Flight Vehicle Dynamics

AEROENG 3520

Description / Conditions

Transcript Abbreviation:
Ft Dyn

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

Course Levels:
Undergraduate (1000-5000 level)

Designation:
Required

General Education Course:
(N/A)

Cross-Listings:
(N/A)

Course Detail

Credit Hours (Minimum if “Range”selected):
3.00

Max Credit Hours:
(N/A)

Select if Repeatable:
Off
Maximum Repeatable Credits:
(N/A)

Total Completions Allowed:
(N/A)

Allow Multiple Enrollments in Term:
No

Course Length:
14 weeks (autumn or spring)
12 weeks (summer only)

Off Campus:
Never

Campus Location:
Columbus

Instruction Modes:
In Person (75-100% campus; 0-24% online)

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.

Electronically Enforced:
No

Exclusions:
(N/A)

Course Goals and Learning Objectives

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

Check if concurrence sought:
No

Contact Hours
## Contact Hours:

<table>
<thead>
<tr>
<th>Topic</th>
<th>LEC</th>
<th>REC out-of-class</th>
<th>REC in-class</th>
<th>Weekly LAB out-of-class</th>
<th>Weekly LAB in-class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental Principles of Developing Math Models for Physical Systems</td>
<td>3.0</td>
<td>3.0</td>
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<tr>
<td>Equations of Motion for a Rigid Body (two and three Dimensional motion), Coordinate Transformations</td>
<td>3.0</td>
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<tr>
<td>Equations of Motion for Aircraft, Stability Axes, Aircraft Forces and Moments</td>
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<tr>
<td>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</td>
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<tr>
<td>Dynamic Stability Analysis; Linearized Longitudinal and Lateral/Directional Equations of Motion for Aircraft, Significance of Stability Derivatives</td>
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<tr>
<td>Short Period, Phugoid (Longitudinal); Dutch Roll, Roll Subsidence, Spiral convergence/divergence (Lateral/Directional) Approximations; Damping ratio, natural frequency calculations</td>
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<tr>
<td>Equations of Motion for Spacecraft, Two Body and Central Force Motion in Gravitational field</td>
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<td>Attitude dynamics of rigid axisymmetric and general bodies, principal body axes; characteristics of torque free motion, nutation, precession and spin.</td>
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<tr>
<td>Attitude Dynamics of rigid spacecraft, Euler’s angles and quaternions, Gravitational torques, linearized equations of motion</td>
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<tr>
<td>Spacecraft external and internal disturbances modeling, actuation configurations for attitude and orbit control</td>
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<tr>
<td>Attitude Dynamics of Spacecraft: Full-scale, short period and long period approximations, computer simulations via MATLAB</td>
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<tr>
<td>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</td>
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<td>Gyroscopic dynamics as an instrument of attitude measurement and control for flight vehicles, rate and integrating gyros; Inertial navigation principles</td>
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**Grading and Texts**

**Grading Plan:**
Letter Grade

**Course Components:**
Lecture

**Grade Roster Component:**
Lecture

**Credit by Exam (EM):**
No
Grades Breakdown:

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Midterm exams (2)</td>
<td>50%</td>
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<tr>
<td>Final exam</td>
<td>35%</td>
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Representative Textbooks and Other Course Materials:

<table>
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<tr>
<th>Title</th>
<th>Author</th>
<th>Year</th>
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<tbody>
<tr>
<td>No Textbooks and Other Course Materials Entered.</td>
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</table>

ABET Student Learning Outcomes

ABET-CAC Criterion 3 Outcomes:
(N/A)

ABET-ETAC Criterion 3 Outcomes:
(N/A)

ABET-EAC Criterion 3 Outcomes:

| Substantial contribution (3-6 hours) | 1 | an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics |
| Some contribution (1-2 hours) | 4 | an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts |
| Some contribution (1-2 hours) | 7 | an ability to acquire and apply new knowledge as needed, using appropriate learning strategies |

Embedded Literacies (UG courses only)

Embedded Literacies Info:
Attachments / Additional Notes or Comments

Attachments:
(N/A)

Additional Notes or Comments:
(N/A)