Fundamentals of Flight Vehicle Control

AEROENG 3521

Course Description:
Linear dynamic systems analysis using Transfer function (Laplace Transformation based) methods and State Space (matrix theory based) methods with emphasis on aircraft and spacecraft models.

Course Goals / Objectives:
Understanding and appreciation of common features of linear time-invariant (LTI) systems encountered in various engineering disciplines
Obtain the responses of LTI systems and quantify their performances both within open-loop and closed-loop environments
Cast various mechanical, aerospace, electrical and electro-mechanical systems into forms amenable to the methods they learn in this course
Identification of characteristic parameters of LTI's from the studies of experimental/test responses
Course Topics:

- Fundamentals of dynamic systems
- Review of solution of differential equations by the Laplace transform methods
- Block-Diagram Algebra
- First-order Linear (LTI) systems Vehicle Simulations: Aircraft lateral and longitudinal dynamics simulations via transfer functions and MATLAB; Spacecraft attitude and rendezvous dynamics simulations via transfer functions and MATLAB
- (LTI) Frequency-domain (Frequency Response) specifications. Connection between time domain and frequency domain, specifications and Bode plots. MATLAB Utility functions; Stability of LTI systems – Routh-Hurwitz criterion; Root Locus Technique
- Multivariable (LTI) systems - State space (Time-domain) representation: The connection between state space and transfer function viewpoints, State-space Transition and Response by simulation; MATLAB Utility functions;
- Vehicle Simulations: Aircraft lateral and longitudinal dynamics simulations via state-space and MATLAB; Spacecraft attitude and rendezvous dynamics simulations via state-space and MATLAB
- Introduction to Digital systems: discrete difference equations, z-transform, sample and hold discrete systems; block diagramming and open and closed-loop transfer functions, z-transform inversion, frequency domain in the z-plane.
- Response to random inputs: Mean, variance, RMS, Fourier transform, Power spectral density, mean square response to random inputs, gust and launch responses, MATLAB utility functions

Grades Breakdown:

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<th>Aspect</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
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<tr>
<td>Midterm exams (2)</td>
<td>50%</td>
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<tr>
<td>Final exam</td>
<td>30%</td>
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Designation:
Required
**Instruction Modes:**
In Person (75-100% campus; 0-24% online)

**Representative Textbooks and Other Course Materials:**

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<thead>
<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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