AAE 50700: Principles of Dynamics

Credit Hours	3
Offered	Fall
Pre-requisites	AAE 340; or graduate standing
Co-requisites	None
Instructional Method	3 hours of lecture per week
Required	Yes

1. Course Description

This course is about deriving and understanding of dynamic principles with a focus on orbital dynamics. It begins with Lagrange's equations. Analytical solutions for rigid body dynamics reveal the behavior of the system to the student and clarify the meaning of the equations of motion. Finally, the student is introduced to the elegant and powerful concepts of the variational principles of dynamics.

2. Instructor Information

Prof. James Longuski

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ARMS 3220

3. Topics Covered

- Lagrange's Equations: degrees of freedom; generalized coordinates and quasi-coordinates; holonomic and non-holonomic constraints; virtual work; integrals of the motion

- Rigid Body Dynamics and Analytical Solutions: Euler's equations of motion; free motion; the Poinsot method; motion of a top; motion with body-fixed torques
- Spacecraft Dynamics: analytical solutions for the thrusting-spinning rocket; two-burn scheme for angular momentum vector control
- Introduction to Variational Principles of Mechanics: the calculus of variations; the Brachistochrone problem, Euler-Lagrange equations; Hamilton's principle for holonomic systems

4. Intended Learning Outcomes

Upon completing this course, the student shall know how to apply Lagrange's equations to fundamental problems of dynamics to:

- Solve rigid body motion and gauge the problem solution and its solution space,
- Formulate and solve open-ended dynamics problems,

5. Assessment Method

Weekly homework assignments, three in-class midterm exams, final project

6. Relation to ABET Outcomes

	Program Learning Outcomes	Included?
1.	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	Yes
2.	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	No
3.	An ability to communicate effectively with a range of audiences.	No
4.	An ability to recognize ethical and professional responsibilities in engineering situations and make	No

	informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	
5.	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	No
6.	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	No
7.	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	Yes