SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF AERONAUTICAL ENGINEERING

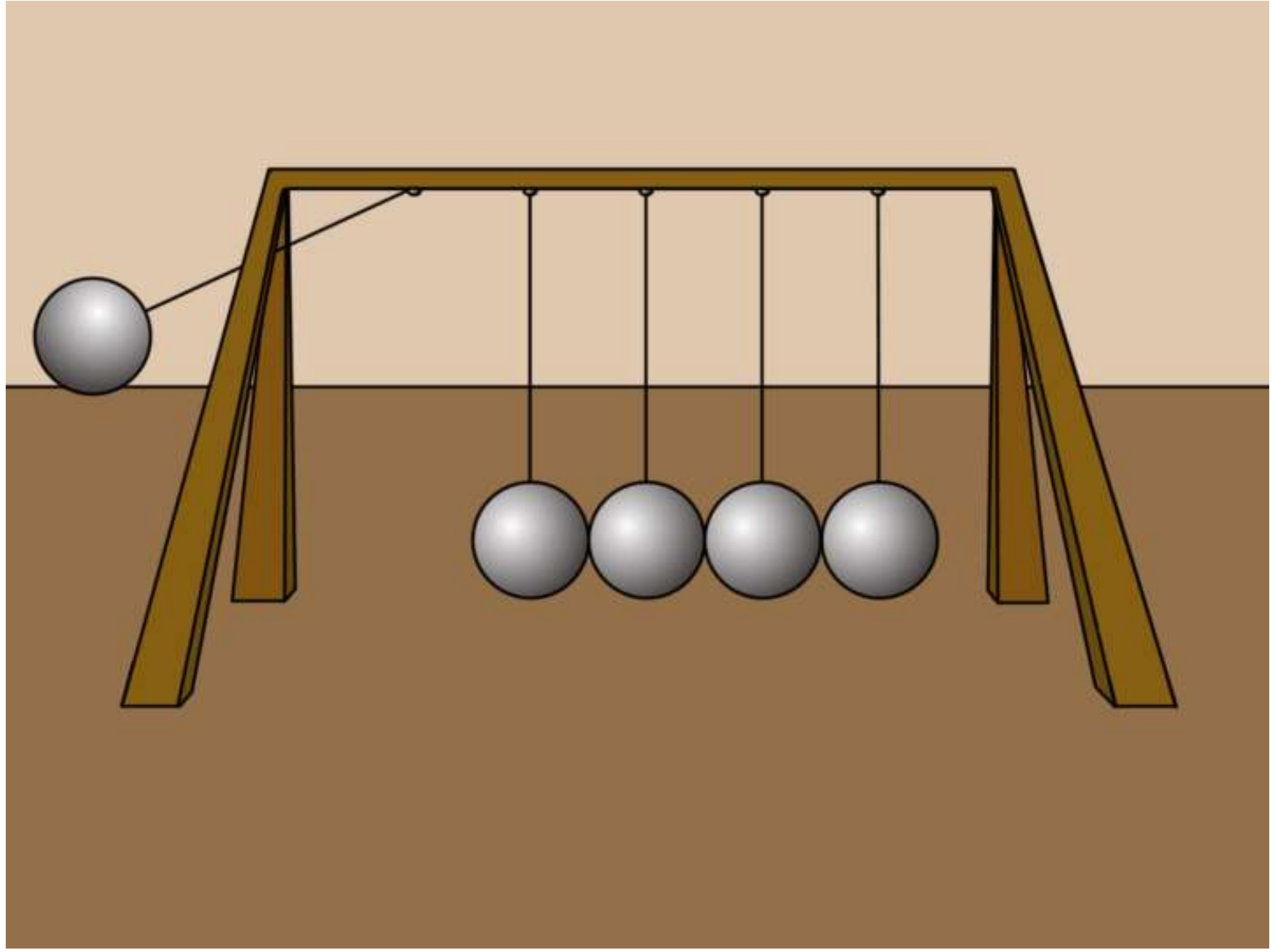
16AE315-THEORY OF VIBRATIONS

III YEAR V SEM

UNIT – I BASIC NOTATIONS

TOPIC 5 – NEWTONS LAW OF MOTION

LEARNING OBJECTIVES



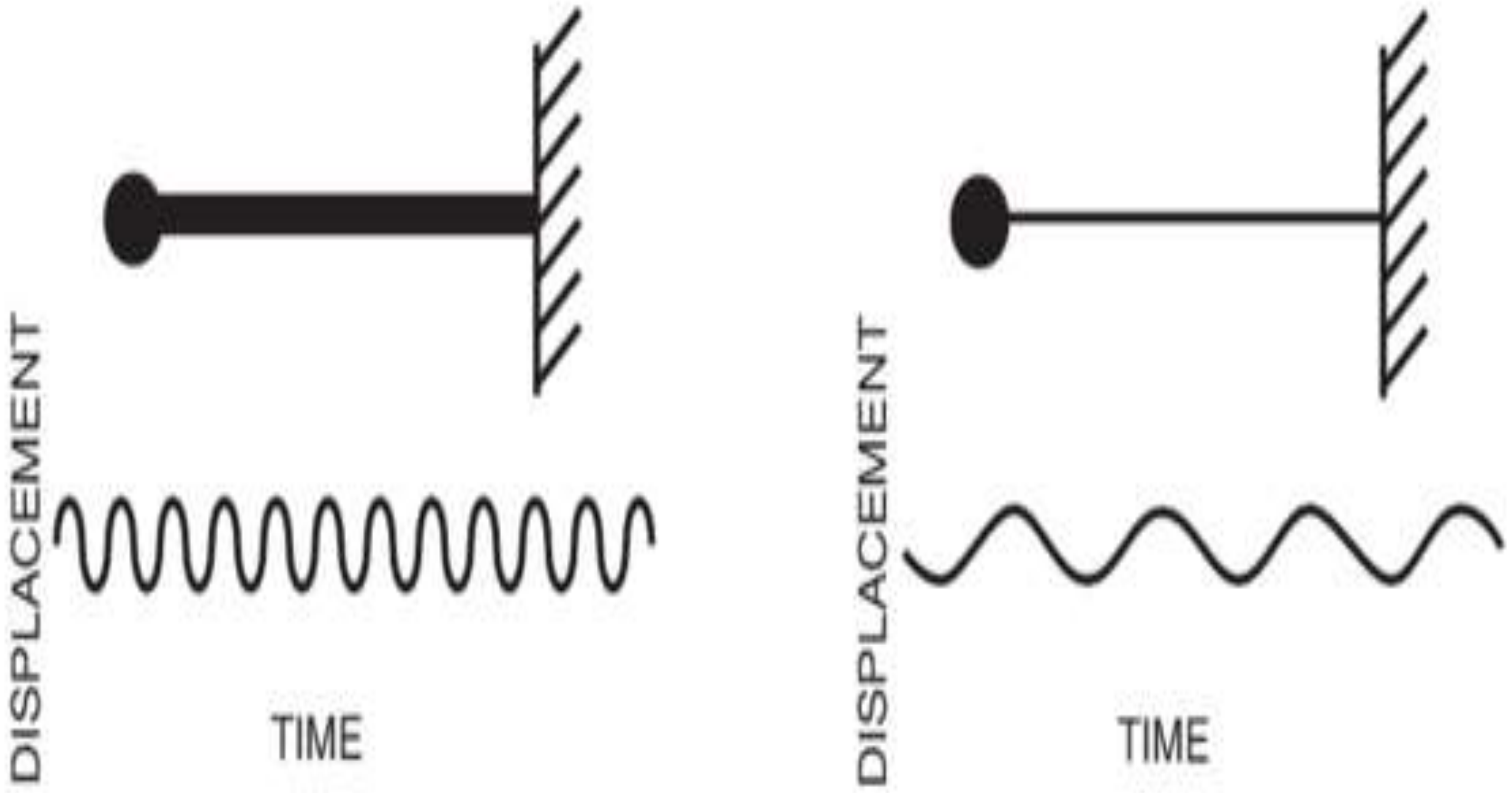
- Newton's first law states that every object remains at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force

- If a net external force is applied the velocity changes because of the force

INTRODUCTION

- Like any moving object, the motion of a vibrating object can be understood in light of Newton's laws
- According to Newton's law of inertia, an object which is moving will continue its motion if the forces are balanced
- Vibrational motion is often contrasted with translational motion

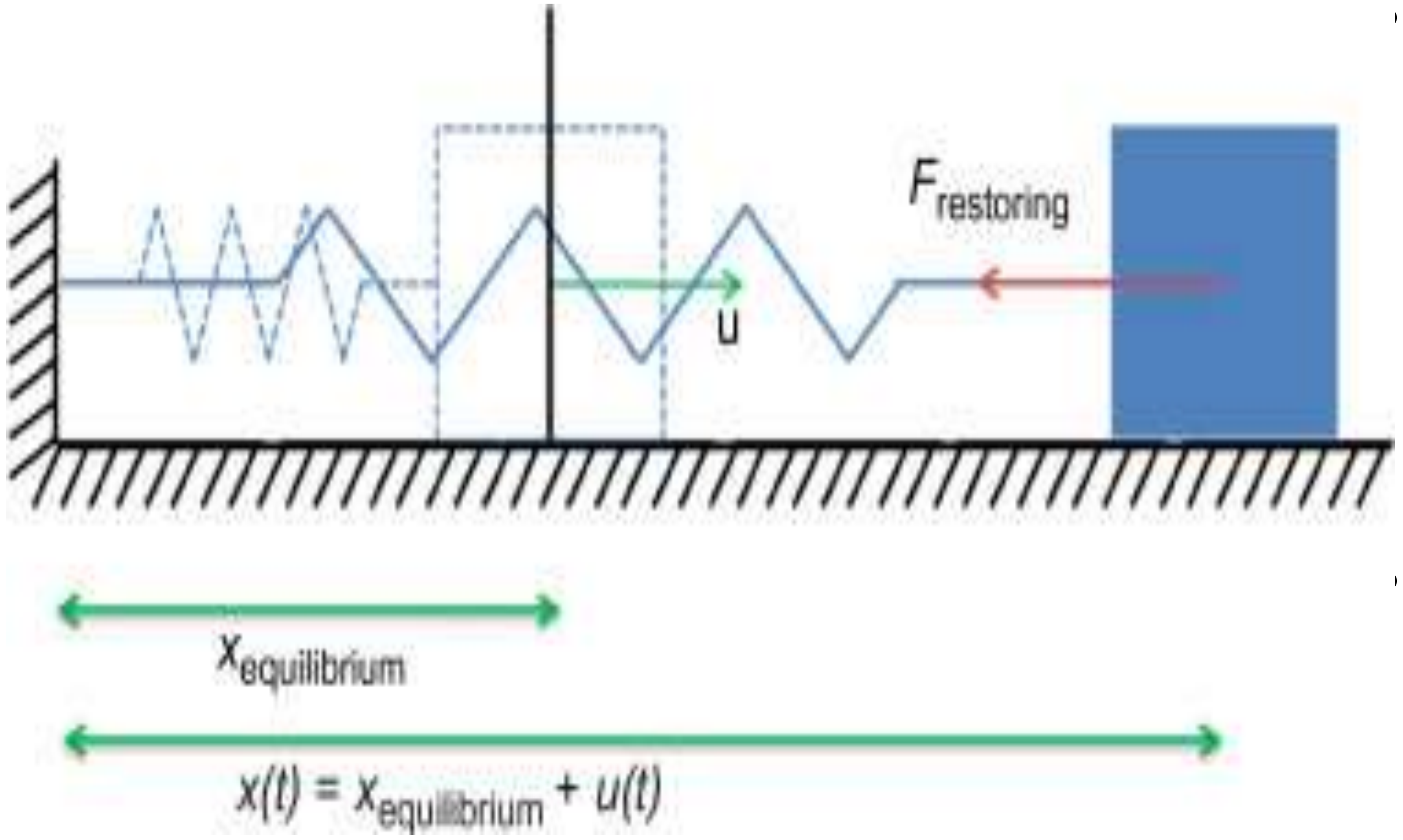
CONDITION OF FREE VIBRATION



- Free vibration means that no time varying external forces act on the system
- A system has one degree of freedom if its motion can be completely described by a single scalar variable We'll discuss this in a bit more detail later
- A system is said to be linear if its equation of motion is linear

QUESTIONS RELATED TO ABOVE SLIDES

EXAMPLES



- swinging - pendulums, swings, metronomes are the example of vibratory motion.

- Moving up and down/side to side - fixed springs out of equilibrium, seesaws, wave patterns (ocean waves, sound waves, radio waves, light waves etc.)

WORKING PRINCIPLE

Newton's law of motion gives

$$m\frac{d^2x}{dt^2} = F(t) - kx - \lambda\frac{dx}{dt}$$

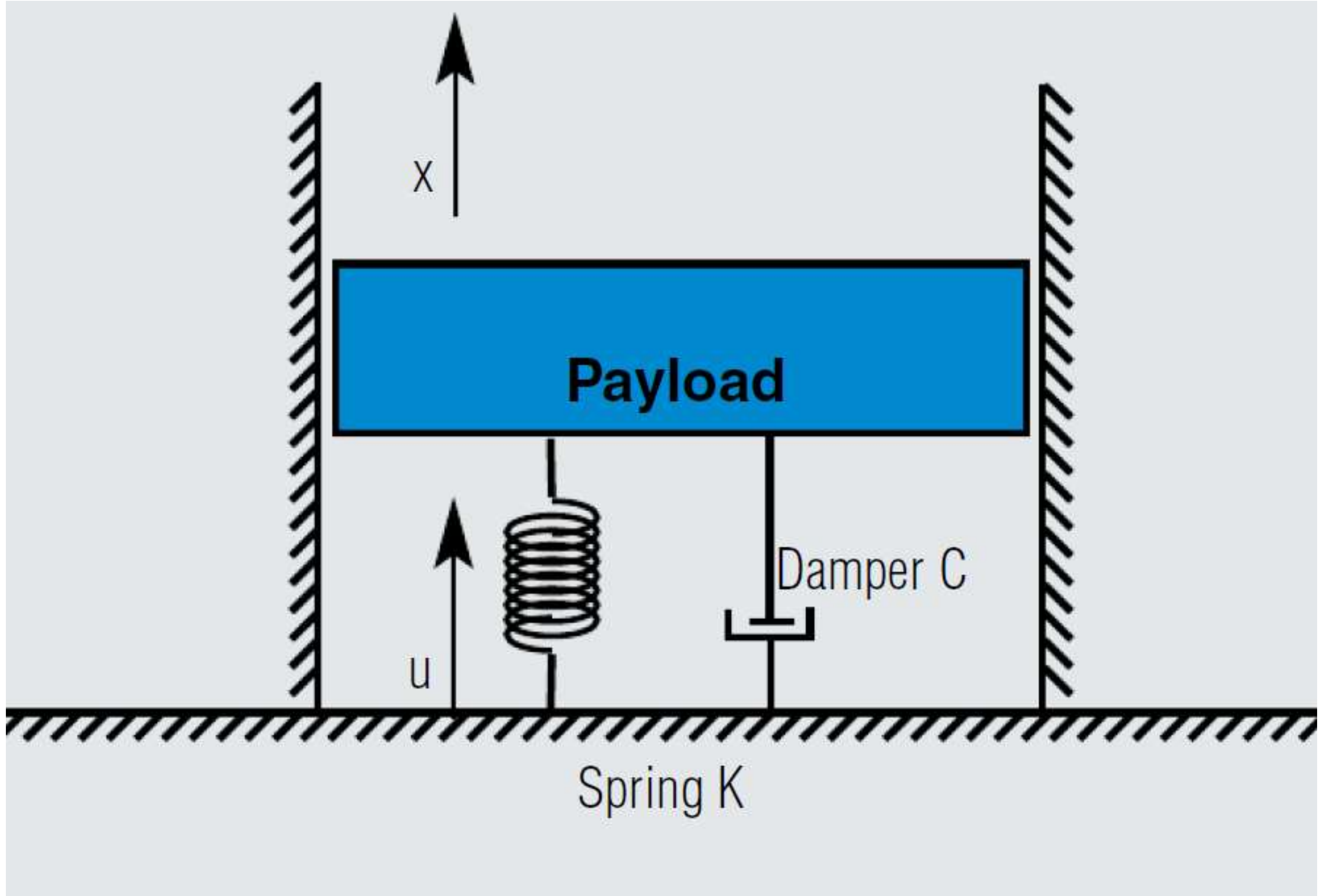
Rearrange and susbstitute for *F(t)*

$$\frac{m}{k}\frac{d^2x}{dt^2} + \frac{\lambda}{k}\frac{dx}{dt} + x = \frac{1}{k}F_0 \sin\omega t$$

Check out our list of solutions to standard ODEs

We find that if we set

$$\frac{1}{\omega_n^2}\frac{d^2x}{dt^2} + \frac{2\varsigma}{\omega_n}\frac{dx}{dt} + x = KF_0 \sin\omega t$$



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Continue…

- The first step in analyzing any physical structure is to represent it by a mathematical model which will have essentially the same dynamic behavior
- A suitable number and distribution of masses, springs, and dampers must be chosen, and the input forces or foundation motions must be defined
- The model should have sufficient degrees-of-freedom to determine the modes which will have significant response to the exciting force or motion

JUST THINK…

- A structure is idealized as a damped spring mass system with stiffness 10 kN/m; mass 2Mg; and dashpot coefficient 2 kNs/m. It is subjected to a harmonic force of amplitude 500N at frequency 0.5Hz. Calculate the steady state amplitude of vibration.

Ans:

REFERENCE LINKS

http://160592857366.free.fr/joe/ebooks/Mechanical%20Engineering%20Books%20Collection/VIBRATIONS/mechVib%20theory%20and%20applications.pdf

https://books.google.co.in/books?id=0fl1pKtaghAC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

https://engfac.cooper.edu/pages/tzavelis/uploads/Vibration%20Theory.pdf

THANK YOU...