Course Number: 28046

Course Name: Advanced Dynamics

Course Type: Theory	Type & Max Unit: Constant 3
Prerequisite:	Corequisite: Nothing
Level: Graduate	First Presentation:
Group: Dynamics and Vibrations	Last Edition: 2017

Objectives:

This course teaches students how to derive and analyze the complex motion of 3D dynamical systems using Newton-Euler, Lagrange and Hamilton approaches.

Topics:

1- **Basic Concepts:** Particle Kinetics, Inertial Coordinates, Kinematics and Dynamics, Newton Laws, Gravity Law

2- **Kinematics:** Cartesian Coordinates, Normal-tangential Coordinates, Cylindrical and Spherical Coordinates, General Orthogonal Curvilinear Coordinates, Rotations, Rotating Coordinates, Velocity and Acceleration in Rotating Coordinates, Angular Velocity, Angular Acceleration, Euler Angles and Euler Parameters

3- **Newton Equations for Rigid Bodies:** Extension of Newton Second Law, Kinetic Energy and Momentum Relations to System of Particles, Inertial Matrix, Principle Axes, Rigid Bodies Equations of Motion, Newton- Euler Equations of Motion, Energy and Momentum Relations for Rigid Bodies, Impulse in Rigid Bodies, Gyroscope effects

4- **Analytical Dynamics:** Generalized Coordinates, Constraint Equations, Holonomic and Nonholonomic Systems, D'Alembert Principle, Virtual Work and Hamilton's Principle, Generalized Force, Lagrange Equations of Motion, Impulse Equations Using Lagrange, Euler Angles, Quasi-Coordinates, Hamilton's Principle, Legendre Transformation and Hamiltonian Function, Hamilton's Canonical Equations of Motion

References:

1- **JERRY H. GINSBERG, Advanced Engineering Dynamics, Second Edition, Transferred to digital printing 2010, Cambridge University Press.**

2- **Haim Baruh, Analytical Dynamics, 1999, McGraw-Hill.**

3- **Greenwood, D. T. (2003). Advanced Dynamics (p. 39). Cambridge: Cambridge University Press.**