ME 2205 Dynamics of Rigid Bodies in Three Dimensional Motion

Catalog Description: ME 2205 Dynamics of Rigid Bodies (1-0-1)

Prerequisites: COE 2001 Statics (C or better), CEE 2040 Dynamics or equivalent

Kinematics and kinetics of rigid bodies in three-dimensional motion. Euler angles and rotational transformation matrices, inertia matrices and properties. Newton-Euler equations; 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 GT Barnes and Noble bookstore.)

Topics Covered:

1. Newton-Euler analysis of planar rigid body systems
2. Angular velocity in three dimensions
3. Angular acceleration in three dimensions
4. Euler angles
5. Rotation matrices
6. Angular momentum
7. Inertia properties
8. Principal moments and axes of inertia
9. Euler equations – 3D rotational motion of rigid bodies
10. Impact – impulse-momentum principles for rigid bodies
11. Work-energy analysis of conservative and nonconservative rigid body systems

Course Objective:

Objective 1: To teach students who already have competence with planar rigid-body dynamics the basic principles of dynamics of rigid bodies in 3D motion.

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

Objective 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 and combine 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 to 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.

Objective 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 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 Student Outcomes:

ME 2205											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
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
Course Outcome 2.5	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

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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