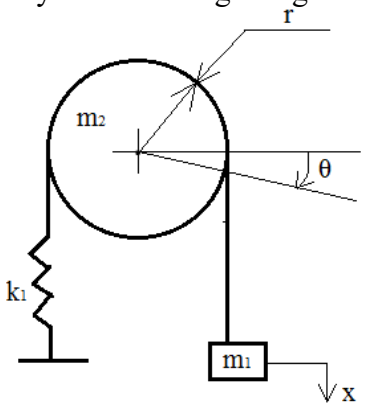
UPES

End Semester Examination, December 2025

Program Name: B. Tech ADE **Semester : VII**
Course Name: Noise Vibration and Harshness **Time : 3 hrs**
Course Code: MEAD4011 **Max. Marks : 100**

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

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Define Harshness in the context of vehicle NVH and state its impact on occupant comfort.	4	CO1
Q 2	Explain the significance of natural frequency and resonant frequency in vibration behavior of a vehicle.	4	CO1
Q 3	Describe the role of powertrain mounts in minimizing vibration transmission to the vehicle body.	4	CO1
Q 4	Summarize the purpose of vibration isolators and dampers used in suspension systems.	4	CO1
Q 5	Explain the term Pass-by Noise and indicate its relevance to vehicle noise regulations.	4	CO1
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Describe the major automotive noise sources including brake squeal, pass-by noise, wind noise, squeak and rattle, interior buzzer/accessory noise, and tyre–road interaction noise. Explain the significance of noise specifications and mandatory standards in regulating these noise levels in vehicles.	10	CO1, CO2
Q 7	Find the time period of small vibrations of the system shown in figure considering no-slip condition. Treat the system as a single degree of freedom system. 	10	CO2

Q 8	Define the term Harshness in vehicle NVH and explain the parameters influencing occupant perception of harshness. Discuss the psychological and comfort-related effects created by harshness during vehicle operation.	**10**	**CO2**
Q 9	Explain in brief the octave band analysis. An octave band analysis was done on an automobile. It was found that the octave band pressure levels were 95 dB at 200 Hz, 98 dB at 1000 Hz, 100 dB at 2000 Hz, 94 dB at 8000 Hz. Determine the total mean square pressure. OR Differentiate between structure-borne sound and air-borne sound in vehicles. Illustrate the characteristics of plane waves and spherical waves with neat, labeled diagrams and explain their relevance in automotive acoustics.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	Discuss in detail the various sources of vibrations in an automobile, covering the powertrain, suspension system, tyres, steering assembly, and body structure. Explain the vibration generation mechanisms, frequency ranges, and transmission paths, and describe suitable engineering methods used for minimizing their impact on vehicle performance and comfort.	**20**	**CO3**
Q 11	Derive the equation of motion for an undamped single degree of freedom (SDOF) system undergoing free vibration and obtain expressions for natural frequency, time period, and displacement response. Explain the physical significance of frequency of vibration, resonant frequency, amplitude, and phase angle in Simple Harmonic Motion (SHM). Additionally, describe the nature of damped vibrations in an SDOF system and compare the cases of underdamping, critical damping, and overdamping. OR A 1200 kg automobile vehicle is mounted on four identical springs of total spring constant k=1.96 x 10^6 N/m and has negligible damping. The vehicle is subjected to a harmonic external force of amplitude F_o = 490 N and frequency 180 rpm. Determine the amplitude of motion of the machine and the maximum force transmitted to the foundation because of unbalanced force.	**20**	**CO3**