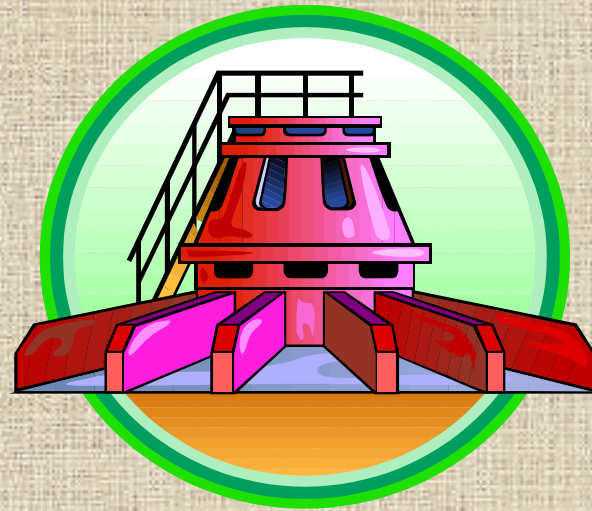


# Mechanical



# Topics

- Vibration
- Valves
- Steam Traps
- Flow sheets

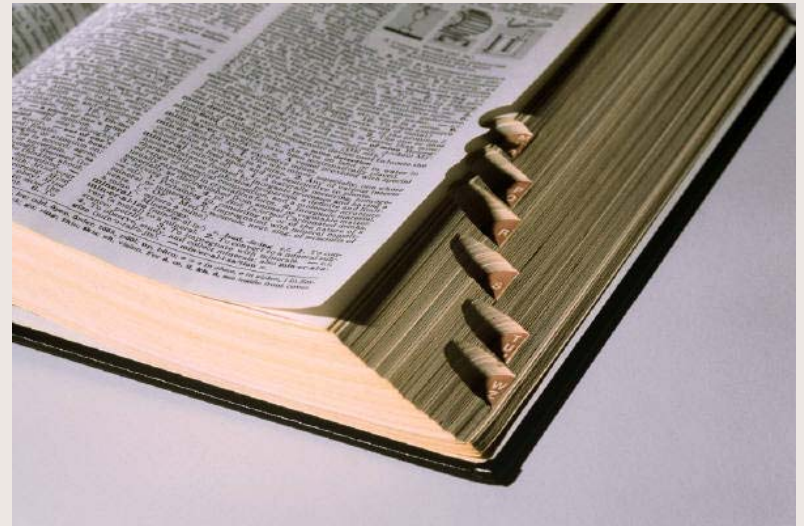


