## ME 2202 Dynamics of Rigid Bodies (Required)

**Catalog Description:** ME 2202 Dynamics of Rigid Bodies (3-0-3)
Prerequisites: COE 2001 Statics
Kinematics and dynamics of particles and rigid bodies in one, two, and three dimensions. Work-energy and impulse-momentum concepts.

**Textbook:** David J. McGill and Wilton W. King, *Engineering Mechanics*, *An Introduction to Dynamics,* 4th Edition, Tichenor Publishing, 2003. (Custom published for Georgia Tech. This book can only be obtained from the bookstore.)

**Topics Covered:**

1. Particle motion
2. Planar kinematics of rigid bodies
3. Newton-Euler analysis of planar rigid body systems
4. Angular velocity in three dimensions
5. Angular acceleration in three dimensions
6. Euler angles
7. Rotation matrices
8. Angular momentum
9. Inertia properties
10. Principal moments and axes of inertia
11. Euler equations
12. Impact; Impulse-momentum relations for rigid bodies
13. Work-Energy analysis of conservative and nonconservative rigid body systems

**Course Outcomes:**

Outcome 1: To teach students the basic principles underlying the dynamics of rigid bodies in planar and 3D motion

1.1 Students will demonstrate an understanding of Newtonian-Eulerian physics and basic equations underlying kinematics and kinetics of rigid bodies in 2D and 3D motion.

Outcome 2: To educate students to identify, formulate and solve engineering problems in rigid body dynamics.

2.1 Students will demonstrate the ability to isolate rigid bodies and to draw clear and appropriate free body diagrams.
2.2 Students will demonstrate an ability to identify kinematic and kinetic knowns and unknowns.
2.3 Students will demonstrate an ability to identify and effectively account for kinematic constraints such as rolling and/or sliding, and their kinetic consequences.
2.4 Students will demonstrate that they can apply the appropriate principles referred to in Objective 1 to the solution of problems.
2.5 Students will demonstrate that they can combine the appropriate principles referred to in Objective 1 in the solution of problems.
2.6 Students will demonstrate that they can determine the mass moments and products of inertia for arbitrary rigid bodies.
2.7 Students will demonstrate that they can calculate the principal coordinates and the principal moments of inertia for arbitrary rigid bodies.

Outcome 3: To introduce students to the concepts of work-energy and impulse-momentum for rigid body systems.

3.1 Students will demonstrate an understanding of work-energy principles as applied to rigid bodies in 2D and 3D motion.
3.2 Students will be able to evaluate the kinetic energy of rigid bodies as well as the potential energy associated with gravity and spring forces.
3.3 Students will demonstrate an understanding of conservation laws for momentum and energy.
3.4 Students will demonstrate an ability to apply impulse-momentum relations where appropriate.
3.5 Students will demonstrate that they can utilize coefficient of restitution data in the solution of impact problems in rigid-body dynamics.

**Correlation between Course Outcomes and Program Educational Outcomes:**

| ME 2202 | | | | | | | | | | | | |
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| | Mechanical Engineering Program Educational Outcomes | | | | | | | | | | | |
| Course Outcomes | a | b | c | d | e | f | g | h | i | j | k | l |
| Course Outcome 1.1 | X | | | | X | | | | | | X | |
| Course Outcome 2.1 | X | | | | X | | | | | | X | |
| Course Outcome 2.2 | X | | | | X | | | | | | X | |
| Course Outcome 2.3 | X | | | | X | | | | | | X | |
| Course Outcome 2.4 | X | | | | X | | | | | | X | X |
| Course Outcome 2.5 | X | | | | X | | | | | | X | X |
| Course Outcome 2.6 | X | | | | X | | | | | | X | |
| Course Outcome 2.7 | X | | | | X | | | | | | X | |
| Course Outcome 3.1 | X | | | | X | | | | | | X | |
| Course Outcome 3.2 | X | | | | X | | | | | | X | |
| Course Outcome 3.3 | X | | | | X | | | | | | X | |
| Course Outcome 3.4 | X | | | | X | | | | | | X | |
| Course Outcome 3.5 | X | | | | X | | | | | | X | |

Prepared by: Wayne Whiteman