

**San José State University**  
**School/Department**  
**Tech 115, Automation and Control, Spring 2018 Semester**

**Course and Contact Information**

<b>Instructor:</b>	Robert Werkman
<b>Office Location:</b>	IS117
<b>Telephone:</b>	Best method of communication is email
<b>Email:</b>	Robert.Werkman@sjsu.edu
<b>Office Hours:</b>	Will be available to meet after class sessions and also available to meet based on individually set meetings with the instructor
<b>Class Days/Time:</b>	Lecture-Tech 115-01: Fri, 8:00-9:45 AM Lab-Tech 115-11: Mon, 6:00-8:45 PM Lab-Tech 115-12: Tue, 7:30-10:15 AM
<b>Classroom:</b>	Lecture-Tech 115-01: IS 216 Lab-Tech 115-11 and Tech 115-12: IS 117
<b>Prerequisites:</b>	<b>TECH 060, PHYS 002A, PHYS 002B, MATH071</b>

**Faculty Web Page and MYSJSU Messaging (This section is optional)**

Course materials such as syllabus, supplementary class readings, class presentations, homework, lab assignments, 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.

## **Learning Outcomes (Required)**

### **Course Learning Outcomes (CLO) (Required)**

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. Understand the design and 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**

Our main textbook for this class will be: Industrial Automation: Hands-On by Frank Lamb. The ISBN is 978-0-07-181645-8. There may be online versions of this text as well as used copies of the text that are available.

#### **Other Readings**

Additional readings, videos, demonstrations, etc. will be assigned for this class via links in Canvas. These additional links will be used as either primary or supplementary material to the textbook or lecture to help in emphasizing key concepts for this class. This material can be the basis for homework or exam questions.

#### **Other equipment / material**

We will be using software tools to give you real world experience with current tools being used by industry. Tools will be accessible through the computers in the IS117 lab but could also be downloaded for use by the student. The software tools will be reviewed in lecture and lab as needed. PLC's (programmable logic controllers), open frame controllers, motion components, sensors, variable frequency drives and motors along with other automation devices will be used in lab

## Course Requirements and Assignments

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in [University Policy S12-3](http://www.sjsu.edu/senate/docs/S12-3.pdf) at <http://www.sjsu.edu/senate/docs/S12-3.pdf>.

- 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 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, module links and readings.
- D. Lab and Lab Assignments: Our laboratory assignments will focus on the use of software tools and automation devices that are used in a real world industrial environment. In addition, some labs will focus on the automation system and how to build bills of materials and review how changing different factors affect an overall automation system. Finally, lab assignments will include specific graded milestones needed for the final project.
- 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 (40% 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. I/O Diagrams (Interface of sensors/transducers, switches, etc. to controller)
  - a. Chart that shows the detail of I/O connections to the controller (list out pin numbers or other detail of the proposed/final wiring)
8. Control program (PLC program in Connected Components or other controller)
9. Conclusion
  - a. Problems encountered
  - b. Changes to the design group would choose to make with more time, resources, etc.

B. Presentation (25% 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
7. Creativity and originality with the presentation

C. Product Demonstration (will be part of the Presentation) (25% of total grading)

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

The demonstration should be functional. If not, your group will lose all of the points for this portion of the final project.

D. Individual Report (10% 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?

[University policy F69-24](http://www.sjsu.edu/senate/docs/F69-24.pdf) at <http://www.sjsu.edu/senate/docs/F69-24.pdf> states, “Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because

active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading.”

### **Grading Policy**

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

Mid-Terms (2)	25%
Final	20%
Lab Assignments	20%
Homework	10%
Final Group Project	25%

Homework will be due by the lecture class after it was assigned. Lab assignments will be due the lab class after it was assigned, unless otherwise assigned within Canvas. Lecture assignments and lab assignments can be turned in after their assigned due date for half credit. All late work will need to be turned in within two weeks after the assigned due date. Late submissions for assignment due dates near the end of the semester will need to be turned in by the end of the day on the final day of the semester (if the 2 weeks would fall beyond the final day of class within the semester)

### **Grade Distribution**

The final course grade distribution will be as follows:

A+	100	A	93-99	A-	90-92
B+	88-89	B	83-87	B-	80-82
C+	78-79	C	73-77	C-	70-72
D+	69	D	65-68	F	Below 65

Extra credit assignments are not a pre-determined portion of the course, but could be added later in the semester by the instructor at his discretion.