# Vibration

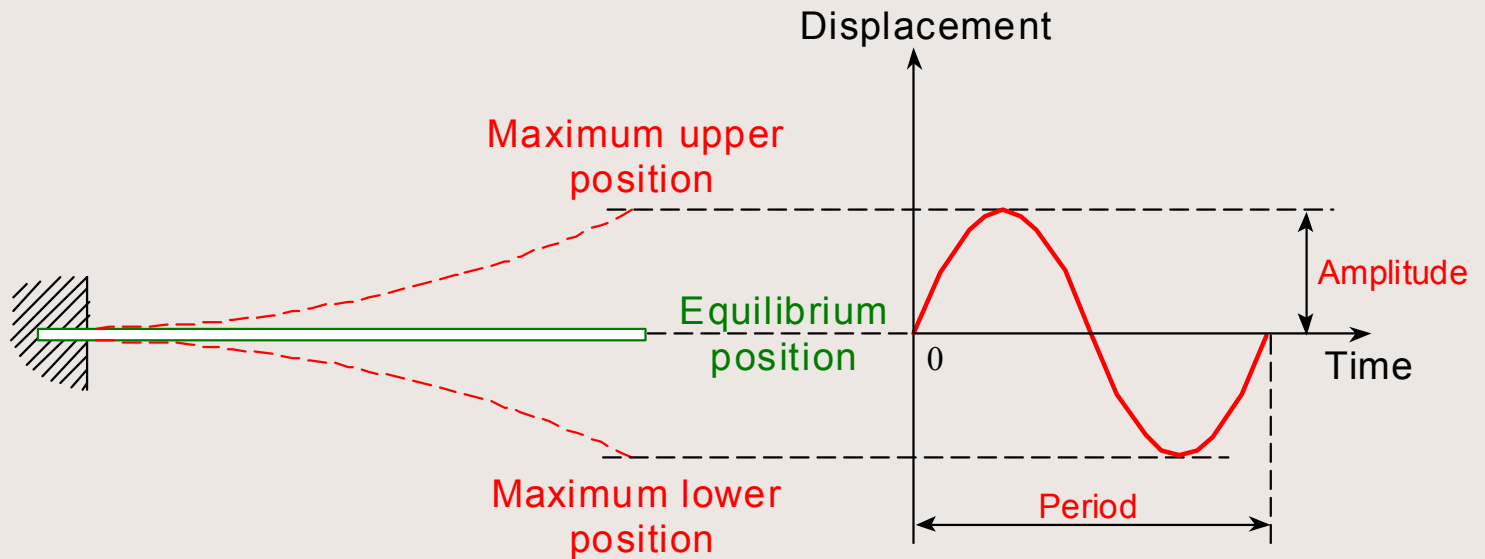


# Definitions

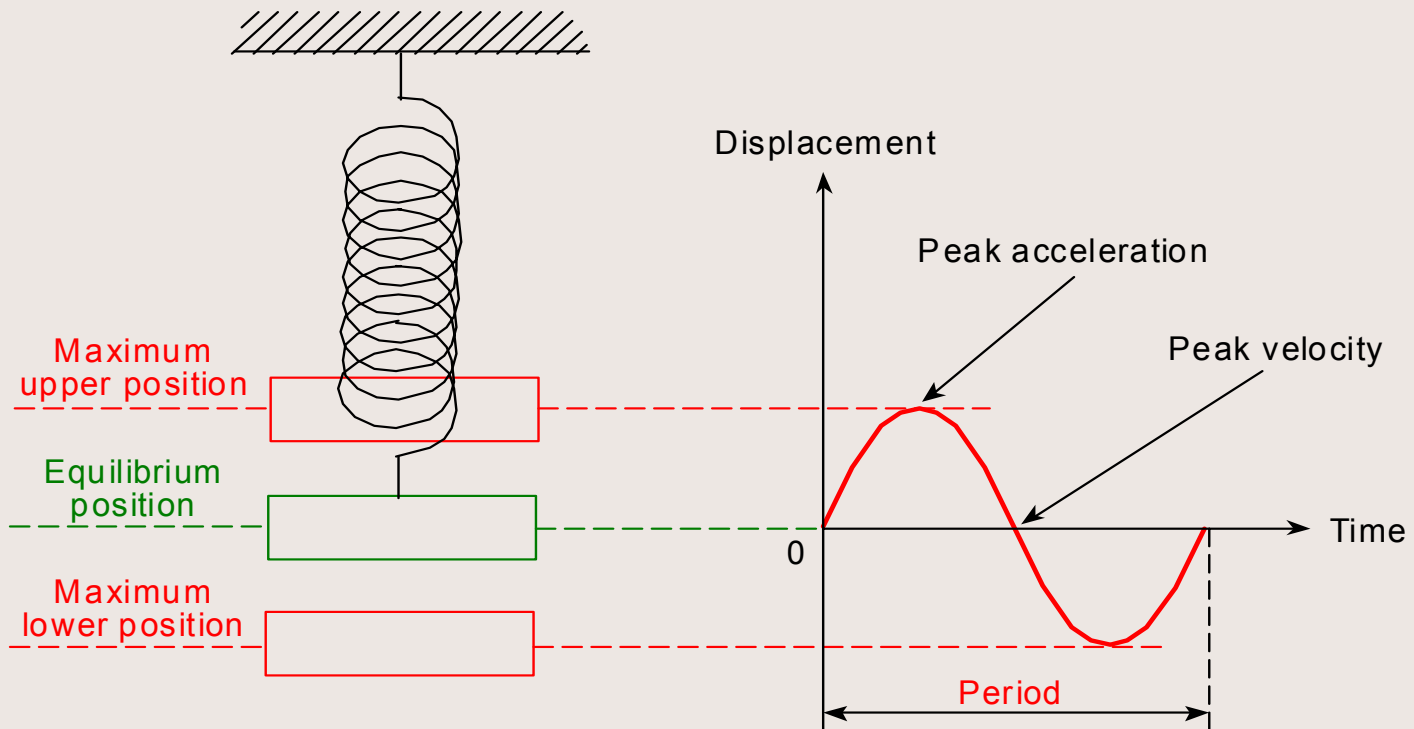
- Amplitude
- Frequency
- Natural Frequency
- Forcing Frequency
- Damping
- Resonance
- Critical Speed



