THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Flight Vehicle Dynamics

AEROENG 3520

Credit Hours:
3.00

Course Levels:
Undergraduate (1000-5000 level)

Course Components:
Lecture

Course Description:
Introduction to mathematical modeling of dynamics (equations of motion) for rigid bodies with specific application towards aircraft and spacecraft.

Prerequisites and Co-requisites:
Prereq: 2200, and enrollment as AeroEng-BS student (No pre-majors can enroll in this course). Prereq or concur: MechEng 2030.

Course Goals / Objectives:
- Educate students about the fundamental principles in developing equations of motions for physical systems
- Enable students to use basic tools of rigid body motion
- Train students to develop mathematical models specifically for aircraft motion and spacecraft motion

Course Topics:

- Fundamental Principles of Developing Math Models for Physical Systems
- Equations of Motion for a Rigid Body (two and three Dimensional motion), Coordinate Transformations
- Equations of Motion for Aircraft, Stability Axes, Aircraft Forces and Moments
- Aircraft Static Stability; Stick Fixed Neutral point; Stick Free analysis; Stick Forces and Stick Force Gradient; Lateral/Directional static stability; Engine Out situation and Minimum Control Speed
- Dynamic Stability Analysis;Linearized Longitudinal and Lateral/Directional Equations of Motion for Aircraft, Significance of Stability Derivatives
- Short Period, Phugoid (Longitudinal); Dutch Roll, Roll Subsidence, Spiral convergence/divergence (Lateral/Directional) Approximations; Damping ratio, natural frequency calculations
- Equations of Motion for Spacecraft, Two Body and Central Force Motion in Gravitational field
- Attitude dynamics of rigid axisymmetric and general bodies, principal body axes; characteristics of torque free motion, nutation, precession and spin.
- Attitude Dynamics of rigid spacecraft, Euler’s angles and quaternions, Gravitational torques, linearized equations of motion
- Spacecraft external and internal disturbances modeling, actuation configurations for attitude and orbit control
- Attitude Dynamics of Spacecraft: Full-scale, short period and long period approximations, computer simulations via MATLAB
- Maneuvering of rigid spacecraft: Gyroscopic behavior; pointing; reaction wheels and control moment gyros; uncoupled dynamics attitude maneuver and control; thruster configurations, pulse width modulation, fuel and power consumptions
- Gyroscopic dynamics as an instrument of attitude measurement and control for flight vehicles, rate and integrating gyros; Inertial navigation principles

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Designation:
Required