MOHAWK VALLEY COMMUNITY COLLEGE

UTICA AND ROME, NEW YORK

COURSE OUTLINE

ENGINEERING DYNAMICS

ES272

REVIEWED AND FOUND ACCEPTABLE ***04/24/2017***

I. CATALOG DESCRIPTION:

ES272 ENGINEERING DYNAMICS C-3, Cr-3

This calculus-based course uses the vector approach to deal with kinematics and kinetics of particles and rigid bodies.

Pre-requisites: MA253 Calculus 3   
ES271 Engineering Statics

II. STUDENT LEARNING OUTCOMES

1. Solve problems involving the kinematics of a particle in three-dimensional space, by resolution of the motion into rectangular, normal and tangential, or radial and transverse components.

2. Solve problems involving the kinetics of a particle, by the application of Newton's Second Law, using rectangular, normal and tangential, or radial and transverse components.

3. Calculate the angular momentum of a particle in three dimensions about any point.

4. Solve satellite motion problems, using the equation of the conic section.

5. Solve problems involving the kinetics of a particle using energy and momentum methods, as well as central-force problems using conservation of energy and angular momentum.

6. Calculate the total momentum and the total angular momentum about any point of a system of many particles.

7. Calculate the location of the center of mass of a system of many particles.

8. Relate the total force on a system of particles to the total momentum of that system, and relate the total moment on a system about a fixed point or the center of mass to the total angular momentum of the system about that point.

9. Resolve problems involving forces and changes in velocity for streams of particles and variable-mass systems.

10. Solve problems involving the kinematics of a rigid body in translational motion, in rotation about a fixed axis, in general plane motion, in general motion about a fixed point, and in general motion in three dimensions.

11. Solve problems involving the kinetics of a rigid body in general plane motion, by application of Newton's Second Law.

12. Calculate the total kinetic energy of a rigid body.

13. Solve problems involving the kinetics of a rigid body in general plane motion using energy and momentum methods.

14. Relate the coefficient of restitution during a collision to the impulses of restitution and deformation, as well as the relative velocities of the contact points after and before the collision.

III. DETAILED COURSE OUTLINE:

I. Kinematics, 2nd Law, and Energy

A. Kinematics of a Particle

1. Velocity and acceleration in rectilinear motion

2. Curvilinear motion

3. Rectangular components

4. Normal and tangential components

5. Radial and transverse components

B. Kinetics of a Particle

1. Newton's Laws of Motion

2. Angular momentum

3. Conservation of angular momentum

4. Space mechanics

5. Kepler's Laws of Planetary Motion

C. Energy Methods

1. Work

2. Kinetic energy of a particle

3. Potential energy of a particle

4. Power

5. Space mechanics

TEST

II. Momentum, Systems, Beginning Rigid Bodies

A. Momentum Methods

1. Linear impulse and momentum

2. Impulse-Momentum Theorem

3. Conservation of momentum

4. Coefficient of restitution

B. Lagrangian Dynamics

1. Calculus of Variation

2. Generalized Coordinates

3. Euler-Lagrange Equation

C. Systems of Particles

1. Newton's Laws of Motion

2. Total momentum

3. Total angular momentum

4. Center of mass

5. Total kinetic energy

6. Stream of particles

7. System changing mass

D. Kinematics of Rigid Bodies

1. Translational motion

2. Rotation about a fixed axis

3. Velocity in general plane motion

4. Instantaneous center of rotation

5. Acceleration in general plane motion

6. General motion about a fixed point

7. General motion of a rigid body

E. Kinetics of Rigid Bodies

1. Newton's Laws of Motion

2. Moment of inertia

3. General plane motion for a body symmetric with respect to a central representative slab staying in that plane

TEST

III. Energy and Momentum of Rigid Bodies and 3D Rigid Bodies

A. Energy and Momentum Methods

1. Work

2. Total kinetic energy

3. Power

4. Impulse-Momentum Theorem

5. Angular Impulse- Angular Momentum Theorem

6. Eccentric collisions

7. Center of percussion

B. Kinetics of 3D

1. Angular Momentum

2. Impulse and Momentum

3. Kinetic Energy

4. Motion in 3D

5. Euler’s Equations

6. Motion about a fixed point and a fixed axis