ME1020 Mechanical Vibration

Project

Introduction:
This individual project, based on the materials discussed in the classes, is worth 15% of the course grade.

Background:
The car suspension system is an important vibration suppression mechanism. This project involves the analysis of car suspension systems using different numerical models. The process would help students to better understand the application of some fundamental concepts covered in this course. It would also serve as starting points for students to further apply their engineering knowledge in design analysis.

A quarter car model of an automobile is shown. The vehicle is travelling with a maximum velocity v = 100 km/h on a sinusoidal road surface with amplitude Y, and a wavelength of λ. Assume m_1 = 1010 kg, m_2 = 76 kg, k_1 = 31110 N/m, and k_2 = 321100 N/m. The values of Y, λ and c will depend on your student ID# (see Table 1). Assume zero initial conditions.

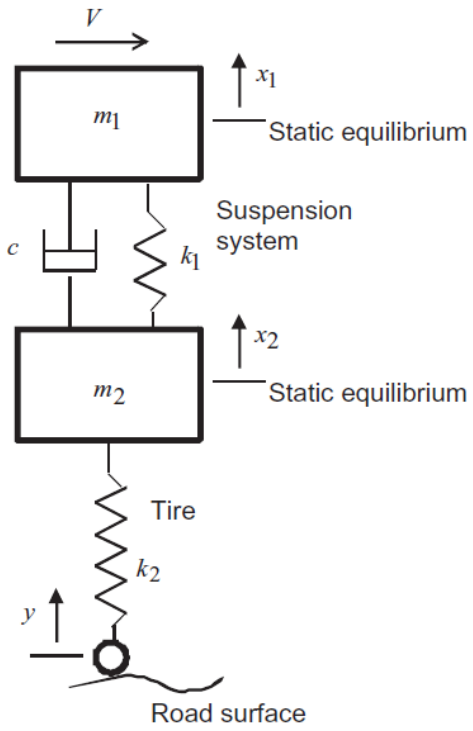

Table 1: Values for Y, λ, and c

	For ID# ending with	Apply the following values
1	0, and 1	Y = 0.011 m, λ=5.2 m, c = 4950 Ns/m
2	2, and 3	Y = 0.013 m, λ=5.1 m, c = 5000 Ns/m
3	4, and 5	Y = 0.015 m, , λ=5.3 m, c = 4900 Ns/m
4	6, and 7	Y = 0.017 m, , λ=5.0 m, c = 4800 Ns/m
5	8, and 9	Y = 0.019 m, , λ=5.5 m, c = 4850 Ns/m

Tasks:

1) Derive the differential equations of motion and obtain the mass, stiffness, and damping matrices, and the force vector.
2) Determine the displacement transmissibility, force transmissibility, natural frequencies and mode shapes, etc. for the systems using MATLAB
3) Use MATLAB to compute the responses (i.e. x_1 versus time and x_2 versus time) of the system with and without the damper. Afterwards, you can vary the values for c and k_1 to examine the effects and the quality of the response (including displacement transmissibility, and force transmissibility), to the input road surface. Determine the values for c and k_1 that would produce the "best" suspension system
4) Search literature for other means of vibration control for the suspension system (only discission is needed, i.e., no need for implementation)
5) Each student must generate a neatly typed written report of the above analysis, comments, suggestions and recommendations (All appropriate calculations, must be included in the report)

Submission requirements:
Each student must submit the report and the MATLAB files to the Blackboard. The deadline for submission is on Friday 18 June 2021 at 23:59 hr. Late submission will not be accepted.

Note:
Student must use the designated values for *Y*, λand *c* or marks will be deducted.