

**San José State University**  
**College of Engineering/Department of Aviation and Technology**  
**TECH 115, Automation and Control, Section 03, Spring Semester 2015**

**Course and Contact Information**

<b>Instructor:</b>	Robert Werkman
<b>Office Location:</b>	IS 104 or meet in required lab or class room before or after class
<b>Telephone:</b>	(408) 924-3190 (main office)
<b>Email:</b>	<a href="mailto:robert.werkman@sjsu.edu">robert.werkman@sjsu.edu</a>
<b>Office Hours:</b>	Th 7:45-8:45 IS 117. Lecturer is also available via email and maybe available for specific appointments scheduled through Canvas
<b>Class Days/Time:</b>	T 4:00 PM – 5:45 PM for Lecture Th 5:00 PM-7:45 PM for Lab
<b>Classroom:</b>	IS 117 for Lecture and Lab
<b>Prerequisites:</b>	<b>TECH 060, PHYS 002A, PHYS 002B, MATH071</b>

**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 the Canvas learning management system course website. You are responsible for regularly checking with the messaging system through MySJSU (or other communication system as indicated by the instructor) to learn of any updates. Course updates and/or changes will be communicated via Canvas Announcements.

**Course Description**

Theory and application of automation elements including analog and digital sensors, controllers, indicators, actuators. Control modes for proportional, derivative, and integral control systems. Hands-on integration practices among PLC, robots, automatic identification devices, computers, and other industrial equipment.

**Course Learning Outcomes (CLO)**

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

1. Understand the basic theory and design of industrial control systems, including motion control, programmable logic control, pneumatics and AC drive systems.
2. Specify components for automation systems, including sensors, motion control components, AC drives, controllers, industrial networks
3. Use standard industry software tools and literature for identifying the components in an automation system.
4. Understand the process in building the control algorithm for an automation system.
5. Understand the basic theory of instrumentation and sensors used for measurement within an automation system.

## **Required Texts/Readings**

### **Textbook**

Industrial Automated Systems: Instrumentation and Motion Control, 1st Edition. Bartelt, Terry L. M., ISBN-10: 1435488881, ISBN-13: 9781435488885

### **Other Readings**

The student companion site for the above textbook is:

[http://www.cengagebrain.com/cgi-wadsworth/course\\_products\\_wp.pl?fid=M20b&product\\_isbn\\_issn=9781435488885&token=3A7A967DF5264AC73B42004536E8F620D7F0D510B51A8E68459FD61C0AF9D4C558FFDC468CB092D28BC12178D822AFF024263B18555218A0](http://www.cengagebrain.com/cgi-wadsworth/course_products_wp.pl?fid=M20b&product_isbn_issn=9781435488885&token=3A7A967DF5264AC73B42004536E8F620D7F0D510B51A8E68459FD61C0AF9D4C558FFDC468CB092D28BC12178D822AFF024263B18555218A0). There will be other links for reference posted on the Canvas site.

### **Other equipment / material requirements (optional)**

A final group project to design and build an automated system will be a core part of the course. Costs will vary based on the complexity of the project, BOM created for the

## **Course Requirements and Assignments**

- A. Readings-The text book will be used on a weekly basis for readings that will reinforce topics introduced in class as well as bring up complementary material unique from class lectures. Readings will be assigned each week and it is expected for the students to read the assigned textbook selections prior to the lecture class.
- B. Homework-Questions will be assigned from the textbook to reinforce class concepts. The homework will should be turned in by or at the next lecture class session. The answer to the homework is important, but the thought pattern and work that is put into attaining the answer is more important. Show/explain your work for each homework problem assignment. Homework will either be done on paper or electronically submitted via Canvas.
- C. Mid-Terms and Final-Tests will be based on material covered in class lectures, labs and lab assignments, homework assignments and readings.
- D. Lab and Lab Assignments: Our laboratory assignments will focus on the use of software tools and devices that are used in a real world industrial environment. In addition, some labs will focus on trying to reinforce some basic concepts of the components used within controllers or concepts of automation technologies.

