Semester:	5				
Course Code:	ME3030				
Course Name:	Dynamics of Mechanical Systems				
Credits Value:	3 (Notional hours: 150)				
Pre-requisites:	EM1030				
Core/ Optional:	Core				
Hourly Breakdown	Lectures (hours)	Tutorials (hours)	Practical classes (hours)	Assignments (hours)	Independent Learning & Assessment (hours)
	30			30	90

Course Aim: 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 system 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.

Course Content:

- **Initial Frames:** Concept of Space-Time and the relationship to inertial observers; the description of motion in inertial frames
- **Momentum:** 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
- **Motion in non-inertial Frames**: Description of motion in moving frames; the meaning of Einstein, Coriolis, centrifugal, and Euler accelerations; modelling of holonomically constrained particle motion in 3D; Rigid body equations

- **Angular Velocity:** The physical meaning of angular velocity; properties of rigid rotations; parameterization of the space of rotations using Euler angles and unit quaternions.
- **Introduction to Vibration:** Vibration due to rotary motion, forced motion of a spring mass damper system, representation of the small amplitude motion of coupled mechanical systems using second order matrix ordinary differential equations (ODEs)
- **Modal analysis:** Modal analysis of n-degree of freedom coupled mechanical systems — Introduction to the method of Fourier analysis:

Teaching/ Learning Methods:
Classroom lectures, tutorials and in-class exercises and assignments

Assessment Strategy:

Continuous Assessment 50%		**Final Assessment** 50%		
Details:		Theory (%)	Practical (%)	Other (%)
Assignments/Quizzes	30%	50%		
Mid semester examination	20%			

Recommended Reading:

- B. Tatum, *Classical Mechanics*, E-Book available at http://astrowww.phys.uvic.ca/~tatum/classmechs.html
- Michael Cohenn (2012), *Classical Mechanics: a Critical Introduction, Hindawi Publications*, Open Access, Available Online at, https://www.hindawi.com/books/cm/
- Clarence W. de Silva (2017), *Modeling of Dynamic Systems with Engineering Applications* CRC Press.
- T. D. Burton (1994), *Introduction to Dynamic Systems Analysis, McGraw-Hill College*.