**IE 431.001 - Principles of Programmable Automation**
**Course Syllabus: Fall 2014**
**MW 9:00 – 10:40AM**
**Ag/ET 118A**


## Instructor:

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Department of Engineering & Technology

## Contact Information:

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***"Appointment Recommended"***


## COURSE INFORMATION

**Materials – Textbooks, Readings, Supplementary Readings:**

*Textbook(s) Required*: Groover, M. P. (2008) *Automation, Production Systems, and Computer-Integrated Manufacturing,* 3rd Ed. Pearson Education. ISBN 0-13-239321-2.

*Required Materials:*
1) Bound notebook, such as a composition notebook (Available at the A&M-Commerce bookstore or any office supply store)
2) *Scientific calculator*

*Reference Materials:* American Psychological Association (APA). (2009). *Publication Manual of the American Psychological Association,* 6th Ed. ISBN 1-4338-0561-8.

**Course Description:**

Concepts, principles, and relationships of automated assembly devices, computer aided drafting/design (CADD), computer-aided manufacturing (CAM), industrial robots, numerical control (NC), industrial lasers, programmable logic controllers (PLCs), automated guided vehicles (AGVs), flexible manufacturing systems (FMS), and computer- integrated manufacturing (CIM). Prerequisite: Consent of instructor.

**Student Learning Outcomes:**

Upon satisfactory completion of the course, the student will be able to:

1. Explain various reasons for employing automation in a manufacturing environment and describe various applications.
2. Describe the basic function of a sensor and an actuator in an automated system and give examples of both categories.
3. Select an appropriate sensor and/or actuator for a given automated application.
4. Describe the fundamentals of NC technology.
5. Use a Programmable Logic Controller (PLC) and embedded microcontroller, to perform specified control functions.
6. Describe the basic anatomy and attributes of an industrial robot.
7. Identify and distinguish the different components and interfaces in a Flexible Manufacturing System.
8. Troubleshoot a system and take appropriate action(s) to resolve the issue(s).
9. Design an automated system to meet defined operational specifications.

**Units of Study**

**Unit I – Introduction to Automation**

- Basic principles and strategies of automation (Chapter 1)
- Overview of manufacturing operations (Chapter 2)
- Basic elements of an automated system (Chapter 4)
- Overview of industrial control systems (Chapter 5)
- Hardware components; sensors, actuators, ADC,DAC (Chapter 6)

**Unit II – Automation and Process Control**

- Logic control systems (Chapter 9)
- Programmable Logic Controllers (Chapter 9)
- Microcontrollers (Chapter 5)

**Unit III – Robotics and Automated Manufacturing Systems**

- Industrial robotics (Chapter 8)
- NC technology (Chapter 7)
- Flexible manufacturing systems (Chapter 19)
- Computer Integrated Manufacturing (Chapter 23)

## COURSE REQUIREMENTS

### Instructional / Methods / Activities Assessments

This course will be presented using formats that include lectures, discussions, laboratory work, and/or group participation. Student participation and interaction is expected.

**Homework/Class Assignments: 15% of total course grade**

Student Learning Outcomes #1, #2, #3, #4, #5, #6, #7

Problems from the textbook or other resources will be assigned to support the instructional material. Students will apply theory and mathematical principles to solve applied engineering problems.

Assessment Method: Points will be allocated to each homework / classroom assignment. The total points per assignment will be based upon the number and complexity of the problems. Assignments will be graded both for accuracy as well as demonstrated knowledge of the topic being addressed.

**Laboratories / Engineering Notebook: 20% of total course grade**

Student Learning Outcomes #1, #2, #3, #5, #6, #7, #8, #9

Laboratory exercises will be assigned to support the instructional material. Students will gain practical hands-on experience in the areas of plant development, analog-to-digital / digital-to-analog conversion, logic control, embedded control, industrial robotics, and other related automation applications. Students will accurately document their laboratory experience through an engineering notebook.

