Date: March 2006

I. Course Name: Mechanics II (Dynamics)
Course Prefix and Number: ESC 212
Credit Hours and Contact Hours: 3 credit hours – 3 contact hours
Course Description:
This course is the second semester of a two-semester sequence in Engineering Mechanics. It presents the fundamental laws of Newtonian dynamics for particles and rigid bodies, provides a rigorous methodology for solution of problems, and presents a wide variety of examples of application. The course relies heavily on the use of vectors and vector algebra. Subject areas discussed are kinematics of particles including rectilinear, relative and curvilinear motion; kinetics of particles including Newton's Laws, dynamic equilibrium, angular momentum, work, energy principle, conservation of energy, and impulse-momentum; kinematics of rigid bodies including Newton's Laws, angular momentum, plane motion, work and energy; introduction to vibrations (time permitting).
Prerequisites: ESC 211

II. COURSE OUTCOMES AND OBJECTIVES

Student Learning Outcomes

Upon completion of the course the student will be able to:

- Calculate the velocity and acceleration of a particle from a given initial condition using the rectangular, polar, or the local orthogonal coordinate systems.
  Determine the complete motion of a particle resulting from an application of a system of forces, using Newton's Laws of motion, or the energy and/or momentum principles.
- Calculate the velocity and acceleration of a point on a rigid body exhibiting either a translational, rotational, or general plane motion.
- Determine the complete motion of a rigid body resulting from an application of a system of forces, using Newton's Laws of motion, or the energy and/or momentum principles.
- Determine the orbit equation for a satellite from the knowledge of the burnout position and velocity.

Relationship to Academic Programs and Curriculum

This course is primarily a technical elective course for the A.S. in Engineering Science program. It is designed for students who wish to pursue a baccalaureate degree in Aerospace, Mechanical, Civil, Environmental, or Electrical Engineering. Other students from other programs may also take the course if they have the appropriate background.

Competencies Addressed in this Course

Competency:	Taught	Practiced	Not Addressed
Writing		*	
Oral Communication		*	
Reading		*	
Mathematics	*		
Computer Literacy	*		
Professional Competency	*		
Problem Solving	*		
Ethics and Values		*	
Citizenship			*
Global Concerns			*
Information Resources		*	

III. PROCEDURES

Course Materials
Current edition of Beer and Johnston, "Vector Mechanics for Engineers - Statics and Dynamics" is used as the textbook. Instructor notes are used as the supplemental source of information for the course content.

Each student is required to have a calculator (a minimum of TI-83 or equivalent).

A course website is maintained on the internet for lecture schedule, test solutions, and other supplemental learning material.

Methods of Instruction
Main avenue for conveying knowledge to the student is the lectures. They are presented in the traditional way, using whiteboard, models, material samples, slides, film, or computer.

In addition to the presentation of the subject matter, lectures also involve class discussion.

Although it is not required, team work among the students is always encouraged, since exchange of ideas creates a more stimulating learning environment.

Assessment Measures
The assessment methods for this course are based on the homework, project, and test results of the students.

Methods of Evaluation
The students are evaluated based on homework, tests, and a final exam.

Attendance, punctuality, class participation are employed to determine final letter in borderline cases between two letter grades.

IV. COURSE OUTLINE

Kinematics of Particles

- Introduction, rectilinear motion of particles, position, velocity, acceleration.
- Uniform and uniformly accelerated rectilinear motions, motion of several particles, dependent motions.
- Curvilinear motion of particle, derivatives of vector functions, rectangular components of velocity and acceleration, projectile motion.
- Motion relative to a frame in translation, tangential and normal components of curvilinear motion.
- Radial and transverse components of curvilinear motion.

Kinetics of Particles: Newton's Second Law

- Kinetics of Particles: Newton's second law, linear momentum, equations of motion - rectilinear components, normal & tangential components.
- Angular momentum, equations of motion - radial & transverse components, motion under central force, Newton's law of gravity.
- Trajectory of a particle under central force, application to space mechanics.

Kinetics of Particles: Energy and Momentum Methods

- Kinetics of Particles: Energy method; work of a force, kinetic energy of a particle, work & energy principle.
- Potential energy, conservative forces, conservation of energy.
- Kinetics of particles: Momentum method; principle of impulse and momentum, impulsive motion.
- Impact, direct and oblique central impact, problems involving energy and momentum.

Systems of Particles

- Systems of particles: Application of Newton's law, linear and angular momentum, motion of the mass center.
- Work-energy, conservation of energy, impulse-momentum principles for a system of particles.
- Variable systems of particles, steady stream of particles, systems gaining or losing mass.

Kinematics of Rigid Bodies

- Kinematics of rigid bodies: translation, rotation about a fixed axis.
- General plane motion, absolute and relative velocity in plane motion.
- Instantaneous center of rotation in plane motion.
- Absolute and relative acceleration in plane motion.
- Plane motion of a particle relative to a rotating frame, Coriolis acceleration.

Plane Motion of Rigid Bodies: Forces and Accelerations

- Equations of motion for a rigid body in plane motion.
- Constrained plane motion.
- Principle of work and energy for the plane motion of a rigid body.
- Principle of impulse and momentum for the plane motion of a rigid body.