- E. Final Group Project- Design and construct an Automation System. The logic and methodology into building your Automation System is the critical portion of the project. A successfully working demo of the system will be a result of the preparation work that is completed. The Automation System should include the following elements:
- a. Transducers (an electronic device that converts energy from one form to another)-qty. 3
  - b. Interlocks (a device that prevents an undesired state in a system)-qty. 2
  - c. Major system elements (controller, PLC, computer, HMI, pneumatics, hydraulics, servo or step motors, mechanical system)-qty. 2

Your final group project should meet the following criteria:

Evaluation Criteria:

A. Report (65% of total grading): The **final report** should include (if applicable):

1. Introductory Section
  - a. Review of the process to select your project
  - b. Review of the individuals in the group and their portion of the project work
  - c. Review of the iterative process to come to a final design
2. Functional Specification/ Sequence of Operation
3. Bill of Materials and Budget
  - a. Budget should identify the following costs:
    - i. Parts/components
    - ii. Potential labor costs
4. Programming Algorithm/Flow Chart
5. System Layout (Layout of Major Components in the System)
6. Power Circuit Diagram/One-Line Diagram (Electric)
7. Mechanical Circuit Diagram (Hydraulic and/or Pneumatic)
8. I/O Diagrams (Interface of sensors/transducers, switches, etc. to controller)
9. Control program (PLC program in Connected Components or other controller)
10. Conclusion
  - a. Problems encountered
  - b. Changes to the design group would choose to make with more time, resources, etc.

B. Presentation (15% of total grading): The presentation should come from the perspective if you were trying to sell the Automation System to investors (think the TV show “Shark Tank” with a more detailed presentation on the technical aspects). Tell us why your idea solves a problem and why it is the “right” solution for the problem.

1. Methodology review for choosing your Automation System project
2. Overview of the functional specification of the Automation System
3. Overview of the budget
4. Overview of the system layout
5. Overview of the program algorithm
6. Conclusion (sales pitch)
  - a. Utilize different tools/apps to present your ideas, including, but not limited to:
    - PowerPoint Slides

- Youtube or other electronic video methods

C. Product Demonstration (will be part of the Presentation) (15% of total grading)

1. Is the final Automation System functional to the specification?
2. What are the aesthetics of the Automation System?

D. Individual Report (5% of total grading) (no more than 1 page)

1. What were the key objectives of the project that you learned?
2. What role did you fulfill in the group?
3. What went well with the project and what did not?
4. How would you improve your Automation System for the future?
5. What has this project taught you about automation?

## Grading Policy

Grading for this class will be based on a straight scale and coursework will include the following evaluation:

Mid-Terms (2)	30%
Final	20%
Lab Assignments	20%
Homework	10%
Final Group Project	20%

Homework will be due by the lecture class after it was assigned. Lab assignments will be due the lab class after it was assigned. Makeup lab days will be provided during the semester to allow for a missed lab assignment. You will be allowed to make up 1 missed lab during the semester.

Note that “All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades.” See [University Policy F13-1](http://www.sjsu.edu/senate/docs/F13-1.pdf) at <http://www.sjsu.edu/senate/docs/F13-1.pdf> for more details.

## Classroom Protocol

*Insert your expectations for participation, attendance, arrival times, behavior, safety, cell phone use, etc. here.*

## University Policies

### Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester’s [Catalog Policies](http://info.sjsu.edu/static/catalog/policies.html) section at <http://info.sjsu.edu/static/catalog/policies.html>. Add/drop deadlines can be found on the current academic year calendars document on the [Academic Calendars webpage](http://www.sjsu.edu/provost/services/academic_calendars/) at [http://www.sjsu.edu/provost/services/academic\\_calendars/](http://www.sjsu.edu/provost/services/academic_calendars/). The [Late Drop Policy](http://www.sjsu.edu/aars/policies/latedrops/policy/) is available at <http://www.sjsu.edu/aars/policies/latedrops/policy/>. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the [Advising Hub](http://www.sjsu.edu/advising/) at <http://www.sjsu.edu/advising/>.

