Fundamental Astronautics

AEROENG 3522

Description / Conditions

Transcript Abbreviation: Astronautics

Course Description:
This course will present a conceptual understanding of different types of orbits in space that arise under the laws of gravitational motion, basics of preliminary orbit determination, design of maneuvers among orbits of different types, a preliminary understanding of perturbations in space, preliminary space propulsion and the patched conics approach for interplanetary mission design.

Course Levels:
Undegraduate (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:
3.00
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)

Off Campus:
Never

Campus Location:
Columbus

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

Prerequisites and Co-requisites:

Electronically Enforced:
No

Exclusions:
(N/A)

Course Goals and Learning Objectives

Course Goals / Objectives:
Conceptually understand and distinguish between different types of orbits in space that arise under the laws of gravitational motion.
Design maneuvers for transferring spacecraft from one orbit to another
Perform preliminary orbit determination
Understand the causes and consequences of perturbations in space
Perform preliminary design of interplanetary missions
Understand principles of propulsion in the space environment and integration of the propulsive system into mission and vehicle design
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>Newtonian particle mechanics, law of gravitation</td>
<td>3.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Keplerian motion (two body problem), geometry of conics, integrals of motion, Kepler's laws</td>
<td>4.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<tr>
<td>Orbital elements</td>
<td>2.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>r v/s t, Kepler's equation</td>
<td>4.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<tr>
<td>Numerical solution for two body problem</td>
<td>2.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
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<tr>
<td>F-G solution, Universal variables for the two body problem</td>
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<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<tr>
<td>Orbit in 3 dimensions</td>
<td>3.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<tr>
<td>Orbital maneuvers: Hohmann/bielliptic maneuvers, phase/apse/plane change</td>
<td>6.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<tr>
<td>Orbital perturbations: oblateness, drag, third-body effects, solar radiation pressure</td>
<td>3.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<tr>
<td>Preliminary orbit determination, Gibbs method and the Lambert's problem</td>
<td>3.0</td>
<td>0.0</td>
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<tr>
<td>Interplanetary trajectories: spheres of influence, patched conics</td>
<td>4.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Thrusters for various missions</td>
<td>2.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<tr>
<td>Low thrust maneuvers: climbs and plane change</td>
<td>3.0</td>
<td>0.0</td>
<td>0</td>
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</table>
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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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Midterm exams (2)</td>
<td>50%</td>
</tr>
<tr>
<td>Final exam</td>
<td>40%</td>
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</tbody>
</table>

Representative Textbooks and Other Course Materials:

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbital Mechanics for Engineering Students</td>
<td>Howard D. Curtis</td>
<td></td>
</tr>
<tr>
<td>Spacecraft propulsion</td>
<td>Charles D. Brown</td>
<td></td>
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</table>

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

### ABET-ETEC Criterion 3 Outcomes:
(N/A)

### ABET-EAC Criterion 3 Outcomes:

<table>
<thead>
<tr>
<th>Significant contribution (7+ hours)</th>
<th>1</th>
<th>an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some contribution (1-2 hours)</td>
<td>2</td>
<td>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</td>
</tr>
<tr>
<td>Some contribution (1-2 hours)</td>
<td>3</td>
<td>an ability to communicate effectively with a range of audiences - pre-2019 EAC SLO (g)</td>
</tr>
<tr>
<td>Some contribution (1-2 hours)</td>
<td>4</td>
<td>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</td>
</tr>
<tr>
<td>Some contribution (1-2 hours)</td>
<td>5</td>
<td>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</td>
</tr>
<tr>
<td>Significant contribution (7+ hours)</td>
<td>7</td>
<td>an ability to acquire and apply new knowledge as needed, using appropriate learning strategies</td>
</tr>
</tbody>
</table>

### Embedded Literacies (UG courses only)

**Embedded Literacies Info:**

### Attachments / Additional Notes or Comments

**Attachments:**
(N/A)

**Additional Notes or Comments:**
(N/A)