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**

Please consult Canvas for the prework required for each class. There will be readings or review of module links required for each class. You must come prepared in order to receive the full benefit of attending class. I prefer that you arrive on time but would rather that you come late than not at all. Try to minimize the disturbance to the class if you do plan on arriving late. Cell phones should be turned to silent mode and emergency calls handled outside of the classroom so as to minimize disruptions to the class. There are no grade points awarded for attendance and I do not require you to attend each class; however you are paying for the class so I encourage your attendance to help your learning of the subject matter.

### **Computer Use**

In the classroom, faculty members allow students to use computers only for class-related activities. These include activities such as taking notes on the lecture underway, following the lecture information that the

instructor has posted, and finding Web sites to which the instructor directs students at the time of the lecture. Students who use their computers for other activities or who abuse the equipment in any way, at a minimum, will be asked to leave the class and may be referred to the Office of Student Conduct and Ethical Development for disrupting the course.

## **University Policies**

### **General Expectations, Rights and Responsibilities of the Student**

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arise. To learn important campus information, view [University Policy S90-5](http://www.sjsu.edu/senate/docs/S90-5.pdf) at <http://www.sjsu.edu/senate/docs/S90-5.pdf> and SJSU current semester's [Policies and Procedures](http://info.sjsu.edu/static/catalog/policies.html), at <http://info.sjsu.edu/static/catalog/policies.html>. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not address the issue, it is recommended that the student contact the Department Chair as the next step.

### **Dropping and Adding**

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. 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**

[University Policy S12-7](http://www.sjsu.edu/senate/docs/S12-7.pdf), <http://www.sjsu.edu/senate/docs/S12-7.pdf>, requires students to obtain instructor's permission to record the course and the following items to be included in the syllabus:

- “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 (Optional)**

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' free tutoring and mentoring is designed to assist students in the development of their full academic potential and to inspire them to become independent learners. Peer Connections tutors are trained to provide content-based tutoring in many lower division courses (some upper division) as well as writing and study skills assistance. Small group and individual tutoring are available. Peer Connections mentors are trained to provide support and resources in navigating the college experience. This support includes assistance in learning strategies and techniques on how to be a successful student. Peer Connections has a learning commons, desktop computers, and success workshops on a wide variety of topics. For more information on services, hours, locations, or a list of current workshops, please 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 and Psychological Services (Optional)**

The SJSU Counseling and Psychological Services is located on the corner of 7th Street and San Carlos in the new Student Wellness Center, Room 300B. Professional psychologists, social workers, and counselors are available to provide confidential 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 and Psychological Services website](http://www.sjsu.edu/counseling) at <http://www.sjsu.edu/counseling>.

# Tech 115 (Automation and Control), Spring 2017

The schedule below is subject to change. Any changes will be advised to the class via Canvas mail or an email from my University email address.

