

VIBRATION ANALYSIS AND MONITORING

BETM 3583

FUNDAMENTAL OF VIBRATION

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LESSON OUTCOME

1. Understand the fundamental of vibration
2. Apply a modeling technique for complex vibration system

Fundamental of Vibration

- Most engineering structures vibrate
- The use of **lightweight materials** in modern structures
- The needs of faster transportation



Fundamental of Vibration

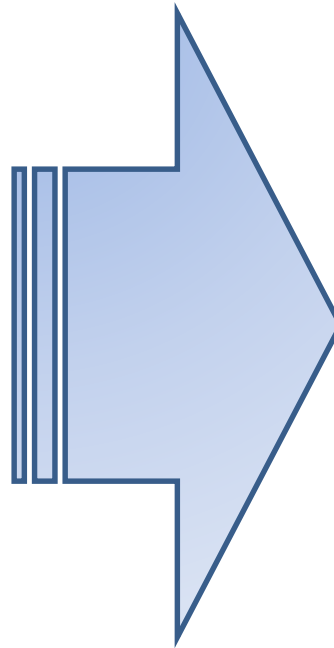
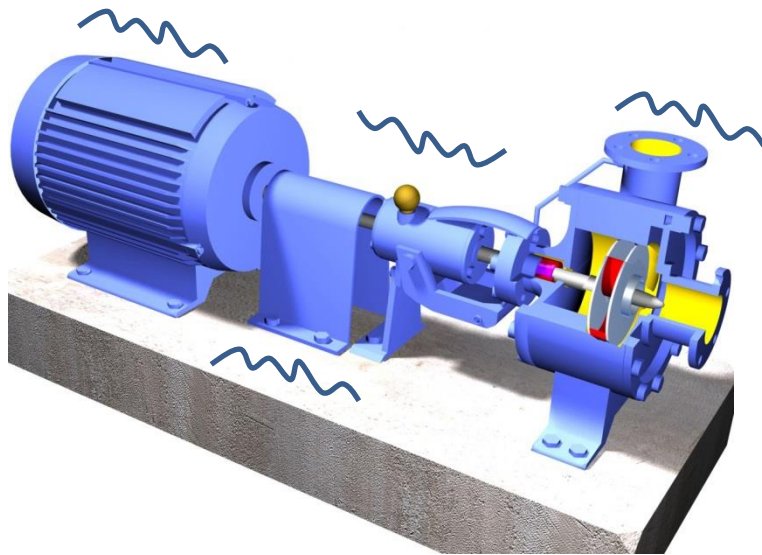
Example : Aircraft Vibration



Identify which part vibrates the most?

Fundamental of Vibration

Effect of excessive vibration : **Failure !**



Fundamental of Vibration

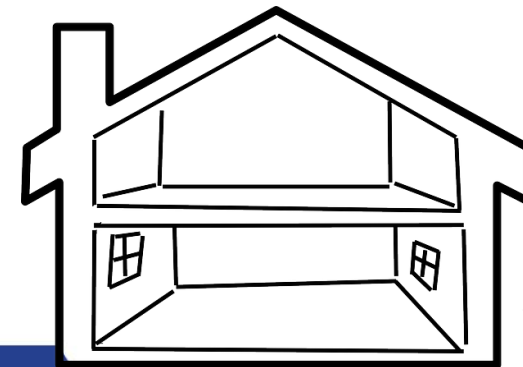
Another effects : **Whole body & hand arm vibration syndrome**



Fundamental of Vibration

Another effects : **Noise**

Undesired sound that can be harmful to the human being



Fundamental of Vibration

Therefore, vibration plays a major important role in modern engineering application

