ISE 716 – 001/601
Automated Systems Engineering

Spring 2015

Class Time: 3:00-4:15 PM, Tu. Th.
Class Room: Daniels 327

Instructor: Professor Yuan-Shin Lee, Ph.D., P.E.
Phone: 919-515-7195

Office: Daniels 414-B
E-mail: yslee@ncsu.edu

Course web site: http://wolfware.ncsu.edu

EOL web site: http://engineeringonline.ncsu.edu/onlinecourses/coursehomepages/SPR-2015/ISE716.html

Office Hours:

Section 001: For on-campus students, my office hours are: Tu., Th. 1:30 - 2:30 PM. Or, you can stop by my office any other time when I am in my office.

Section 601: For distance education students, Email questions at any time to me or TA, and we will answer as soon as possible. (When I am in traveling for meetings, I might be slow in responding E-mails though). If you want to talk by phone, you can send an Email and we can schedule a teleconference meeting time.

Teaching Assistants:

Mr. Caesar Qin
TA's E-mail: xqin2@ncsu.edu
TA’s Phone: 919-373-5508

TA Office Hours:
Office Hrs: Mon., 1:30 - 2:30 PM
Wed., 1:30 - 2:30 PM
Fri., 1:30 - 2:30 PM

TA Office: Daniel Hall 110 (Systems Lab)

Prerequisites: Graduate Standing.


Lecture notes available through the class web site.

Course Overview:

This is an introductory course to automated systems engineering that will cover the basic automation technologies used in the industry. This is a graduate introductory level engineering course intended to introduce students to automated systems engineering. This course introduces basic automation techniques of programmable logic controls, robotics programming, computer aided manufacturing, computer numerical control, and computer
integrated manufacturing systems. No prior knowledge of automated systems engineering is assumed. The course includes lectures, two midterm exams, a final semester project, and approximately 6-8 homework assignments.

Course Objectives:

Upon completion of this course, students should be capable of:

- Describe the system control loops and the new trend of automated manufacturing systems
- Analyze, select, and design the programmable logic control (PLC) systems using Boolean logic, ladder diagrams, concept of blocks, scan cycle, and PLC programming for sequential controls in manufacturing automation
- Design and apply the real-time control systems by applying the response diagrams, counters, timers, and PLC programming for the synchronous and asynchronous controls in manufacturing automation
- Describe, select, apply the robotics control, robotics programming, material handling automation, assembly automation, and robotics automation technologies for the flexible manufacturing systems automation
- Describe, select and apply the computer aided manufacturing (CAM), the Automatic Programming Tool (APT), and computer numerical controlled (CNC) programming techniques for the computer aided design/manufacturing (CAD/CAM) systems
- Describe, select, apply the group technology (GT), rank-order clustering algorithms, the decision-tree, decision-table, generative, variant process planning, for the process planning and cellular manufacturing automation

COURSE ORGANIZATION:

This course consists of the following:

1. Lectures
2. Homework assignments*, In-class quizzes* and Mini-Project assignments*- homework or in-class quizzes* will be given from time to time. Programming and simulation-based mini-project assignments will be given in the class. Mini-Project assignments usually are more difficult and you need more time in solving the lab assignments. (*. The exact numbers of homeworks, and in-class quizzes will be determined throughout the course of the semester.)
3. Midterm Tests - Two midterm tests will be given in the class.
4. Final Term Project: A final project will be assigned and completed during the semester.

GRADING:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>Homeworks and In-class Assignments</td>
<td>15%</td>
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<tr>
<td>Mini-Project Assignments</td>
<td>15%</td>
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<tr>
<td>Midterm Test</td>
<td>20%</td>
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<tr>
<td>Final Project &amp; Reports</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
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</table>
The plus/minus grading system will be used in this class. The course letter-grade is determined by the plus/minus grading system will be used in this class. The course letter-grade is determined by the following scale (G = grade):

\[
\begin{align*}
100 & > G \geq 96.67 = A+; \\
96.67 & > G \geq 93.33 = A; \\
93.33 & > G \geq 90 = A-; \\
90 & > G \geq 86.67 = B+; \\
86.67 & > G \geq 83.33 = B; \\
83.33 & > G \geq 80 = B-; \\
80 & > G \geq 76.67 = C+; \\
76.67 & > G \geq 73.33 = C; \\
73.33 & > G \geq 70 = C-; \\
70 & > G \geq 66.67 = D+; \\
66.67 & > G \geq 63.33 = D; \\
63.33 & > G \geq 60 = D-; \\
60 & > G = F.
\end{align*}
\]

**ADMINISTRATIVE POLICIES:**

1. No late homework will be accepted. Homework is due during on the date and time specified at the course web page and should be submitted through the online system before the due time.

