

AE 157: Automatic Control & Systems Design for Aerospace Systems

Professor Kamran Turkoglu, Department of Aerospace Engineering, San Jose State University, Spring 2018

Syllabus

Contact Information

Instructor: Kamran Turkoglu
Office Location: ENG 272C
Email: kamran.turkoglu@sjsu.edu
Office Hours: Tuesday, 8-10am
Class Hours: Monday-Wednesday, 10.30am - 11.45am
Classroom: Boccardo Business Center 004
Prerequisites: "C" or better in Math 129A, Math 133A, and AE 138
Class Code:
Website: <http://www.engr.sjsu.edu/kamran/>

TA: (Grader) Zach Hughes - zachary.hughes@sjsu.edu

Problem solving hours: TBA
TA/Grader Office Hours: TBA

Mid-term Exam(s):

There will be 2(two) 75min in-class written exams, and 4(four) 15min written Quizes.
 Quizes and (final) exams canNOT be made up without a valid, documented excuse (i.e. Dr.'s note).
 There is NO make up exam policy!!

Final Exam

There will be a final project with a due date of May 21st, 2018 Monday at 12pm (with online delivery in Canvas). NO late deliveries will

Text Book:

- K. Ogata, Modern Control Engineering, Prentice Hall.
- Classnotes
- Handouts

(HIGHLY Reccomended) Refference(s):

- Gene F. Franklin, J. Da Powell, Abbas Emami-Naeini, Prentice Hall, Feedback Control of Dynamic Systems (7th Edition) Hardcover, May 9, 2014
- R. Murray, Feedback Control Theory, Caltech, 2015
- William L. Brogan, Modern Control Theory (3rd Edition) Paperback, October 11, 1990
- Farid Golnaraghi, Benjamin C. Kuo, Automatic Control Systems, Wiley, 2009
- Bernard Friedland, Control System Design: An Introduction to State-Space Methods (Dover Books on Electrical Engineering) Paperback, March 24, 1988
- John C. Doyle, Bruce A. Francis, Allen R. Tannenbaum, Feedback Control Theory (Dover Books on Electrical Engineering) Paperback, January 15, 2005
- Norman S. Nise, Control Systems Engineering Hardcover, December 14, 2010, Wiley

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!*

Important

All Monday classes will be held online, while all Wednesday classes will meet in person, n BBC_04!

Important

Students will have 1(one) week grace period where they could share any possible concern about their grade of that specific assignment. After that 1(one)-week grace period, the grades will be final. PLEASE do not come and discuss your HW-01 on Week14 ...etc. !

- Week-1:
 - (01/23) Wednesday :
 - Introduction and class material review
- Week-2:
 - (01/29) Monday **ONLINE** :

- Introduction to Control Systems (1/2)
 - **Reading Assignment Week 01: (Ogata) Chapter 1 - Introduction to Control Systems**
- (01/31) Wednesday :
 - Introduction to Control Systems (2/2)
- Week-3:
 - (02/05) Monday **ONLINE**:
 - Introduction to Matlab and Simulink
 - (02/07) Wednesday:
 - Laplace Transform
 - **HW_01 out!!**
 - **Reading Assignment Week 02: (Ogata) Chapter 2 - Laplace Transform**
- Week-4:
 - (02/12) Monday **ONLINE**:
 - Mathematical Modeling of Dynamic Systems (1/2)
 - **Reading Assignment Week 03: (Ogata) Chapter 3 - Mathematical Modeling of Dynamic Systems**
 - (02/14) Wednesday:
 - Mathematical Modeling of Dynamic Systems (2/2)
- Week-5:
 - (02/19) Monday **ONLINE**:
 - Transient Response Analysis (1/2)
 - **Reading Assignment Week 04: (Ogata) Chapter 4 - Transient Response Analysis**
 - (02/21) Wednesday:
 - Transient Response Analysis (2/2)
 - **Quiz_01 !!!**
 - **HW_01 in!!**
 - **HW_02 out!!**
- Week-6:
 - (02/26) Monday **ONLINE**:
 - Basic Control Actions and Response of Control Systems (1/2)
 - **Reading Assignment Week 05: (Ogata) Chapter 5 - Basic Control Actions and Control Response**
 - (02/28) Wednesday:
 - Basic Control Actions and Response of Control Systems (2/2)
- Week-7:
 - (03/05) Monday **ONLINE**:
 - Root Locus Analysis (1/2)
 - **Reading Assignment Week 06: (Ogata) Chapter 6 - Root Locus Analysis**
 - (03/07) Wednesday:
 - **HW-02 in !!!**
 - Root Locus Analysis (2/2)
 - Control Systems Design (1/2)
 - **Reading Assignment Week 07: (Ogata) Chapter 7 - Control System Design**
- Week-8:
 - (03/12) Monday **ONLINE**:
 - Control Systems Design (2/2)
 - (03/14) Wednesday:
 - Frequency Response Analysis (1/2)
 - **Reading Assignment Week 08: (Ogata) Chapter 8 - Frequency Response Analysis**
- Week-9:
 - (03/19) Monday:
 - **Exam_01 !!!**
 - (03/21) Wednesday:
 - **Quiz_02 !!**
 - **HW_03 out !!**
 - Frequency Response Analysis (cont'd) (2/2)
- Week-10:
 - (03/26) Monday:
 - **SPRING BREAK!! No Class!**
 - (03/28) Wednesday:
 - **SPRING BREAK!! No Class!**

- Week-11:
 - (04/02) Monday **ONLINE**:
 - Control Systems Design by Frequency Domain Method
 - **Reading Assignment Week 09: (Ogata) Chapter 9 - Control System Design by Freq. Domain Methods**
- (04/04) Wednesday:
 - **HW_03 in !!**
 - **HW_04 out !!**
 - PID control and Introduction to Robust Control (1/2)
 - **Reading Assignment Week 10: (Ogata) Chapter 10 - PID and Robust Control**
- Week-12:
 - (04/09) Monday **ONLINE**:
 - PID control and Introduction to Robust Control (2/2)
 - (04/11) Wednesday:
 - Analysis of Control Systems in State Space
 - **Reading Assignment Week 11: (Ogata) Chapter 11 - Analysis of Control Systems in State Space**
- Week-13:
 - (04/16) Monday **ONLINE**:
 - Design of Control Systems in State Space (1/2)
 - **Reading Assignment Week 12: (Ogata) Chapter 12 - Design of Control Systems in State Space**
 - (04/18) Wednesday:
 - **Quiz_03 !!**
 - **HW_04 in !!**
 - **HW_05 out !!**
 - Design of Control Systems in State Space (2/2)
- Week-14:
 - (04/23) Monday:
 - **Exam_02 !!**
 - (04/25) Wednesday:
 - **NO CLASS !!**
- Week-15:
 - (04/30) Monday **ONLINE**:
 - Lyapunov Stability Analysis (1/2)
 - **Reading Assignment Week 14: (Ogata) Chapter 13 - Lyapunov Stability**
 - (05/02) Wednesday:
 - Lyapunov Stability Analysis (2/2)
- Week-16:
 - (05/07) Monday **ONLINE**:
 - Introduction to Discrete Time Control and Systems (1/2)
 - (05/09) Wednesday:
 - **Quiz_04 !!**
 - **HW_05 in !!**
 - Introduction to Discrete Time Control and Systems (2/2)
- Week-17:
 - (05/14) Monday **Will meet in person!:**
 - Final project presentations.

Course Description

Modeling and analysis of aerospace feedback control systems. Stability analysis, root locus design, and frequency response methods for aerospace vehicles and automatic control systems. Nyquist/Bode diagrams. Lead-lag, PID compensator designs for aircraft and spacecraft.

Course Goals

- Develop an understanding of aerospace automatic control systems design and develop specific strategies to tackle practical engineering problems in the aerospace engineering.
- Provide background in automatic control systems design with specific applications on aircrafts, spacecraft and satellites.
- Develop an understanding of the fundamental elements in classical control theory as applied to the aircrafts and spacecrafts.

Student Learning Objectives

- Outline the fundamental concepts of classical control theory as applied to aircraft and spacecraft.
- Describe transient response analysis in aircraft and satellites.