## **Consent for Recording of Class and Public Sharing of Instructor Material**

- “Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor’s permission to make 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 intellectual 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 semester 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 publicly 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 S07-2](http://www.sjsu.edu/senate/docs/S07-2.pdf) at <http://www.sjsu.edu/senate/docs/S07-2.pdf> requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The [Student Conduct and Ethical Development website](http://www.sjsu.edu/studentconduct/) is available at <http://www.sjsu.edu/studentconduct/>.

## **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](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) at [http://www.sjsu.edu/president/docs/directives/PD\\_1997-03.pdf](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) requires that students with disabilities requesting accommodations must register with the [Accessible Education Center](http://www.sjsu.edu/aec) (AEC) at <http://www.sjsu.edu/aec> to establish a record of their disability.

## **Accommodation to Students' Religious Holidays**

San José State University shall provide accommodation on any graded class work or activities for students wishing to observe religious holidays when such observances require students to be absent from class. It is the responsibility of the student to inform the instructor, in writing, about such holidays before the add deadline at the start of each semester. If such holidays occur before the add deadline, the student must notify the instructor, in writing, at least three days before the date that he/she will be absent. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed. See [University Policy S14-7](http://www.sjsu.edu/senate/docs/S14-7.pdf) at <http://www.sjsu.edu/senate/docs/S14-7.pdf>.

## **Student Technology Resources (Optional)**

Computer labs for student use are available in the [Academic Success Center](http://www.sjsu.edu/at/asc/) at <http://www.sjsu.edu/at/asc/> located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the

Martin Luther 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 monitors.

### **SJSU Peer Connections (Optional)**

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, enhanced 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 or by appointment basis. Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and memory, alleviating procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space is also available for student use in Room 600 of Student Services Center (SSC).

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

### **SJSU Writing Center (Optional)**

The SJSU Writing Center is located in Clark Hall, Suite 126. All Writing Specialists have gone through a rigorous hiring process, and they are well trained to assist all students at all levels within all disciplines to become better writers. In addition to one-on-one tutoring services, the Writing Center also offers workshops every semester on a variety of writing topics. To make an appointment or to refer to the numerous online resources offered through the Writing Center, visit the [Writing Center website](http://www.sjsu.edu/writingcenter) at <http://www.sjsu.edu/writingcenter>. For additional resources and updated information, follow the Writing Center on Twitter and become a fan of the SJSU Writing Center on Facebook. (Note: You need to have a QR Reader to



scan this code.)

### **SJSU Counseling Services (Optional)**

The SJSU Counseling Services is located on the corner of 7<sup>th</sup> Street and San Fernando Street, in Room 201, Administration Building. Professional psychologists, social workers, and counselors are available to provide consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To schedule an appointment or learn more information, visit [Counseling Services website](http://www.sjsu.edu/counseling) at <http://www.sjsu.edu/counseling>.

## TECH 115-03, Automation and Control, Spring Semester 2015 Course Schedule

This course calendar is subject to change with fair notice.

