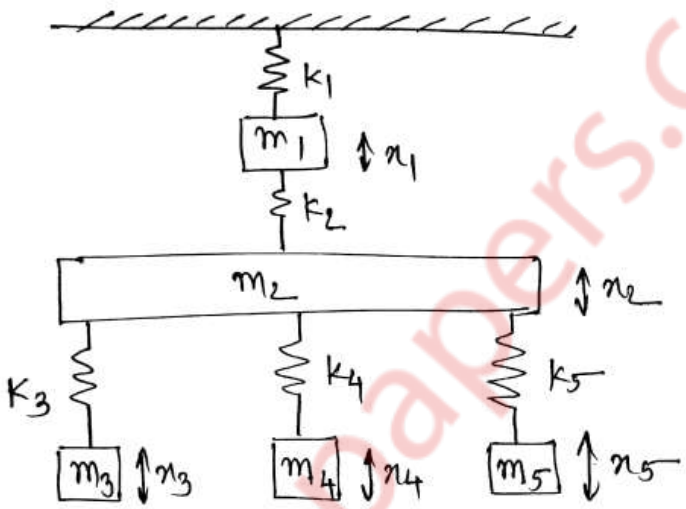
**Q. P. Code: 40683**

3 Hours

N.B. (Total marks: 80)

- Attempt any four questions.
- Assume suitable data if required with justification. State assumptions clearly.
- Illustrate answers with sketches if necessary.
- Figures to the right indicate marks.
- Answers to the questions showed be grouped and written together.

Q1. 1. Five masses are attached as shown in figure and are constrained to move in vertical direction. Derive frequency equations for the following system. (10 marks)




2. A commercial vibration pick up has a damped natural frequency of 4.5 Hz and damping ratio of 0.5. Calculate the range of impressed frequency at which the amplitude can be read directly from the pickup with maximum error of 2%. (10 marks)

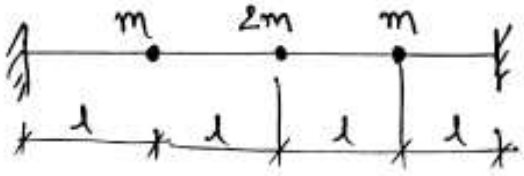
Q2. 1. With a neat sketch explain and relevant formulae methods for vibration control with the following methods;

i. mass/inertia control ii. Stiffness control iii. Damping control (10 marks)

2. Derive solution for non-linear equation of simple pendulum with use of Ritz-Galerkin method. (use one term approximation) (10 marks)

Q3. 1. With a neat sketch explain working of active control system applied for vibration isolation. Also explain advantages of using the active system over that of the conventional passive system. (10 marks)

2. Calculate three natural frequencies of a taut string having tension T and three concentrated masses as shown the figure. (10 marks)




Q4. 1.a Explain use of LVDT in case of vibration measurement. (03)

b. Explain how choice of the damping factor and stiffness are associated with working range of a piezoelectric accelerometer. (07)

2. a. Explain the following in context to the modal analysis (05)

i. choice of exciter (i.e. impact hammer or shaker)

ii. location of sensors

b. Explain procedure to determine mode shapes and natural frequencies with free vibration response analysis. (05)

Q5. 1. Evaluate the following consequences in context to vibration based diagnosis; (10)

i. Rise in the vibration amplitude for frequencies that are integer multiples (above 10 times) of operating frequency

ii. Sudden reduction and then increase in vibration amplitude

2. Explain procedure to estimate damage detection in structures using change in mode shapes and frequency. (10)

Q6. 1. Explain the following in context to vibration based fault diagnosis; (10)

a. Trending of the vibration time series data

b. choice of sensors used for vibration based diagnosis

c. location of sensors for vibration based diagnosis

2. a. Explain how frequency of solution for Duffing's equation is affected by nature of the spring (05)

b. Explain the following terms; (05)

i. Phase plane ii. Jump Phenomenon

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