California State University, Chico
Mechanical and Mechatronic Engineering and Sustainable Manufacturing
{Semester}
MECA 482: Control System Design

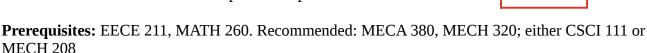**Class time and location:**

MECA 482-01	(3323) - MWF 12:00PM – 12:50PM	LANG 104
MECA 482-02	(5182) - MWF 1:00PM - 1:50PM	LANG 104

Instructor: H. Sinan Bank, hsbank@mail.csuchico.edu, 530-898-4619
Office: OCNL 428
Office Hrs.: Please request a meeting via calendly.com/
MW 2:00 pm – 4:00 pm

Prerequisites: EECE 211, MATH 260. Recommended: MECA 380, MECH 320; either CSCI 111 or MECH 208

Course Usage of Blackboard Learn:
The course syllabus and other material will be posted on Blackboard Learn. You are responsible for regularly checking the on-line resources, which is accessed through the Chico State Portal. We will also use a course web-page to show off some of the details for the class publicly.

Course Objectives:
1. To elicit the dynamic performance of the system
2. To design controllers which satisfies specifications and requirements of
- Stability
- Tracking the input
- Robustness in the presence of disturbance
- Frequency Response
3. Understand and implement the system identification aspects with a given system's input

Coverage includes the following topics:
- Classical control theory for Single-Input-Single-Output (SISO) systems
- Introduction to matrices and modern control system theory
- Addition, subtraction, multiplication, and inversion of matrices
- Derivation of models of components and systems in the time domain
- Derivation of state space formulations for the models,
- Numerical methods for solving the system of state equations
- Derivation of the Laplace transform solutions of state equations
- Derivation of state transition matrix and its application in solving state equations
- Converting from State Space to a Transfer Function
- Deriving conditions for stability in state space
- Block diagrams
- Analysis
- Controllers
- Learning-based control system design (Reinforcement Learning)

Textbook
Nise, "Control Systems Design", Wiley, 2015 7th Ed. (E-book is acceptable).

Other suggested books/ references for students self-learning efforts and the instructor would incorporate some questions from there. Please see more information at the corresponding Blackboard's Section.

Feedback Systems: An Introduction for Scientist and Engineers, Karl J. Astrom, Richard M. Murray
Automatic Control Systems, by Farid Golnaraghi, Benjamin Kuo, Tenth Edition, McGraw-Hill, 2017
System Dynamics and Control, by K. Ogata, 4th Edition, Pearson Education, 2013
Modeling and Analysis of Dynamic Systems, by C.M.Close, D.K. Frederick, John Wiley, 2003, 3rd Edition
Feedback Control of Dynamic System, 4th Edition, by Charles L. Phillips, Troy Nagle, Aranya Chakrabortty
Mechatronics with Experiments, Sabri Cetinkunt, 2015

Software
The details of the software package for the lab is provided here. Short list is below
- Mathworks MATLAB Suite with additional required toolboxes as pointed in the Black Board
- Python 3.6 (see requirement.txt on the course repository)
- V-REP for physics-based simulation of labs and some of the examples

Hardware
We will have in class labs for you to realize the theoretical knowledge into something tangible. In control theory, using simple systems to test the theoretical application is a generic approach.

Assignments and Grading Policies

(3+1) x Quiz*	20%
8 HWs	20%
5 Labs	10%
Group Project	20%
Final Exam	30%

Quizzes: There will be in-class exams. Each successive exam may include prior course material.

Note:
1. These subject to change with a fair notification.
2. Late homework will be accepted with additional penalties.

Topics/ Tentative Schedule (Please note that the topics are subject to change with a fair notification.)