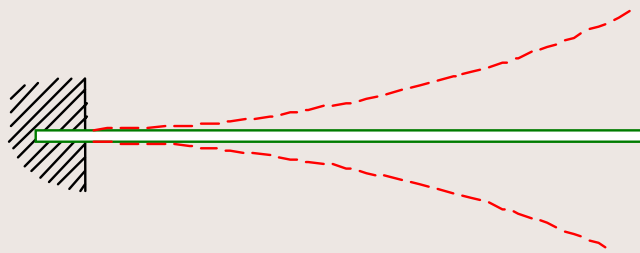
# Amplitude & Frequency



# Natural Frequency



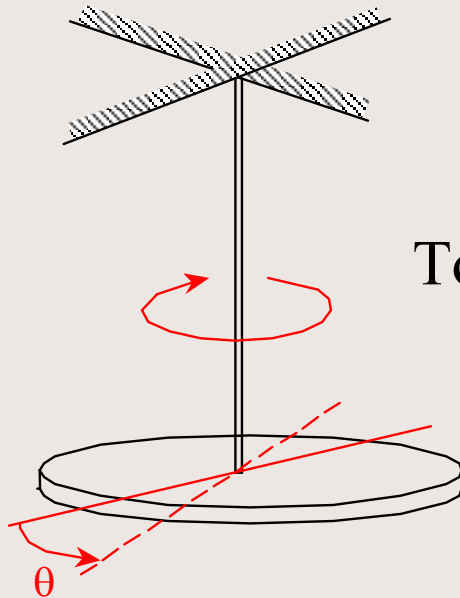
# Types of Vibration



Lateral



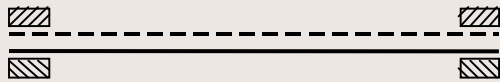
Axial



Torsional

# Modes of Vibration

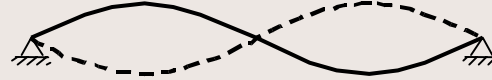
Stiff Shaft in  
Loose Bearings



Flexible Shaft in  