Assessment Method: Points will be allocated to each laboratory based upon the complexity of the exercise. The total points will include the required documentation in an engineering notebook. Labs will be graded both for accuracy as well as demonstrated knowledge of the topic being addressed. Students will work in groups of two individuals to develop teamwork skills. Each group will keep an accurate record of the laboratory projects in an engineering notebook. The notebook must be bound with page numbers. The notebook should be used to record key meetings as well as ideas, results, observations, references, and any other information related to a project. This includes all design ideas and tests, whether they were successfully implemented or not.

***Sufficient detail should be included, which would allow someone to replicate the design and/or project with limited or no prior knowledge of the project.***

Key Guidelines:

- Entries should be legible and made in ink.
- Entries should be made at the time the work is completed rather than taking notes on scratch paper and transferring it at a later time.
- The first few pages should be reserved for the Table of Contents. The description title and associated page number should be included separately for each entry made in the notebook. Ensure the title of the entry is used in the Table of Contents.
- Date each entry in the notebook.

- Title each entry so it can be easily associated with a given project.
- For every entry, list each person who participated in the meeting, test, or effort being documented. Ideally, each lab partner will initial and date following each entry but this is not required as long as the individuals are clearly identified.
- Include all design iterations and tests, whether they were successfully implemented or not. The notebook should be a history of the project not just a report on the characteristics of the final product.
- Include descriptions of the equipment and/or software used in tests and/or analyses. Software versions are critical as later versions may or may not perform in the exact same manner.
- Line out errors, never erase.
- Include graphics, schematics, and tables as appropriate.

A format similar to the one shown in the following examples should be used for the Table of Contents and journal entries, unless otherwise specified by the instructor. The examples are intended to represent two random pages out of a notebook.

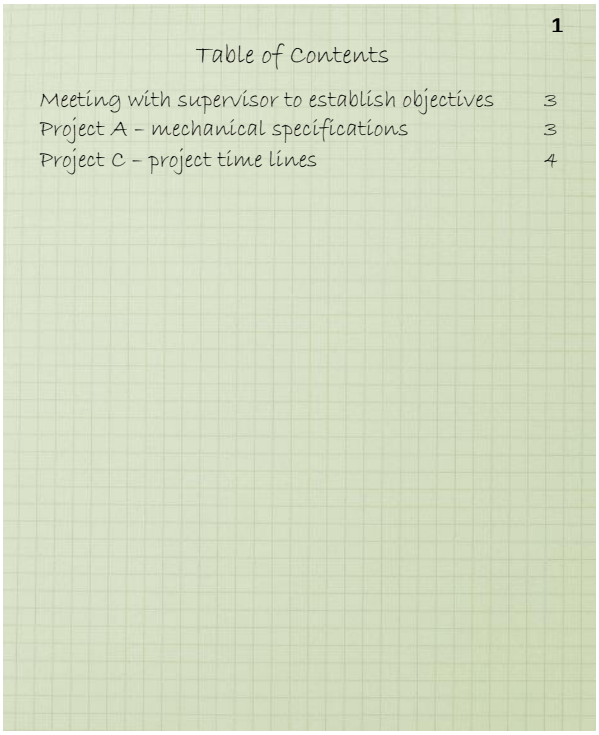

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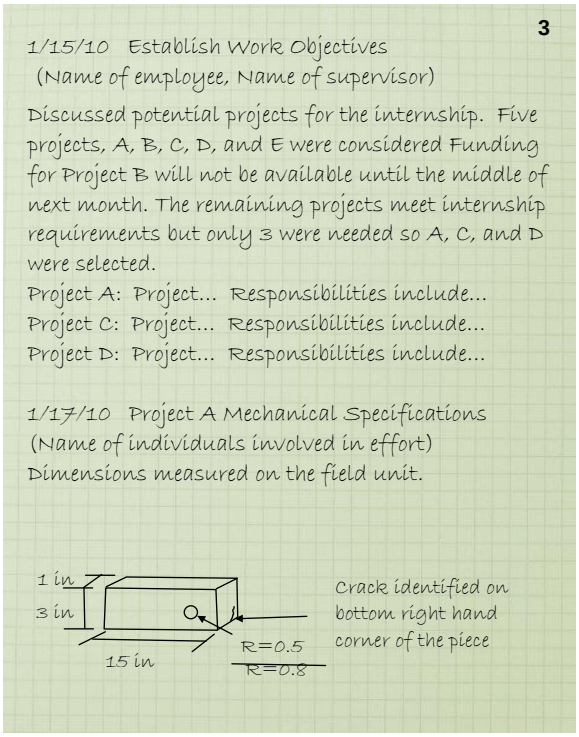
Table of Contents