### Course Schedule

Week	Date	Topics, Readings, Assignments, Lab Assignments
Lab 1	1/22/15	<b>Automation and PLC Basics</b>
Lab 1	1/22/15	Reading-Chapter 1, Chapter 21-5 to 21-11
Lec 1	1/27/15	<b>PLC Basics-Digital and Relay Logic</b>
Lec 1	1/27/15	Reading-Chapter 21-1 to 21-4, HW Q's
Lab 2	1/29/15	<b><i>IAB and Micro 800 Lab</i></b>
Lab 2	1/29/15	<i>IAB and Micro 800 Lab Assignment</i>
Lec 2	2/3/15	<b>Basic PLC Programming</b>
Lec 2	2/3/15	Reading-Chapter 22, HW Q's
Lab 3	2/5/15	<b><i>Connected Components Workbench Basics Lab</i></b>
Lab 3	2/5/15	<i>Connected Components Workbench Basics Lab Assignment</i>
Lec 3	2/10/15	<b>Operational Amplifiers</b>
Lec 3	2/10/15	Reading-Chapter 2, HW Q's
Lab 4	2/12/15	<b><i>Operational Amplifiers Lab</i></b>
Lab 4	2/12/15	<i>Operational Amplifiers Lab Assignment/Final Project Problem Statements Due</i>
Lec 4	2/17/15	<b>Control Concepts (PID Loops)</b>
Lec 4	2/17/15	Reading-Chapter 4, HW Q's
Lab 5	2/19/15	<b><i>Final Project Work/Functional Specifications</i></b>
Lab 5	2/19/15	
Lec 5	2/24/15	<b>Mid-Term 1</b>
Lab 6	2/26/15	<b><i>Final Project Work/Programming Algorithm</i></b>
Lab 6	2/26/15	
Lec 6	3/3/15	<b>Thyristors</b>
Lec 6	3/3/15	Reading-Chapter 3, HW Q's
Lab 7	3/5/15	<b><i>Final Project Work/Bill of Materials Selection</i></b>
Lab 7	3/5/15	
Lec 7	3/10/15	<b>AC Motors and VFD's</b>
Lec 7	3/10/15	Reading-Chapter 9, HW Q's

<b>Week</b>	<b>Date</b>	<b>Topics, Readings, Assignments, Lab Assignments</b>
Lab 8	3/12/15	<b><i>Powerflex 4 Lab</i></b>
Lab 8	3/12/15	<i>Powerflex 4 Lab Assignments</i>
Lec 8	3/17/15	<b>Motion Control (Review of Electrical and Mechanical Components)</b>
Lec 8	3/17/15	Reading-Chapter 7, Chapter 24, HW Q's
Lab 9	3/19/15	<b><i>Motion Analyzer Lab</i></b>
Lab 9	3/19/15	<i>Motion Analyzer Lab Assignment</i>
Lec 9	3/31/15	<b>No Lecture (Cesar Chavez Day)</b>
Lab 10	4/2/15	<b><i>Ultra 3000 Motion Lab/Final Project Progress Report Due</i></b>
Lab 10	4/2/15	<i>Ultra 3000 Motion Lab Assignment</i>
Lec 10	4/7/15	<b>Sensors and Transducers (Basic Sensor Theory and Types)</b>
Lec 10	4/7/15	Reading-Chapter XX, HW Q's
Lab 11	4/9/15	<b><i>Pneumatic Cylinder Control Lab</i></b>
Lab 11	4/9/15	<i>Pneumatic Cylinder Control Lab Assignment</i>
Lec 11	4/14/15	<b>Sensors and Transducers (Temperature, Flow and Pressure)</b>
Lec 11	4/14/15	Reading-Chapter XX, HW Q's
Lab 12	4/16/15	<b><i>Sensors and Transducers Lab</i></b>
Lab 12	4/16/15	<i>Sensors and Transducers Lab Assignment</i>
Lec 12	4/21/15	<b>Mid-Term 2</b>
Lab 13	4/23/15	<b><i>Final Project Work</i></b>
Lab 13	4/23/15	
Lec 13	4/28/15	<b>PLC Basics-Intermediate Programming and Other Topics</b>
Lec 13	4/28/15	Reading-Chapter 23, HW Q's
Lab 14	4/30/15	<b><i>Final Project Work</i></b>
Lab 14	4/30/15	
Lec 14	5/5/15	<b>Industrial Networks-Ethernet and Other Fieldbus Technologies</b>
Lec 14	5/5/15	Reading-Chapter 27, HW Q's
Lab 15	5/7/15	<i>Final Project Presentations and Deliverables are due</i>
Lec 15	5/12/15	<b>Review for the Final</b>
Final Exam	5/20/15	<b>Final (1445-1700)</b>