Stiff Bearings



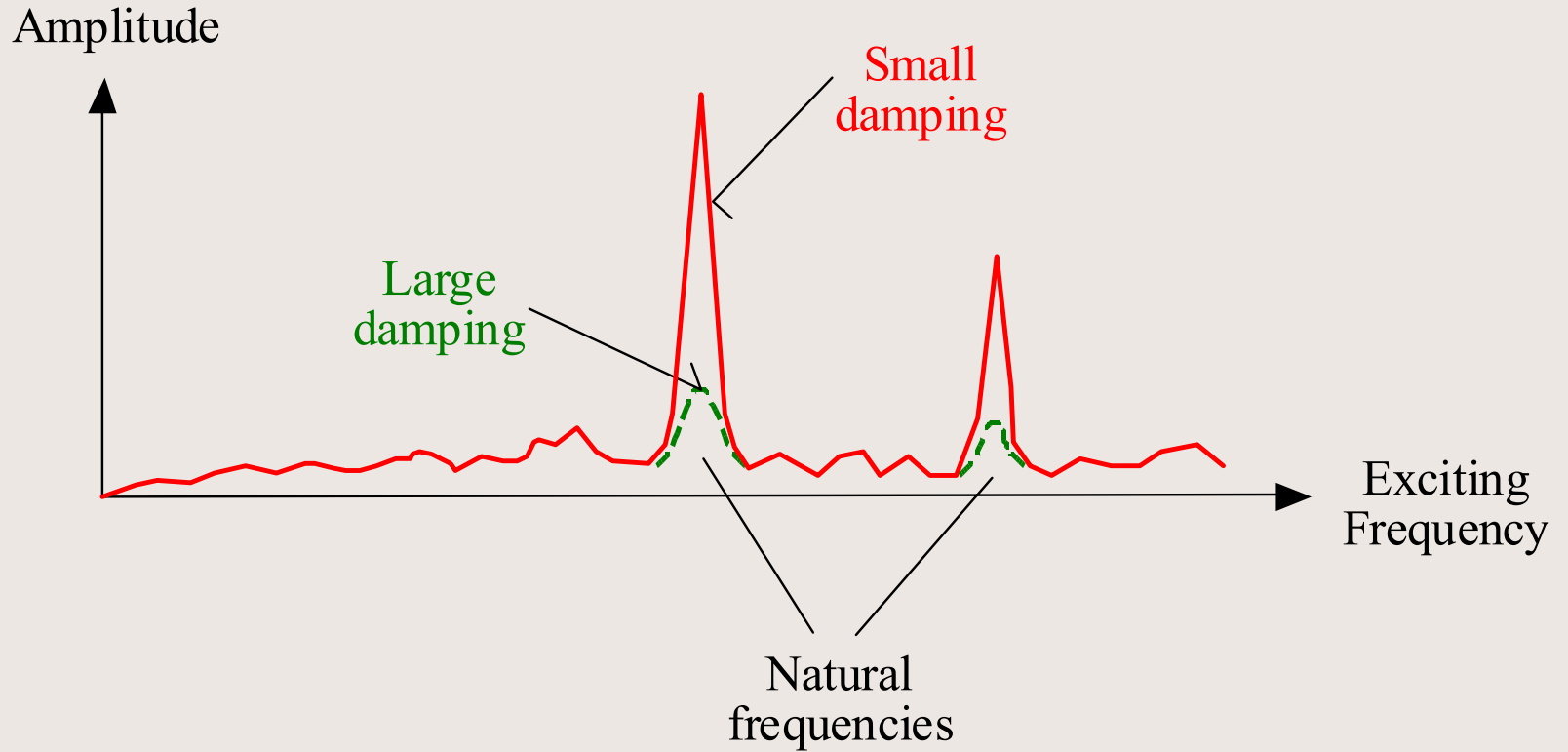
2 Nodes



3 Nodes



# Natural Frequency



# Factors Affecting Natural Frequencies

Inertia 

Frequency 

Rigidity 

Frequency 

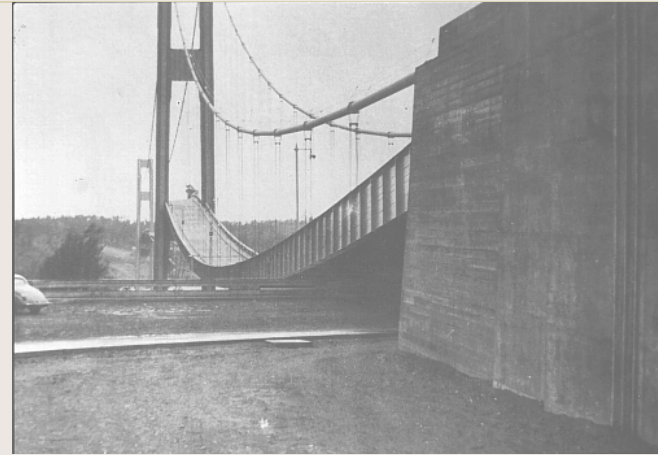
# Damping



- Internal friction
- Friction between object and its surroundings
- Friction between object and surrounding fluid



