San Jose State University
Department of Aviation/Technology
College of Engineering

Tech 167: **Control Systems**
IS 216 Lec: TuTh 12:00 pm – 12:50 pm
IS 117 Lab: R 9:00 am – 11:45 am
Fall Semester 2018
Email: tom.brown@sjsu.edu

Tom Brown, Jr.
Office:
Ph:
Office Hrs:TuTh 10:45-11:45am

Course Description

Theory and applications of feedback systems, transfer functions and block diagrams. Transducers, analog and digital controllers, signal conditioners, and transmission. Analysis, testing, and troubleshooting of electronic systems with feedback.

Prerequisite: Tech 63, Tech 115

Textbook

Johnson, Curtis D. (2006). 8th Edition. "Process Control Instrumentation Technology." Upper Saddle River, NJ: Prentice Hall.

Course Objectives

Upon successful completion of this course, students will be able to:

- Draw a block diagram of a process-control loop and identify each element.
- Explain the difference between analog and digital control systems.
- Design an RC low-pass and high-pass filter circuits to eliminate unwanted signals.
- Design a Wheatstone bridge circuit to convert resistance change to voltage change.
- Explain how a successive approximate ADC operates.
- Calculate the expected output of a bipolar DAC for a given input.
- Develop the design of a system to measure temperature using a solid-state temperature sensor.
- Describe electromagnetic (EM) radiation in terms of frequency, wavelength, speed of propagation, and spectrum.

Course Evaluation Criteria

Examinations

Examination #1	September 27	10%	100
Examination #2	November 08	10%	100

Quizzes

Quiz #1	September 06	5%	50
Quiz #2	October 18	5%	50
Project		15%	150
Laboratory		25%	250
Homework		10%	100
Final: Friday, December 14		20% Time: 0945 - 1200	200
Total		100%	1000

Grading

97 - 100	A+	85 - 88	B+	73 - 76	C+	61 - 64	D+
93 - 96	A	81 - 84	B	69 - 72	C	57 - 60	D
89 - 92	A-	77 - 80	B-	65 - 68	C-	0 - 56	F

Late Assignments

Late assignments will not be accepted. Assignments include **homework** and **laboratory** reports. Homework will be assigned Thursday of each week and must be submitted at the next Thursday's class.

A missed examination or quiz will be given a score of zero. If you cannot take a scheduled examination or quiz, notification must be given prior to the scheduled examination or quiz.

Similar, experiments are to be submitted on their designated dates. Each experiment assigned will be discussed in the Lecture and in the Laboratory as required for clarification. The experiments that we will be doing are listed as follows, but not necessarily in the sequence as to when an experiment will be done:

1.	DC Current and Voltage Measurements	25
2.	Multistage closed-loop amplifiers	25
3.	Evaluate a Low pass passive and active single pole filter	25
4.	Wheatstone Bridge to measure an unknown resistor/temperature	25
5.	Differentiator	25
6.	Integrator	25
7.	Comparator	25
8.	Db meter Evaluation	25
9.	Digital-to-analog converter	25
10.	Analog-to-digital converter	25
	Total	250

Some experiments will take more than one lab period. So, the specific date to turn-in an experiment will be given in the lab a week before the experiment is due. Submit one laboratory report per group. A group is two students. Upon completion, you must submit a final lab report. Do not submit the example report given to you. Submit a written experiment report and use the **Experiment Write-Up Format** as a guide to submit your group report.

Campus is close on the following days:

- Monday, September 03: Labor Day
- Monday, November 12: Veteran's Day
- Thursday – Friday, November 22 – 23: Thanksgiving Holiday

Experiment write-up Format

A written laboratory report for each experiment is required. The report should contain the following components:

Cover Page: This page includes the title of the experiment, the date, the course number, the course name, and each team member's name with signatures as an indication that each member contributed toward the experiment completion. Do not sign a person name, if that person was not there to help with the experiment.

Objective: The objective tells what the experiment is all about. Write short sentences to explain the reasons for doing the experiment.

Equipment: Write down the equipment and the components used for the experiment, and the group station number.

Procedure: Write down the steps in a logical sequence to do the experiment. Any one should be able to take your group experiment and follow the procedure to obtain similar results. For example, construct Figure 1 which means to connect your circuit exactly like Figure 1.