3

1/15/10 Establish Work Objectives
(Name of employee, Name of supervisor)

Discussed potential projects for the internship. Five projects, A, B, C, D, and E were considered Funding for Project B will not be available until the middle of next month. The remaining projects meet internship requirements but only 3 were needed so A, C, and D were selected.
Project A: Project… Responsibilities include…
Project C: Project… Responsibilities include…
Project D: Project… Responsibilities include…

1/17/10 Project A Mechanical Specifications
(Name of individuals involved in effort)
Dimensions measured on the field unit.



**Tests & Final Exam: 65% of total course grade**

Student Learning Outcome #1, #2, #3, #4, #5, #6, #7

Tests and a final exam will be used to asses a student's knowledge and skills related to industrial automation.

Assessment Method: Two tests and a final exam will be conducted. Test #1 will assess the material / topics covered under Unit 1. Test #2 will assess the material / topics covered under Unit 2. The final exam will be comprehensive and will assess material / topics from all three units but with an emphasis on Unit 3. The tests and final exam will

be worth 100 points each. The tests will each account for 20% of the final grade and the final exam will account for 25% of the final grade.

No make-up tests/exams will be given. If a student misses one of the first two tests, then that missed examination will be assigned 85.0% of that student's Final Exam grade, regardless of the reason(s) for missing the examination. An examination grade equal to "0" because of a violation of the student expectations or academic dishonesty policy stated earlier counts as a missed test, but the grade cannot be replaced. Upon missing the second of the first two tests, students will be assigned a final grade of "F" for the course and will not be allowed to attend any more class meetings, regardless of the reason(s) for missing the examination. If a student misses the Final Exam, then that student will be assigned a final grade of "F" for the course, regardless of the reason(s) for missing the Final Exam. A Final Exam grade equal to "0" because of a violation of the student expectations or academic dishonesty policy stated earlier counts as a missed Final Exam. Students are required to use 8.5"×11" sheets of green engineering paper handwritten front and back for any graphical requirements will be done on the green engineering paper. Students will need a scientific calculator for each test - unless the instructor states otherwise, it is the only computing or electronic storage device allowed during tests. If an examination is designated to be “open book” examination, the student will **NOT** be allowed to use an electronic book format during the exam period.

**Grading**

The ***final course grade*** will be based upon the following:

| Assessments | | Grading Scale | |
|---|---|---|---|
| Homework/Class assignments | 15% | 90 – 100 | A |
| Labs/Engineering Notebook | 20% | 80 – 89 | B |
| Test #1 | 20% | 70 – 79 | C |
| Test #2 | 20% | 60 – 69 | D |
| Final Exam | 25% | <60 | F |

***All assignments are due one week from the day they were assigned unless specified otherwise in the syllabus or by the instructor. Late work will not be accepted and a grade of “0” will be assigned, unless prior arrangements are worked out with the instructor. Late penalties will be assessed to any prior-arranged approved late work.***

## TECHNOLOGY REQUIREMENTS

The following technologies will be required for this course.

- Internet access / connection
- Microsoft Word
- Microsoft Excel

The following technologies will be provided and utilized in the course.

- MultiSIM
- BASIC Stamp Windows Editor version 2.4.2
- Boe-Bot Robotic kit
- CM-184 PLC Training System
- Industrial robotics
- NC / CNC machining tools

## COMMUNICATION AND SUPPORT

**Interaction with Instructor Statement:**

Outside of the classroom, email will be the primary communication tool. Students should communicate with the instructor via email at the address provided in this syllabus. The instructor will communicate with students via email through their myLeo email address.