# Resonance



When a forcing frequency is equal to a natural frequency

# Critical Speed

- Every rotating machine has them
- The speed of rotation is equal to a resonant frequency of the support structures
- Vibrations are high
- Don't leave machine spinning at critical speeds



# Vibration Damage

- Fatigue
- Rubbing or Fretting
- Impact
- Loosening of parts

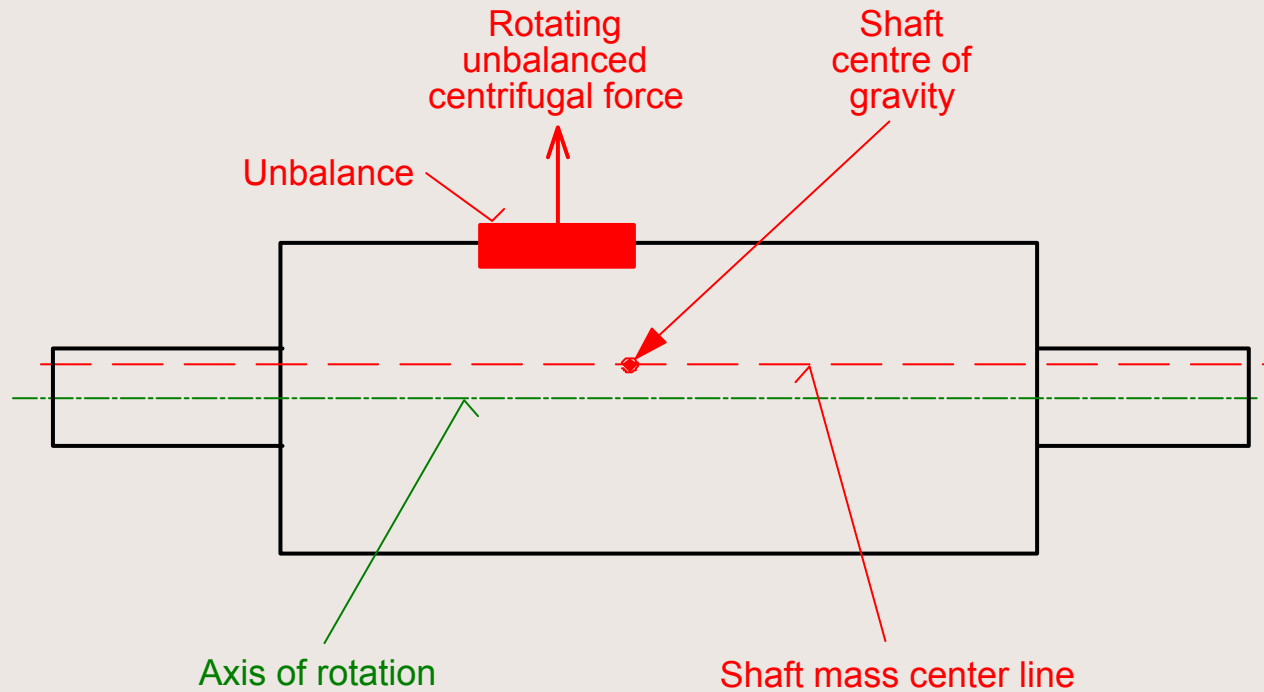


# Sources of Vibration

- Mass Unbalance
- Misalignment
