

## ENGR 3004: Dynamics

This course is required for all engineering majors.

### Course Coordinator:

Tarek Abdel-Salam

### Catalog Description:

Fundamental topics in particle and rigid body dynamics. Planar kinematics of a particle. Planar kinetics of a particle: force and acceleration, work and energy, and impulse and momentum. Planar kinematics of a rigid body. Planar kinetics of a rigid body: force and acceleration, work and energy, and impulse and momentum.

### Course Structure:

Three 50-minute lectures (three credits)

### Prerequisites:

ENGR 2022, MATH 2153

### Required Materials:

1. Engineering Mechanics: Dynamics, 11<sup>th</sup> Edition. R.C. Hibbeler Prentice Hall 2007 ISBN: 0132215047.
2. Fundamental Of Engineering Supplied-Reference Handbook (p) NCEES, 7th edition, National Council of Engineering Examiners , ISBN: [1-932613-19-6](#).

Students are expected to have a laptop computer per engineering program requirements, with Microsoft Office and MATLAB software installed.

### Course Learning Outcomes:

Upon completion of this course, students shall be able to:

- Identify and formulate dynamics problems.
- Draw particle and rigid-body free body diagrams.
- Analyze particle and rigid body dynamics.
- Analyze dynamic forces on design elements using different techniques : force and acceleration, impulse and momentum, and work and energy.
- Apply knowledge of vectors, differentiation and integration to the solution of dynamics problems.

### Lecture Topics

- Rectilinear motion
- Curvilinear motion: Curvilinear Motion, Rectangular Components
- Curvilinear Motion: Normal and Tangential Components
- Absolute Dependent Motion, Analysis of Two Particles
- Newton's Laws of Motion.
- Kinetics of a particle: Force and Acceleration
- Rectangular Coordinates. Normal and Tangential Coordinates.
- Equation of Motion for a System of Particles.
- Equations of Motion: Cylindrical Coordinates
- Kinetics of a particle: Work and Energy
- Principle of Work and Energy for a System of Particles
- Power and Efficiency. Conservative Forces and Potential Energy.
- Kinetics of a particle: Impulse and Momentum
- Principle of Linear Impulse and Momentum.
- Conservation of Linear Momentum for a System of Particles.
- Kinematics of a Rigid Body: General Plane Motion Analysis.
- Relative-Motion Analysis: Velocity Kinematics of a rigid body
- Instantaneous Center of Zero Velocity.
- Relative-Motion Analysis: Acceleration. Relative-Motion Analysis Using Rotating Axes
- Moment of Inertia. Planar Kinetic Equations of Motion

- Equations of Motion: Translation. Equations of Motion: Rotation About a Fixed Axis.
- Kinetics of a Rigid Body: Work and Energy
- Kinetic energy, the work of a force, the work of a couple, conservation of energy
- Kinetics of a Rigid Body: Impulse and Momentum
- Impact. Angular Momentum.
- Relation Between Moment of a Force and Angular Momentum.

Laboratory/Recitation Topics:

- Solving curvilinear motion of particles problems with MATLAB( 2 labs)
- Solving motion of projectiles problems with MATLAB(2 labs)
- Solving relative motion of particles problems with MATLAB
- Solving Newton's second law analysis problems with MATLAB
- Solving general motion of rigid bodies problems with MATLAB
- Solving power, work, energy problems of particles and rigid bodies with MATLAB (2labs)

Relevant Program Outcomes:

Graduates of the Engineering Program will demonstrate

- a) an ability to apply knowledge of mathematics, science and engineering.
- e) an ability to identify, formulate, and solve engineering problems.

Professional Component Content:

Math/Science: 0; Engineering: 3 credits; General Education: 0

Assessment Requirements:

Targeted Exam Questions

- Application of physics of mechanics (outcome a)
- Solution of engineering problems(outcome e)

Student Course Survey

Last Review:

Feb 5, 2008 by Tarek Abdel-Salam