Montgomery County Community College
EGR 204
Engineering Dynamics
3-2-2

COURSE DESCRIPTION:
This course is a vector approach to the study of the rectilinear and curvilinear motion of particles and rigid bodies as described by rectangular, polar, and path coordinates and the study of the forces that produce such motion as described through the application of Newton's second law of motion, work-energy relationships, and impulse and momentum principles, including rigid body rotation and relative motion. This course is subject to a course fee. Refer to http://mc3.edu/adm-fin-aid/paying/tuition/course-fees for current rates.

REQUISITES:
*Previous Course Requirements*
- EGR 203 Engineering Statics

*Concurrent Course Requirements*
- MAT 201 Calculus and Analytic Geometry II

| LEARNING OUTCOMES Upon successful completion of this course, the student will be able to: | LEARNING ACTIVITIES | EVALUATION METHODS |
|---|---|---|
| 1. Apply the concepts of position, velocity, and acceleration to determine motion along a straight line, to represent the same graphically, and to characterize particle motion along a straight line using different coordinate systems. Analyze dependent motion of two particles and to be able to describe the principles of relative motion of two particles using translating axes. | Lecture<br>Problem Solving Assignments<br>Design of Experiments | Section Examination<br>Design of Experiments Review |

| LEARNING OUTCOMES | LEARNING ACTIVITIES | EVALUATION METHODS |
|---|---|---|
| 2. Apply Newton's Laws of Motion and Gravitational Attraction to define mass and weight, to analyze the accelerated motion of a particle using the equation of motion with different coordinate systems, and to investigate central-force motion and apply it to problems in space mechanics. | Lecture<br>Problem-Solving Assignments<br>Design of Experiments | Section Examination<br>Design of Experiments Review |
| 3. Apply the principle of work and energy to solve problems involving force, velocity, displacement, power and efficiency including those involving conservative forces and the theorem of conservation of energy. | Lecture<br>Problem-Solving Assignments<br>Design of Experiments | Section Examination<br>Design of Experiments Review |
| 4. Apply the principles of impulse and momentum for a particle to solve problems involving conservation of linear momentum for particles, direct and oblique collisions, linear and angular impulse and momentum, and steady fluid streams and propulsion with variable mass. | Lecture<br>Problem-Solving Assignments<br>Design of Experiments | Section Examination<br>Design of Experiments Review |

| LEARNING OUTCOMES | LEARNING ACTIVITIES | EVALUATION METHODS |
|---|---|---|
| 5. Identify the various types of rigid-body planar motion, rigid-body translation, and motion about a fixed axis, and produce a relative motion analysis of velocity and acceleration using translating and rotating frames of reference, including the identification of the instantaneous center of zero velocity and the velocity of a point on a body. | Lecture<br>Problem-Solving Assignments<br>Design of Experiments | Section Examination<br>Design of Experiments Review |
| 6. Determine the mass moment of inertia of a body by applying the planar kinetic equations of motion for a symmetric rigid body, including bodies undergoing translation and rotation about a fixed axis and general plane motion. | Lecture<br>Problem-Solving Assignments<br>Design of Experiments | Section Examination<br>Design of Experiments Review |
| 7. Apply the principles of work and energy to solve rigid-body planar kinetic problems that involve force, velocity, and displacement and show how the conservation of energy can be used to solve the same. | Lecture<br>Problem-Solving Assignments<br>Design of Experiments | Section Examination<br>Design of Experiments Review |

| LEARNING OUTCOMES | LEARNING ACTIVITIES | EVALUATION METHODS |
|---|---|---|
| 8. Apply the principles of linear and angular impulse and momentum to solve rigid-body planar kinetic problems that involve force, velocity, and time, including those involving the conservation of momentum. | Lecture<br>Problem-Solving Assignments<br>Design of Experiments | Section Examination<br>Design of Experiments Review |

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria*.

SEQUENCE OF TOPICS:

**1. Kinematics of Particles**
- a. Rectilinear Motion of Particles
- b. Special Cases and Relative Motion
- c. Curvilinear Motion of Particles
- d. Non-Rectilinear Components

**2. Kinetics of Particles: Newton's Second Law**
- a. Newton's Second Law and Linear Momentum
- b. Angular Momentum and Orbital Motion

**3. Kinetics of Particles: Energy and Momentum Methods**
- a. Work and Energy
- b. Conservation of Energy
- c. Impulse and Momentum
- d. Impacts

**4. Systems of Particles**
- a. Applying Newton's Second Law and Momentum Principles to Systems of Particles
- b. Energy and Momentum Methods for a System of Particles

**5. Kinematics of Rigid Bodies**
- a. Translation and Fixed Axis Rotation
- b. General Plane Motion: Velocity
- c. Instantaneous Center of Rotation
- d. General Plane Motion: Acceleration
- e. Analyzing Motion with Respect to a Rotating Frame

**6. Plane Motion of Rigid Bodies: Forces and Accelerations**
- a. Kinetics of a Rigid Body
- b. Constrained Plane Motion

**7. Plane Motion of Rigid Bodies: Energy and Momentum Methods**

a. Energy Methods for a Rigid Body
b. Momentum Methods for a Rigid Body
c. Eccentric Impact

**8. Kinetics of Rigid Bodies in Three Dimensions**

a. Energy and Momentum of a Rigid Body

LEARNING MATERIALS:
Present selected text:
Beer, F.P., Johnston, E.R. Jr., Mazurek, D.F., Eisenberg, E.R. (2010). *Vector Mechanics for Engineers: Statics and Dynamics* (9th Ed.). McGraw-Hill.

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

COURSE APPROVAL:

Prepared by: William Brownlowe Date: 3/1/2004
VPAA/Provost Compliance Verification: Dr. John C. Flynn, Jr. Date: 6/9/2004

Revised by: Dr. David Brookstein, Dean for STEM Date: 3/8/2013
VPAA/Provost or designee Compliance Verification:
Victoria L. Bastecki-Perez, Ed.D. Date: 4/16/2013

Revised by: Chengyang Wang, Ph.D. Date: 12/21/2017
VPAA/Provost or designee Compliance Verification: Date: 1/10/2018

*This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.*