## COURSE AND UNIVERSITY PROCEDURES/POLICIES

**Course Specific Procedures:**

**Academic Dishonesty**

Texas A&M University-Commerce will not condone plagiarism in any form. Plagiarism represents disregard for academic standards and is strictly against University policy. Plagiarized work can result in a "0" on a given assignment(s) or an "F" for the course as well as further administrative sanctions permitted under University policy. You may discuss course work and other course materials with fellow students (except during tests), but it is inappropriate to have another student do your course work or provide you with any portion of it.

Guidelines for properly quoting someone else's writings and the proper citing of sources can be found in the APA Publication Manual. If you do not understand the term "plagiarism", or if you have difficulty summarizing or documenting sources, contact your professor for assistance.

**University Specific Procedures:**

**Students with Disabilities**

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services
Texas A&M University-Commerce
Gee Library, Room 132
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
StudentDisabilityServices@tamuc.edu

**Student Conduct**

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. (See *Code of Student Conduct from the Student Guide Handbook).*

Students are expected to attend all class periods and to be prepared for each class. Students are expected to refrain from any disruptive behaviors during class, which includes but is not limited to working on assignments/projects from another course, reading non-course materials, or using the computer for non-class purposes. Cell phones and other electronic devices should be turned off during class.

## COURSE OUTLINE / CALENDAR

| | Topic | Assignment(s) |
|---|---|---|
| Week 1 | **Unit I – Introduction to Automation**<br>Course Introduction | Reading: Chap 1<br>Lab:<br>Assignment: |
| Week 2 | Manufacturing operations | Reading: Chap 2<br>Lab: New Plant Development Case Study<br>Assignment: |
| Week 3 | Introduction to automation<br>Introduction to industrial control systems | Reading: Chap 4, 5 (p. 88-97)<br>Lab:<br>Assignment: |
| Week 4 | Sensors<br>Actuators<br>Analog-to-Digital/Digital-to-Analog converters | Reading: Chap 6<br>Lab: ADC / DAC Conversions<br>Assignment: |
| Week 5 | Analog-to-Digital/Digital-to-Analog converters<br>**TEST #1 (Unit 1)** | Reading: Chap 6<br>Lab:<br>Assignment: |
| Week 6 | **Unit II – Automation and Process Control**<br>Industrial Controllers<br>Logic control systems | Reading: Chap 9 (p. 250-257)<br>Lab: Logic Control Circuits<br>Assignment: |
| Week 7 | Industrial Controllers<br>Logic control systems | Reading: Chap 9 (p. 250-257)<br>Lab: Logic Control Circuits<br>Assignment: |
| Week 8 | Industrial Controllers<br>Programmable Logic Controllers (PLC) | Reading: Chap 9 (p. 258-270)<br>Lab: Ladder Logic / PLCs<br>Assignment: |
| Week 9 | Industrial Controllers<br>Programmable Logic Controllers (PLC) | Reading: Chap 9 (p. 258-270)<br>Lab: Ladder Logic / PLCs<br>Assignment: |
| Week10 | Industrial Controllers<br>Microcontrollers | Reading: Chap 5 (p. 97-111), handouts<br>Lab: Embedded Control<br>Assignment: |
| Week 11 | Industrial Controllers<br>Microcontrollers | Reading: Handouts<br>Lab: Embedded Control<br>Assignment: |
| Week 12 | **TEST #2 (Unit 2)**<br>**Unit III – Robotics and Automated Mfg Sys**<br>Industrial robotics | Reading: Chap 8<br>Lab:<br>Assignment: |
| Week 13 | Industrial robotics | Reading: Chap 8<br>Lab: Industrial Robotics<br>Assignment: |
| Week 14 | NC Technology | Reading: Chap 7<br>Lab: NC Demonstration<br>Assignment: |
| Week 15 | Flexible manufacturing systems (FMS)<br>Computer Integrated Manufacturing (CIM) | Reading: Chap 19, 23 (p. 697-712)<br>Lab: CIM Demonstration<br>Assignment: |
| Week 16 | **Final Exam (Unit 1, 2, & 3)** | |