Aerospace Engineering **Division:**
Level and Major:

Course Title: Mechanical Vibration **Number of Credits: 3** **Prerequisite**
Lecturer: Dr. Ovesy

Course Goals and Objectives:

Getting familiarized with basic concepts in vibration, Development of vibration equations through either Newton/Euler equation or energy method, Natural frequency calculation, Vibration system response to harmonic or transient excitations and familiarization with the vibration applications.

Course Topics:

1) **Oscillatory Motion**

Basic definitions – Harmonic motion and its characteristics – Dynamical system Degrees of Freedom (DoF) – Linear and Non-linear systems.

2) **Free Vibration of Single DoF System**

Development of equations of motion through either Newton/Euler equation or energy method – Natural frequencies of damped or undamped systems – Damped vibration – Logarithmic decrements – Effective mass or stiffness - Rayleigh method for natural frequency calculation.

3) **Forced Vibration of Single DoF System Subjected to Harmonic Excitation**

Steady state response in time or frequency domain when the system is subjected to either force excitation or support motion – Superposition law for linear systems – Response to rotating unbalance – Rotating shafts balancing – Whirling of shafts with discs - Transmissibility and vibration isolation – Energy dissipation due to viscous damping – Equivalent viscous damping – Coulomb damping – Viscoelastic and structural damping –Vibration measuring equipment – Phase distortion.

4) **Forced Vibration of Single DoF System Subjected to Transient Excitation**

Impulse response – Convolution and Duhamel's integral – Response spectrum – Laplace transform.

5) **Vibration of two DoF system**

Development of equations of motion through either Newton/Euler equation or Lagrange method – Natural frequencies and mode shapes – Stiffness, mass and damping matrices – Generalized coordinates – Coordinates coupling – Principle coordinates – Beat phenomena – Modal analysis of undamped system – Forced vibration and oscillation dampers.

6) **Vibration of multi DoF system**

An introduction to the vibration of multi degrees of freedom systems.

Reading Resources:

- Theory of Vibration with Applications, (Printice Hall)
  By: William T. Thomson, Marie Dillon Dahleh

- Mechanical Vibrations: Theory and Applications, (Pearson Higher Education)
  By: Francis S. Tse, Iran E. Morse, Rolland T. Hinkle

Evaluation: