BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
End Semester: MTECH - II (SP/2022)
ME510: Advanced Vibration & Simulation

Total Marks = 50
Time: 2 Hours

INSTRUCTIONS

- Attempt all the questions.
- The missing data, if any, may be assumed suitably.
- Students should write their full name, Roll No., course code and course name on the answer sheet.

MODULE 1

Q1.1 Derive the governing equation of motion for a simple spring-mass system corresponding to Figure 1.1. **[5 marks]**

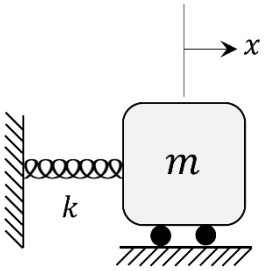


Figure 1.1

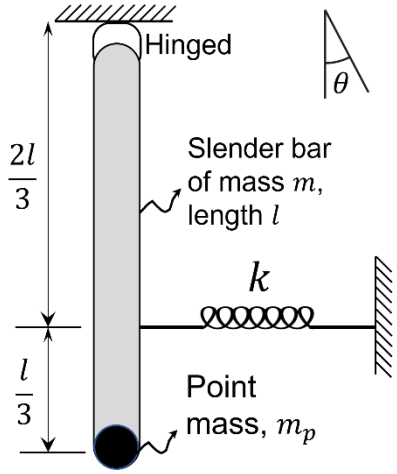


Figure 1.2

Q1.2 Determine the governing equation of motion for small oscillations about the vertical equilibrium position for Figure 1.2. Use θ as the chosen generalized coordinate. **[5 marks]**

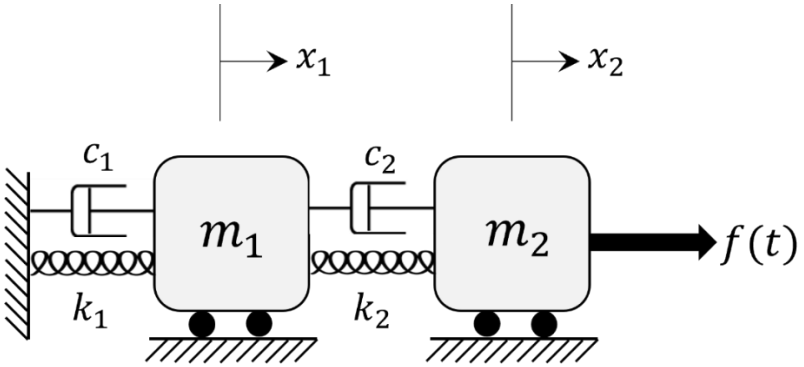
Q1.3 Name atleast 4 damping models used in vibration analysis. **[4 marks]**

MODULE 2

Q2.1 For a beam of total length l, write down the boundary conditions at its both ends namely $x = 0$ and $x = l$ for the following cases**.** **[1+1+1+2 marks]**

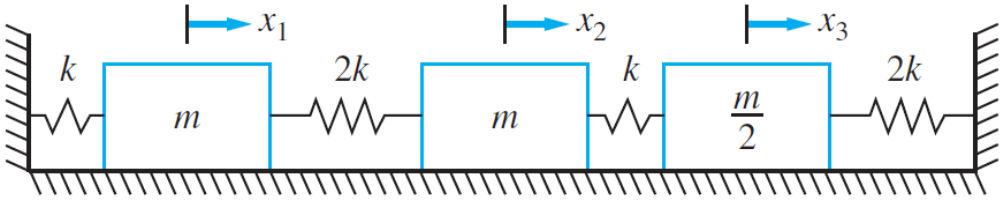
- Both ends free
- Both ends fixed
- One end fixed and another end is free
- Simply supported ends

Q2.2 For the system shown below, draw the free body diagram and derive the governing equations of motion, clearly mentioning the Law used. **[5 marks]**



MODULE 3

Q3.1. Using Matrix iteration method find the first three natural frequencies of the following system. **[5 marks]**



Q3.2. Determine the fundamental frequency of the vibration of the system using Dunkerley's method for the above system. **[5 marks]**

MODULE 4

Q4.1 Consider free Duffing equation as $\ddot{x} + \omega_n^2 x + \beta x^3 = 0$; where β is very small to incorporate weak non-linearity. Find the solution of the equation comprising of both complimentary function and particular integral. **[5 marks]**

Q4.2 Explain the Jump phenomenon with a neat diagram. **[3 marks]**

Q4.3 Write the Mathieu equation explaining the parameters involved and give one example of it's applicability. **[4 marks]**

MODULE 5

Q5.1. Explain the basic principle of operation of electrodynamic shaker with a neat diagram. **[4 marks]**

29/04/2022