## Course Schedule

Week	Lecture Date/Lab Date	Topics, Readings, Assignments, Deadlines
1(Lec)	1/26/18	<b>Introduction to Automation and PLC's</b> Reading: Ch 1-Ch 2.3, 3.1, 3.2 and Module Links
1(Lab)	1/29/18, 1/30/18	<i>Final Project Overview</i> <b>Final Project-Read Ch 9 and 10</b>
2(Lec)	2/2/18	<b>Digital and Relay Logic/Specification of Components</b> Reading: Ch 2.4-2.10, 3.3, 3.4 and Module Links Homework_Intro to Automation_Logic_Components
2(Lab)	2/5/18, 2/6/18	<i>Arduino Basics Lab, How to Specify Controller</i> <b>Final Project-Group Formation Due</b>
3(Lec)	2/9/18	<b>Basics of PLC Programming</b> Reading: Ch 6 and Module Links Homework_Basics_PLC_Programming
3(Lab)	2/12/18, 2/13/18	<i>Introduction to Connected Components Workbench Lab, Ladder Logic Problems</i> <b>Final Project-Project Idea Due</b>
4(Lec)	2/16/18	<b>Op Amps, Control Concepts and PID Loop Theory</b> Reading: Read pgs 13-15 on PID Control, Ch 5 and Module Links Homework_Control_Concepts_PID
4(Lab)	2/19/18, 2/20/18	<i>Arduino Project</i> <b>Final Project-Project Functional Spec/Sequence of Operations Due</b>
5(Lec)	2/23/18	<b>Automation Component Selection Problem</b> Homework_Automation_Components
5(Lab)	2/26/18, 2/27/18	<i>No Lab This Week</i>
6(Lec)	3/2/18	<b>Mid Term 1</b>
6(Lab)	3/5/18, 3/6/18	<i>Arduino Project (Con)</i> <b>Final Project-Programming Algorithm/Flow Chart Due</b>
7(Lec)	3/9/18	<b>Motion Control Basics (Servo Motors, Step Motors, Amplifiers)</b> Reading: Ch 3.6 and Module Links Homework_Motion_Control_Basics_1
7(Lab)	3/12/18, 3/13/18	<i>No Lab This Week</i>

<b>Week</b>	<b>Lecture Date/Lab Date</b>	<b>Topics, Readings, Assignments, Deadlines</b>
8(Lec)	3/16/18	<b>Motion Control Basics (Mechanical Products and System Sizing)</b> Reading: Read 3.5, 3.7, 3.8, Ch 4 and Module Links Homework_Motion_Control_Basics_2
8(Lab)	3/19/18, 3/20/18	<i>Motion Analyzer Lab</i>
9(Lec)	3/23/18	<b>Motion Control Selection Problem</b> Homework_Motion Control Problem
9 (Lab)	3/26/18, 3/27/18	<i>Motion Analyzer Lab 2</i>
10 (Lec)	3/30/18	<i>No Lecture</i>
10(Lab)	4/2/18, 4/3/18	<b><i>Final Project Work</i></b>
11(Lec)	4/6/18	<b>Thyristors, AC Motors and Drives</b> Reading: Ch, 2.4, 3.6 (pg 121-122), 3.6.1 and 3.6.5 and Module Links Homework_Thyristors, AC_Motors_Drives
11(Lab)	4/9/18, 4/10/18	<i>AC Motors and Drives Lab</i> <b><i>Final Project Work</i></b>
12(Lec)	4/13/18	<b>Thyristors, AC Motors and Drives (con)</b> Reading: Ch, 2.4, 3.6 (pg 121-122), 3.6.1 and 3.6.5 and Module Links Homework_Thyristors, AC_Motors_Drives_2
12(Lab)	4/16/18, 4/17/18	<i>AC Motors and Drives Lab</i> <b><i>Final Project Work</i></b>
13(Lec)	4/20/18	<b>Mid-Term 2</b>
13(Lab)	4/23/18, 4/24/18	<b><i>Final Project Work</i></b>
14 (Lec)	4/27/18	<b>Sensors and Transducers</b> Reading: Module Links Homework_Sensors_Transducers_1
14 (Lab)	4/30/18, 5/1/18	<b><i>Final Project Work</i></b>
14(Lec)	5/4/18	<b>Sensors and Transducers/Trends in Manufacturing</b> Reading: Module Links Homework_Sensors_Transducers_2
14(Lab)	5/7/18, 5/8/18	<b><i>Final Project Work/Presentations</i></b>
15 (Lec)	5/11/18	<b>Final Review/Final Project Presentations</b>
15 (Lab)	5/14/18	<b><i>Final Project Presentations</i></b>
Final Exam	5/18/18	IS 216 Scheduled Time: 7:15 AM-9:30 AM (715-930)

