Course Code	ME 320
Course Title	Dynamics of Mechanical Systems
No. of Credits	3
Pre-requisites	None
Compulsory/Optional	Compulsory for Mechanical Engineering stream

Aim(s): To introduce the basic principles governing the motion of macroscopic objects as required for the understanding and application of physical phenomena related to motion. At the end of the course all students are expected to be able to qualitatively and quantitatively describe the motion of interconnected rigid body systems so that they will be able to model, analyze and predict the behavior of complex mechanical systems such as mechanisms, machines, and robots.

Intended Learning Outcomes:

On successful completion of the course, the students should be able to;

- relate the law of conservation of linear momentum to the laws of mechanics as stated by Newton and the principle of conservation of angular momentum,
- derive the governing equations of a system that can be approximated as a systems of constrained particles including rigid bodies,
- find the representation of angular velocity of rotating frames both with respect to inertial, frames and body fixed frames and represent rigid rotations using Euler angles and unit quaternions,
- relate the modes of vibration to the physical behavior of systems in resonance.

Time Allocation (Hours) : Lectures 30, Assignments 30
(Notional Hours : 150)

Course content / Course description :

- **Concept of Space-Time and the relationship to inertial observers**: The description of motion in inertial frames
- **Conservation of Linear momentum and its relationship to Newton's Laws:** The concept of force; Conservation of angular momentum; Kinetic energy of particles; Moment of inertia; Moment of a force; Particle collisions and thermalization
- **Description of motion in moving frames**: The meaning of Einstein, Coriolis, Centrifugal, and Euler accelerations; Modeling of holonomically constrained particle motion in 3D; Rigid body equations
- The meaning of angular velocity; Properties of rigid rotations; Parameterization of the space of rotations using Euler angles and unit quaternions.
- Why does rotary motion give rise to vibrations, Forced motion of a spring mass damper system, Representation of the small amplitude motion of coupled mechanical systems using second order matrix ODEs
- Modal analysis of N-DOF coupled mechanical systems — Introduction to the method of Fourier analysis:

Recommended Texts (if any):

- Cohenn, M. (2012). *Classical Mechanics: a Critical Introduction*. Hindawi Publications. Cairo, Egypt.
- de Silva, C.W. (2017). *Modeling of Dynamic Systems with Engineering Applications*, (1st Edition). CRC Press, Florida, United States.
- Burton, T. D. (1994). *Introduction To Dynamic Systems Analysis*, McGraw-Hill, New York, USA.

Assessment	**Percentage Mark**
In-course	
Tutorials/Assignments/Quizzes/Practicals	30
Mid Semester Examination	20
End-semester: Written examination	50