- Formulate basic control actions and frequency response of aerospace automatic control systems.
- Explain the concept of feedback and its function in aerospace vehicles.
- Analyze stability and stability margins in aerospace vehicle motions.
- Outline the fundamentals of modern control theory as it is applied to aerospace vehicles
- Determine the natural frequencies and damping ratios of aerospace vehicle dynamics.
- Evaluate the effect of feedback on aircraft and satellite control system performance.
- Justify the significance of the negative and positive feedback.
- Derive transfer functions and plot vehicle time and/or frequency response.
- Use frequency response design techniques to design closed-loop control systems: rate-damping, attitude control, altitude control.
- Design a satellite control law using classical/modern automatic control system design principles (such as PID, pole placement ... etc.).
- Design a 3-axis control law for an aerospace vehicle.

Exams

- 2(Two) 75minutes in-class Mid-term exams
- Final project.

Grading

- 4(Four) Quizzes 10%
- Homework 10%
- Two 75min Exams 50%
- 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 - 75% B-
- 74.99 - 70% C+
- 69.99 - 65% C
- 64.99 - 60% C-
- 59.99 - 56% D+
- 55.99 - 53% D
- 52.99 - 50% D-
- < 50% 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.

Academic Success

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of forty-five hours over the length of the course (hours per unit per week with 1 of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to clinical practice. Other course structures will have equivalent workload expectations as described in the syllabus.

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on my faculty web page at <http://www.engr.sjsu.edu/kamran> responsible for regularly checking with the messaging system through MySJSU (or other communication system as indicated by the instructor) to learn any

University Policies

Dropping and Adding

Students are responsible for understanding the policies and procedures about *adddrop*, *grade forgiveness*, etc. Refer to the current semester's Catalog Policy <http://info.sjsu.edu/static/catalog/policies.html>. Adddrop deadlines can be found on the current academic year calendars document on the Academic Calendar http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at <http://www.sjsu.edu/aars/policies/latedrops/policy/>. Students are aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at <http://www.sjsu.edu/advising>. Consent for Recording of Class and Public Sharing of Instructor Material University Policy S12-7, <http://www.sjsu.edu/senate/docs/S12-7.pdf>, requires students to obtain instructor's permission to record the c

- Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission for audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the property of the instructor; you have not been given any rights to reproduce or distribute the material.
- Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent.

Academic integrity

Your commitment as a student to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy So7-2 at <http://www.sjsu.edu/senate/docs/So7-2.pdf> requires you to be honest in all your academic course work. Faculty members are required to report all infractions of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at <http://www.sjsu.edu/studentconduct/>. Academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless specified. If you would like to include your assignment or any material you have submitted, or plan to submit for another class, please note that SJSU's Academic Integrity Policy So7-2 requires approval of instructors.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 at <http://www.sjsu.edu/president/docs/directives/> requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at <http://www.sjsu.edu/aec> to record their disability. In 2013, the Disability Resource Center changed its name to be known as the Accessible Education Center, to incorporate a philosophy of education for students with disabilities. The new name change reflects the broad scope of attention and support to SJSU students with disabilities and the University's continued advocacy and commitment to increasing accessibility and inclusivity on campus.

Student Technology Resources

Computer labs for student use are available in the Academic Success Center at <http://www.sjsu.edu/at/asc/> located on the 1st floor of Clark Hall and in the Students Lab on the 2nd floor of the Student Union. Additional computer labs are available in engineering department. Computers are also available in the King Library.

A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include DV and HD digital camcorders; digital still cameras; video, slide and overhead projectors; DVD, CD, and audiotape players; sound systems, wireless microphones, projection screens and more.

SJSU Peer Connections

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, study and time management skills, more effective critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals.

In addition to offering small group, individual, and drop-in tutoring for a number of undergraduate courses, consultation with mentors is available on a drop-in appointment basis. Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and managing procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space are also available for student use in Room 600 of the Academic Services Center (SSC).

Peer Connections is located in three locations: SSC, Room 600 (10th Street Garage on the corner of 10th and San Fernando Street), at the 1st floor entrance in the Living Learning Center (LLC) in Campus Village Housing Building B. Visit Peer Connections website at <http://peerconnections.sjsu.edu> for more information.

Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, requires students to obtain instructor's permission to record the course.

- Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission for audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the property of the instructor; you have not been given any rights to reproduce or distribute the material.
 - It is suggested that the greensheet include the instructor's process for granting permission, whether in writing or orally and whether for the whole class or on a class by class basis.
 - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent.