

AE 200 – Engineering Analysis and Control of Aerospace Systems

Instructor Info	Dr. Kamran Turkoglu Office Location: ENG 272C Office Hours: Monday 4:00pm – 6:30pm Email: kamran.turkoglu@sjsu.edu
Credit	3 units
Class Days / Time	Tuesday, 6:00pm – 8:45pm
Classroom	CL 222
Prerequisites	BSc degree in Aerospace Engineering
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Description

Engineering analysis and control; Linear algebra; Ordinary differential equations; Laplace Transformation; Complex analysis; Singular values; Matrix perturbations; and observability; Feedback stabilization; H₂ and H-infinity optimization.

Goals

- Outline engineering analysis problems with emphasis on advanced level mathematics and control theory and aerospace systems.
- Investigate of aerospace systems that evolve with time. Typically these systems have inputs and outputs; it is of interest to understand how the input affects the desired output).
- In particular, concentrate on systems that can be modeled by Ordinary Differential Equations (ODEs), and that satisfy certain linearity and time-invariance conditions.

Learning Objectives

Students completing AE200 should be able to:

- Outline analysis skills in real and functional analysis, complex analysis methods.
- Investigate the response of these systems to inputs and initial conditions from the control theory perspective.
- Analyze systems obtained as interconnections (e.g., feedback) of two or more other systems.
- Derive (control) systems (and properties) that ensure desirable properties (e.g.,

AE 200 – Engineering Analysis and Control of Aerospace Systems

controllability, observability, stability, performance) of the interconnection.

- Analyze least squares solutions to linear problems.
- Explain singular values and matrix perturbations.
- Derive solutions to state space models
- Derive input output relationships and transfer functions between systems.
- Analyze input output stability of control systems.
- Use Bode's sensitivity integral to outline robust stability.
- Formulate reachability and observability.
- Use minimal and balanced realizations.
- Outline H2 and Hinf. optimization in control systems.

Midterm Exam(s):

There will be 2(two) 120min in-class written exams, and 4(four) 25min written Quizzes.

Quizzes and (final) exams cannot be made up without a valid, documented excuse.

*There is *NO* make up exam policy!!*

Final Exam:

There will be a final take-home exam/project with a due date of Dec 15th, 2015 Tuesday at 5.15pm. Delivery will be online in CANVAS.

(Recommended) Text Book(s):

Classnotes
Handouts

(Recommended) Reference(s):

- Kreyszig, Advanced Engineering Mathematics, 9th edition, 2006
- Bernstein, D. S., Matrix Mathematics: Theory, Facts, and Formulas (Second Edition), 2009
- Kailath, Thomas, Linear Systems, Prentice Hall, 1980, ISBN: 9780135369616.
- Doyle, J., Bruce F., and Tannenbaum, A. Feedback Control Theory. Dover, 2009.
- Vaccaro, Richard. Digital Control: A State-Space Approach. McGraw-Hill, 1995.

AE 200 – Engineering Analysis and Control of Aerospace Systems

Exams:

- 2(Two) 120 minutes –inclass Mid-term exams.
- Final project.

Grading:

- Homework 15%
- 4(four) Quizzes 15%
- Two 120min Exams 40%
- Final Project 30%

Important !!

All exams must be taken to receive a passing grade.

Grading Policy

100 - 95% A
94.99 - 90% A-
89.99 - 85% B+
84.99 - 80% B
79.99 - 76% B-
75.99 - 72% C+
71.99 - 68% C
67.99 - 64% C-
63.99 - 61% D+
60.99 - 57% D
56.99 - 53% D-
< 53% F

Important !!

This is only a rough scale. This scale may be adjusted depending on the performance of the class. Any adjustments to the scale will only lower the cut-offs to achieve a specified grade; cut-offs will not be raised beyond those listed here.

Schedule**Important**

**If you miss a lecture, please make sure that you obtain the notes of that specific class from your class-mates.*

*'I did not know how to do this problem, because I missed lecture the day this material was covered' is, unfortunately, NOT a valid excuse!**

- Week-1:
 - (08/25, 2015) Tuesday :
 - HW_01 Out !!
 - Introduction to engineering analysis and control
 - Ordinary differential equations (1/2)
- Week-2
 - (09/01, 2015) Tuesday:
 - NO Class !!
- Week-3:
 - (09/08, 2015) Tuesday :
 - Ordinary differential equations (2/2)
 - Laplace Transformation (1/2)
- Week-4:
 - (09/15, 2015) Tuesday :
 - **Quiz_01 !!**
 - **HW_01 in !!**
 - **HW_02 out !!**
 - Laplace Transformation (2/2)
- Week-5:
 - (09/22, 2014) Tuesday :
 - **HW_02 in !!**
 - Linear algebra review (2/2)
 - Partial differential equations
- Week-6:
 - (09/29, 2015) Tuesday :
 - **HW_02 in !!**
 - Fundamentals of complex analysis
 - **Review** questions!
- Week-7:
 - (10/06, 2015) Tuesday :
 - **Exam_01 !!**
 - **HW_03 out !!**
- Week-8:
 - (10/13, 2015) Tuesday :
 - **Quiz_02 !!**
 - Least Squares Estimation

AE 200 – Engineering Analysis and Control of Aerospace Systems

- Week-9:
 - (10/20, 2015) Tuesday :
 - **HW_03 in !!**
 - Singular values and matrix perturbations
- Week-10:
 - (10/27, 2015) Tuesday :
 - **HW_04 out !!**
 - State space models and ODE solutions in Aerospace Systems
- Week-11:
 - (11/03, 2015) Tuesday :
 - Transfer functions and input/output stability
- Week-12:
 - (11/10, 2015) Tuesday :
 - **Quiz_03 !!**
 - **HW_04 in !!**
 - Bode's sensitivity integral and Robust Stability
- Week-13:
 - (11/17, 2015) Tuesday :
 - **Exam_02 !!**
- Week-14:
 - (11/24, 2015) Tuesday :
 - **HW_05 out !!**
 - Reachability and Observability
 - Minimal and Balanced Realizations
- Week-15:
 - (12/01, 2015) Tuesday :
 - **Quiz_04 !!**
 - Feedback stabilization
- Week-16:
 - (12/08, 2014) Tuesday :
 - **HW_05 in !!**
 - H2 optimization & H-infinity optimization

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