Theory: The solution to the expected problem should exemplify the theory with calculations. All steps must be clarified with circuit diagrams. After you have solved the problem your next step will be to make a table showing all the parameters to be verified when you do the actual experiment. In other words, you simply want to verify your theoretical results or calculations in the laboratory.

Data: Your data must represent the experimental results.

Conclusion: The conclusion tells what you accomplished by doing the experiment. In other words, did the experimental results agreed with your expected results?

General Comments: The report must be neat, legible, and double spaced, and submitted in a type written form (use your computer). Use simple sentences that get right to the point. Be specific! Use 8 ½ x 11-inch paper with **no holes** or **perforated edges**. Staple all the pages together at the upper left-hand corner. **Do not tear** or **fold** the corners!

Tentative Calendar

Week of	Lecture Topics	Problems
08/21/18	Green Sheet, Lab Procedures 1.1 Introduction	
08/28/18	1.2 Control Systems 1.3 Process-Control Block Diagram	1.3, 1.5 1.9, 1.11,1.13
09/04/18	1.4 Control System Evaluation 1.5 Analog and Digital Processing	1.15,1.17,1.19,1.21,1.23 1.27,1.29,1.30,1.31,1.33
09/06/18	Quiz #1	
09/18/18	2.1 Introduction 2.2 Principles of Analog Signal Conditioning 2.3 Passive Circuits	2.1,2.3, 2.5, 2.7, 2.9 2.11,2.13,2.15, 2.17, 2.19
09/27/18	Examination #1	
10/02/18	2.4 Operational Amplifiers 2.5 Op Amp Circuits in Instrumentation 2.6 Design Guidelines	2.23, 2.25, 2.27,2.29,2.31 2.33, 2.35,2.37,2.39
10/16/18	3.1 Introduction 3.2 Review of Digital Fundamentals 3.3 Converters	3.1, 3.3, 3.5,3.7,3.9 3.11, 3.17, 3.19,3.21,3.23
10/18/18	Quiz #2	
11/23/18	4.1 Introduction 4.2 Definition of Temperature 4.4 Thermistors 4.5 Thermocouples	4.1, 4.3,4.5,4.7,4.9 4.11, 4.13,4.15,4.17, 4.23, 4.25
11/08/18	Examination #2	
12/04/18	6.1 Introduction 6.3 Photodetectors 6.5 Optical Sources	6.1, 6.3, 6.5, 6.13,6.15 6.17,6.19,6.21
Friday, December 14, 2018	**Final, IS 117, Time:0945 – 1200 noon**	

Subject to change with fair notice

Project

Each student will submit a project report. The report content must be related to Process Control Instrumentation Technology. The written report must include a title page, index, introduction, main body, conclusions, and references. The main body should have between 10 to 15 pages, double spaced. Submit your project topic for approval **September 11, 2018**. The project report is due November 27, 2018. Finally, you are required to give a 15 to 20 minutes presentation to explain your project findings. Do not submit a copy of the presentation. You are required to submit only a copy of your project report. The oral presentations will begin November 27, 2018. So, November 27, 2018 you will give a 15 to 20 minutes presentation which include a demonstration of your project along with submitting your final written project report. Shown is a list of preferred projects:

1. Design and build a Successive Approximation Analog-to-Digital Converter
2. Design and build a Positive and Negative Clampers with an application
3. Design and build a Sample and Hold Circuit with an application
4. Design and build a 3-bit Flash Analog-to-Digital Converter
5. Design and build a 4-bit R/2R Ladder Digital-to-Analog Converter
6. Develop the design of a system to measure temperature using a solid-state temperature sensor.
7. Design and build a basic AGC circuit.
8. Design and build a multistage closed-loop common emitter amplifiers circuit
9. Design and build a Class C amplifier
10. Design and build a double pole bandpass filter (active or passive)

Each project will be evaluated using the following guide lines:

Presentation	20 points
Workable Project	50
Work Quality	30
Report	50
Total	150

University, College, or Department Policy Information

a) **Academic Integrity statement (from Office of Student Conduct and Ethical Development)**:
"University Policies: Office of Graduate and Undergraduate Programs maintain university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc."
You may find all syllabus related University Policies and resources information listed on GUP' Syllabus Information web page at http: www.sjsu.edu/gup/syllabusinfo/

b) **Campus policy in compliance with the Americans with Disabilities Act**:
"If you need course adaptations or accommodations because of a disability, or if you need 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 requires that students with disabilities requesting accommodations must register with DRC to establish a record of their disability."