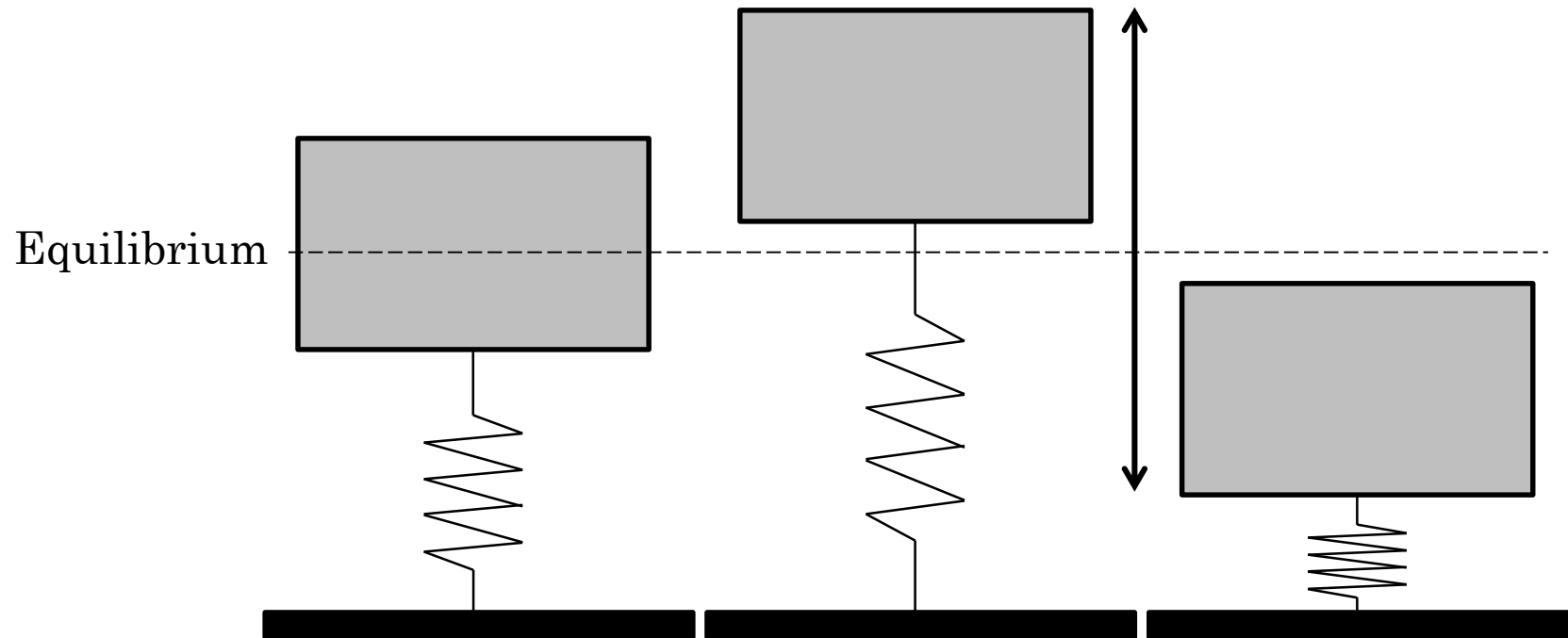
Studying vibration is compulsory for **mechanical engineer** and **technologist**.