- Eccentricity



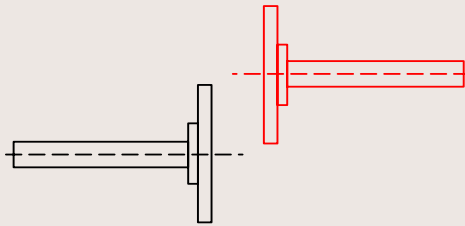
# Mass Unbalance



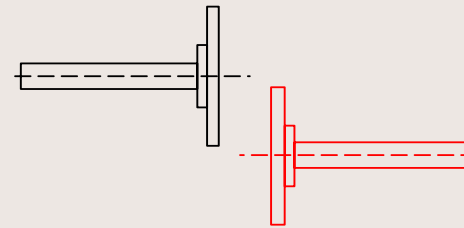


# Coupling Misalignment

Parallel Misalignment

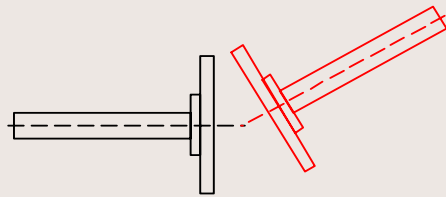


I

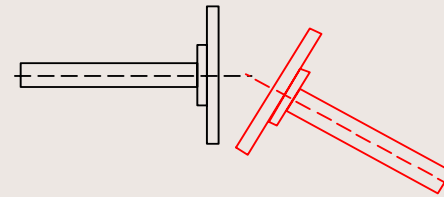


II

Angular Misalignment

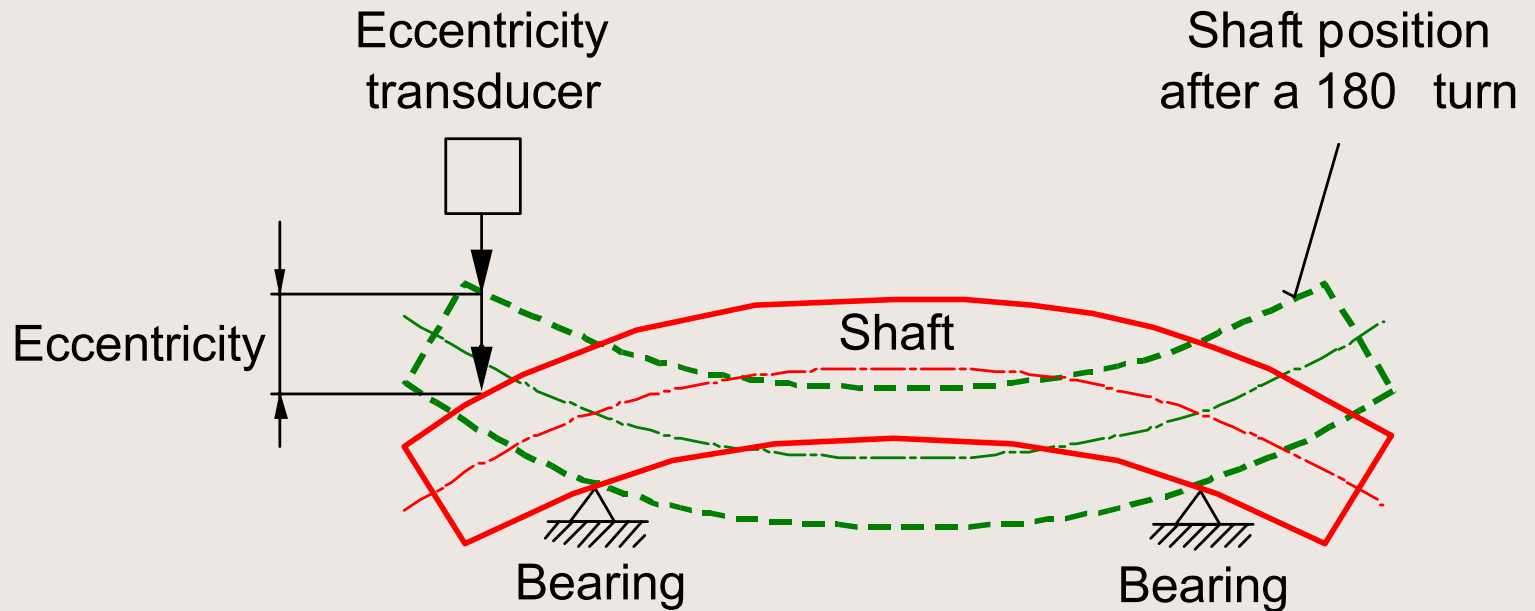


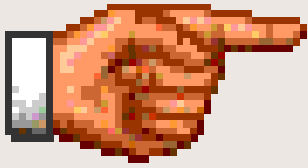
III



IV

# Eccentricity





# You

- Read the section titled Vibration
- Answer the questions page 22