Topic	Wk	Hours	Sections	Lab	Suggested Problems	HW DUE
1- Introduction	1	2 hrs				N/A
2- Modeling in Frequency Domain	2-3	5 hrs		L1 (1 hr)		HW1
3- Modeling in Time Domain	4	3 hrs				HW2
4- Time Response	5	2 hrs		L2 (1 hr)		HW3
5- Reduction of Multiple Sub-systems	6	2 hrs 30 mins				HW4
Quiz 1	6	30 mins				
6- Stability	7	2 hrs		L3 (1 hr)		N/A
7- Steady State Error	8	2 hrs 30 mins				N/A
Quiz 2	8	30 mins				
DUE: Final Project Proposal	**8**					
8- Root Locus and Design via Root Locus	9	2 hours 30 mins		L4 (30 mins)		HW5
9- Frequency Response Techniques and Design via Frequency Response	10	2hrs 30 mins				HW6
Quiz 3	10	30 mins				
10- Design with State Space	11	3 hrs		L5 (30 mins)		N/A
11- Digital Control	12	2hrs 30 mins				HW7
Quiz 4*	12	30 mins				N/A
N/A	13	N/A		N/A		N/A
12- Learning-based Control (Optional)	14	3 hrs				HW8
13- Final Project Presentation [5 mins.]	15	3 hrs				N/A
14- Final Project Presentation [5 mins.]	16	3 hrs				N/A
17 – Final	17					N/A
Total	17	45 hrs, 8 Homeworks, 3+1 Quizzes, 5 Labs, 1 Final, 1 Group Projects				

The details of the group projects:
The project consist of the presentation and a concise documentation similar to provided templates. The other criteria for the projects are as follows:
- Theoretical rigor (20%)
- Complexity of control application (15%)
- Documentation and presentation (25%) - the presentations are limited to 5 mins
- Results and final implementation (40%)
- The vote from other groups/ group members (*optional) (10-20%) - if the students give free points the instructor has the veto and change power for fairness
Your project is 20% of the total grade of the class. The groups can ask more questions during the office hours.

Dropping and Adding:
You are responsible for understanding the policies and procedures about add/drops, academic renewal, etc., found in the CSU Chico University Catalog. You should be aware of the new deadlines and penalties for adding and dropping classes.

Classroom Protocol:
Needless to highlight, during class, please do not engage in any activities that are not related to the class, i.e. personal web surfing, online shopping, e-mail, Facebook, LinkedIn, Snap Chat, Kik, etc.

University Policies and Campus Resources

Academic Integrity
Students are expected to be familiar with the University's Academic Integrity Policy. Your own commitment to learning, as evidenced by your enrollment at California State University, Chico, and the University's Academic Integrity Policy requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the Office of Student Judicial Affairs (Office of Student Conduct, Rights & Responsibilities) . The policy on academic integrity and other resources related to student conduct can be found on the Student Judicial Affairs (Office of Student Conduct, Rights & Responsibilities) web site.

Student Services
Student services are designed to assist students in the development of their full academic potential and to motivate them to become self- directed learners. Students can find support for services such as skills assessment, individual or group tutorials, subject advising, learning assistance, summer academic preparation and basic skills development. Student services information can be found on the current students page of the CSU Chico web site.

Americans with Disabilities Act
If you need course adaptations or accommodations because of a disability or chronic illness, 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. Please also contact Accessibility Resource Center (ARC) as they are the designated department responsible for approving and coordinating reasonable accommodations and services for students with disabilities. ARC will help you understand your rights and responsibilities under the Americans with Disabilities Act and provide you further assistance with requesting and arranging accommodations.

Accessibility Resource Center
530-898-5959, Student Services Center 170, arcdept@csuchico.edu

Student Learning Center
The mission of the Student Learning Center (SLC) is to provide services that will assist CSU, Chico students to become independent learners. The SLC prepares and supports students in their college course work by offering a variety of programs and resources to meet student needs. The SLC facilitates the academic transition and retention of students from high schools and community colleges by providing study strategy information, content subject tutoring, and supplemental instruction. The University Writing Center has been combined with the Student Learning Center. You can also visit the Student Learning Center web site.