Fundamental of Vibration

Definition and Modeling

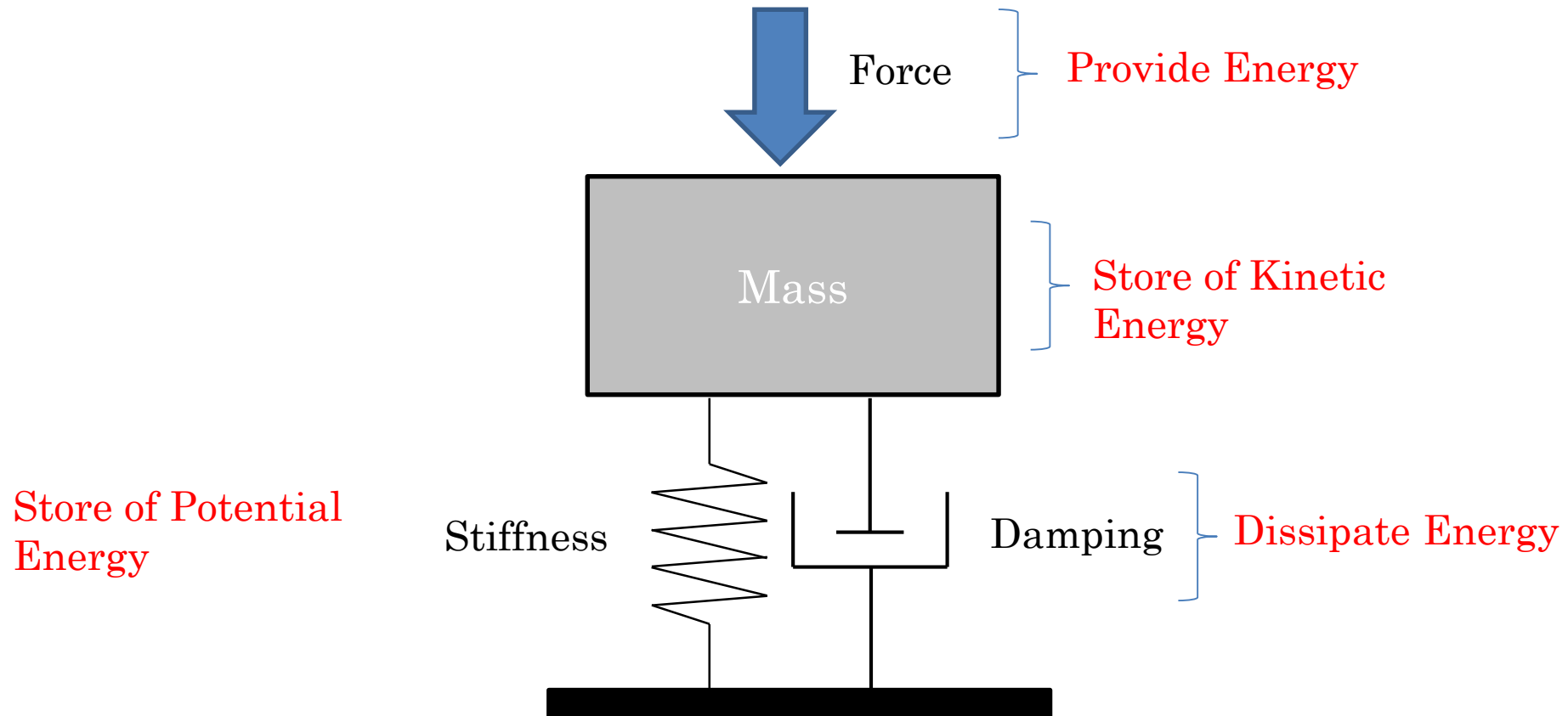
Definition and Modeling

Vibration can be defined as mechanical oscillations occurred about an equilibrium position.



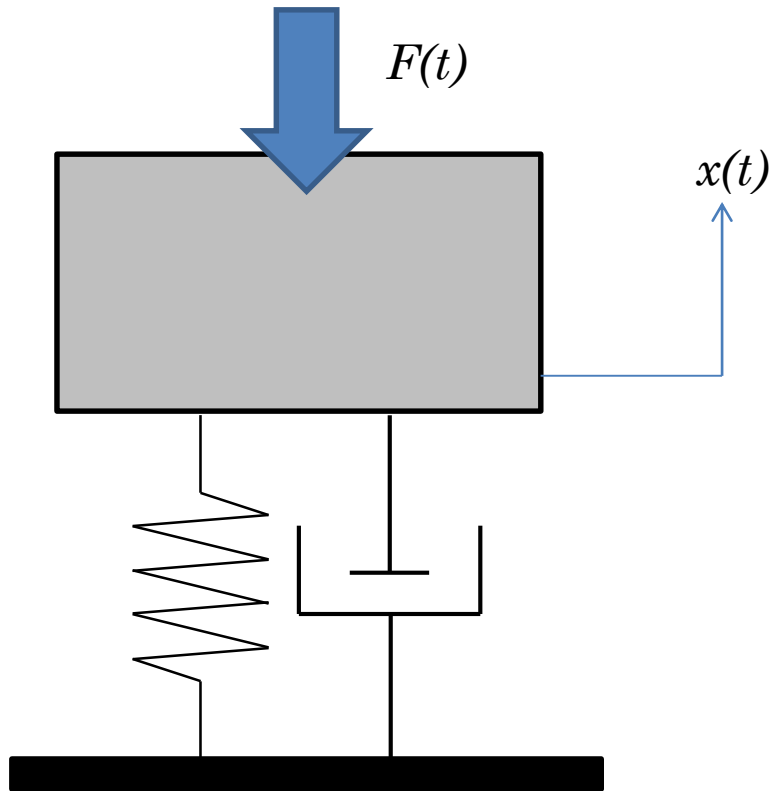
Fundamental of Vibration

Vibration modeling – Spring mass system



Fundamental of Vibration

Time harmonic system : periodic motion that repeats at regular interval



$$x(t) = X e^{j\omega t}$$

$$F(t) = F e^{j\omega t}$$

Fundamental of Vibration

Vibration Units

Displacement

$$x(t) = Xe^{j\omega t}$$

Velocity

$$\dot{x} = v(t) = \frac{dx(t)}{dt} = j\omega X e^{j\omega t}$$

Amplitude

$$\ddot{x} = a(t) = \frac{d^2x(t)}{dt^2} = -\omega^2 X e^{j\omega t}$$

Fundamental of Vibration

Modeling

Describing a real complex system into a simple system using mathematical / analytical approach.

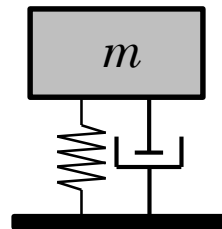
Degree of Freedom (DOF) is the number of independent parameters that define its configuration

Fundamental of Vibration

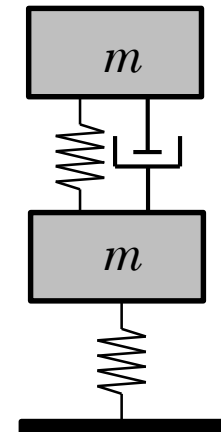
Modeling



1 DOF

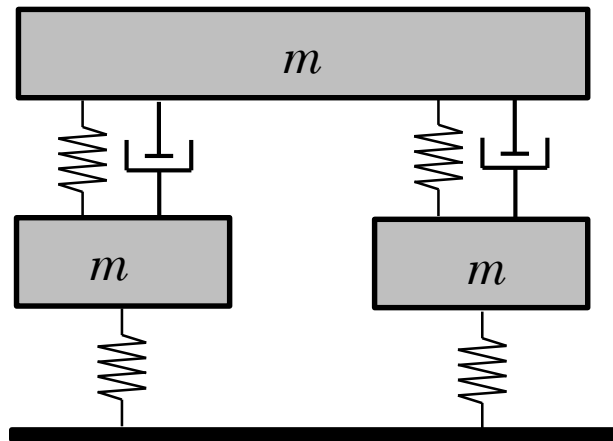


2 DOF

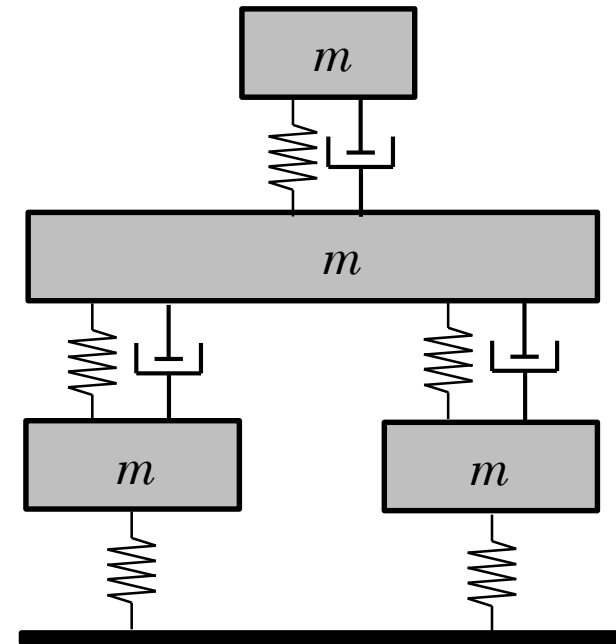


Fundamental of Vibration

Modeling



3 DOF

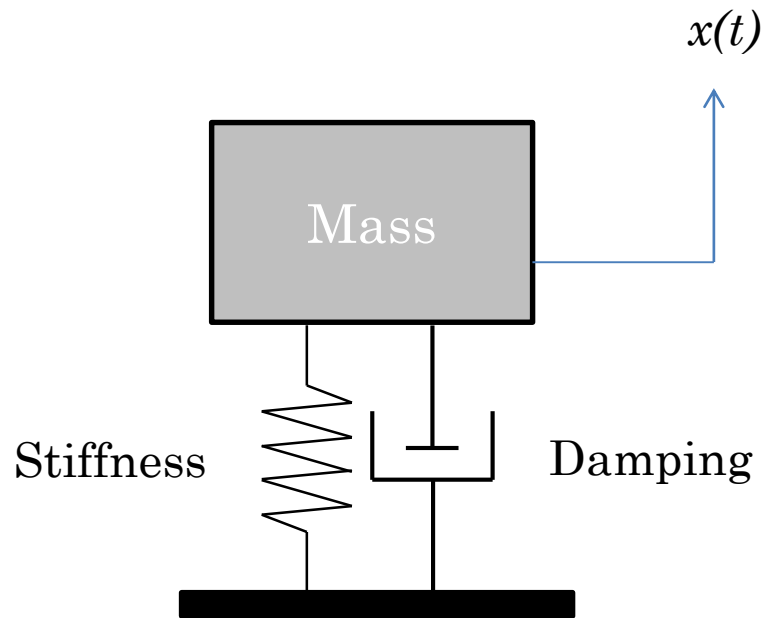


4 DOF

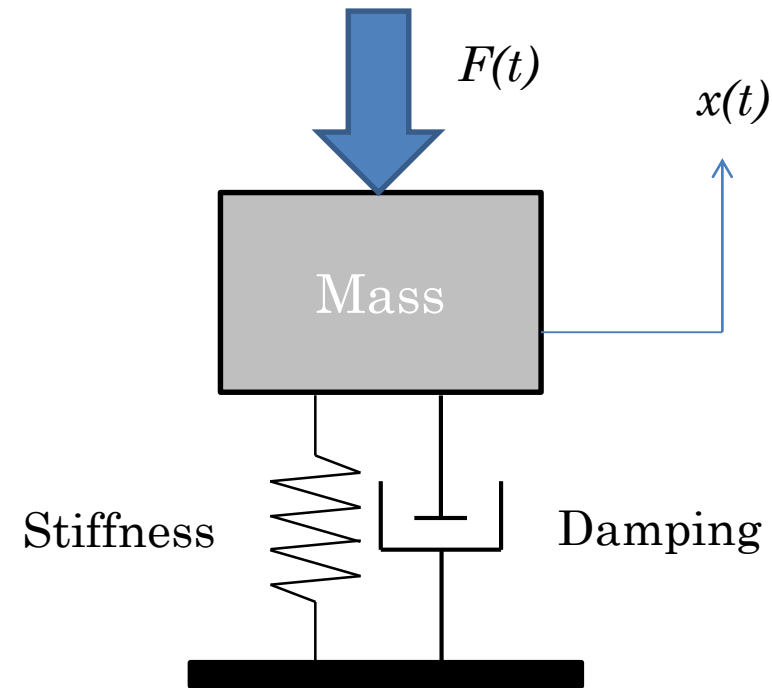
Fundamental of Vibration

Modeling

For this course → **Only 1 DOF**



Free Vibration

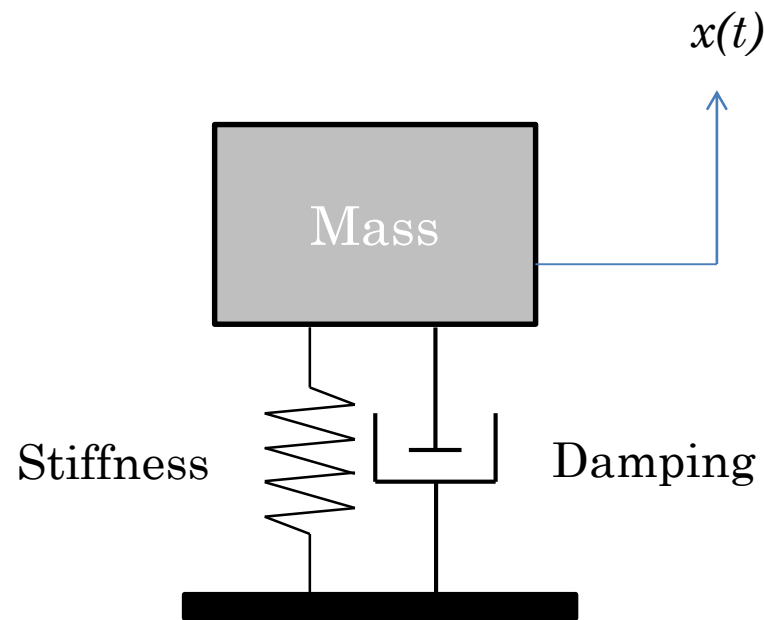


Forced Vibration

Fundamental of Vibration

Modeling

For this course → **Only 1 DOF**



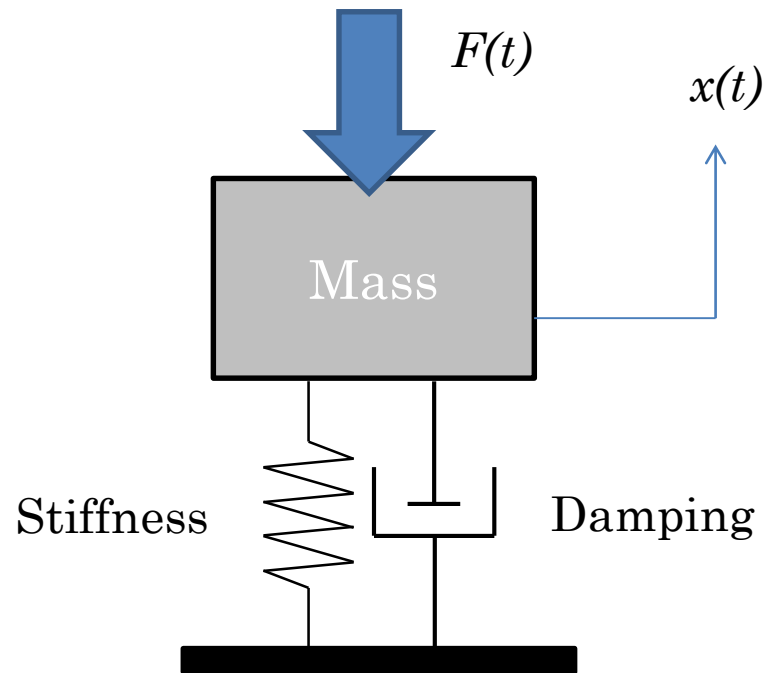
$$m\ddot{x} + c\dot{x} + kx = 0$$

Free Vibration

Fundamental of Vibration

Modeling

For this course → **Only 1 DOF**



$$m\ddot{x}(t) + c\dot{x}(t) + kx(t) = F(t)$$

Forced Vibration

Fundamental of Vibration

Summary :

1. Fundamental of Vibration
2. Definition
3. Modeling

Question ?

Thank you