2. **No after-fact excuse** on missing assignment or test will be accepted. If you shall have a job interview you will have to let me know at least a week in advance. After-fact excuse is not acceptable.

3. You must show all calculations or procedures in your exams and homework assignments in order to get full credit.

4. This is an engineering course, you are expected to act as a responsible engineer. Every document handed-in must be neatly prepared. Sloppy work may cost you points.

5. **Academic Integrity:** It is understood and expected that all work turned in under your name is your own work and that you have neither given nor received unauthorized aid. The University policy on academic integrity can be found in the Code of Student Conduct (see Appendix L of the Handbook for Advising and Teaching: [www.fis.ncsu.edu/ncsulegal/41.03-codeof.htm](http://www.fis.ncsu.edu/ncsulegal/41.03-codeof.htm)).

6. **Incomplete Grades and Late Assignments:** If requested by a student, the grade of Incomplete will be given for work not completed because of a serious, documented interruption in the student’s work not caused by their own negligence.

7. **Absences and Scheduling Make-up Work:** A make-up exam will be scheduled if a student has an excused absence according to the University regulations (see [http://www.ncsu.edu/provost/academic_regulations/attend/reg.htm](http://www.ncsu.edu/provost/academic_regulations/attend/reg.htm) for NC State’s policy on excused absences). There are no make-up in-class quizzes; the lowest one of the in-class quizzes will be dropped in lieu of any absence.

8. Online class evaluations will be available for students to complete during the last two weeks of the semester. Students will receive an email message from the University directing them to a website where they can login using their Unity ID and complete evaluations.

**COURSE MATERIAL AND SCHEDULE:** (next page)
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Textbook</th>
<th>Homework</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Th. 1/8</td>
<td>Introduction of Manufacturing Automation</td>
<td>Chapt. 1</td>
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<tr>
<td>2</td>
<td>Tu. 1/13, Th. 1/15</td>
<td>Elements of Automation, Industrial Control Systems &amp; Process Control</td>
<td>Chapt. 4, Chapt. 5</td>
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<tr>
<td>3</td>
<td>Tu. 1/20, Th. 1/22</td>
<td>Hardware Components for Automation, Discrete Control</td>
<td>Chapt. 6, Chapt. 9</td>
<td>HW#1</td>
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<tr>
<td>4</td>
<td>Tu. 1/27, Th. 1/29</td>
<td>Logic Control &amp; Switch Theory, Programmable Logic Control &amp; Boolean Algebra</td>
<td>PLC_Note1, PLC_Note2</td>
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<tr>
<td>5</td>
<td>Tu. 2/3, Th. 2/5</td>
<td>Ladder Diagrams for Controls, Flip-Flops &amp; Sequential Control</td>
<td>PLC_Note3, PLC Note4</td>
<td>HW#2</td>
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<tr>
<td>6</td>
<td>Tu. 2/10, Th. 2/12</td>
<td>Mini-Project of RSLogix and Programming, Finite State Diagrams for Control Syst. Design</td>
<td>PLC_Note5</td>
<td>Min.Pjt. #A</td>
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<td>7</td>
<td>Tu. 2/17, Th. 2/19</td>
<td>Timers &amp; Counters for Controls, Scan Cycle &amp; Programmable Logic Control (PLC)</td>
<td>PLC_Note6, PLC Note7</td>
<td>HW#3</td>
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<tr>
<td>8</td>
<td>Tu. 2/24, Th. 2/26</td>
<td>Response Diagrams for Control Syst. Design, Exam 1 - (in-class exam)</td>
<td>PLC_Note8</td>
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<tr>
<td>9</td>
<td>Tu. 3/3, Th. 3/5</td>
<td>Mini-Project of PLCs and Automation Exercises, Robot Control Systems and Applications.</td>
<td>Chapt. 8</td>
<td>Min.Pjt.#B, FPrjt. Prosl</td>
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<td>10</td>
<td>Tu. 3/10, Th. 3/12*</td>
<td>(No class --- Spring Break), (No class --- Spring Break)</td>
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<td>11</td>
<td>Tu. 3/17, Th. 3/19</td>
<td>Robotic Programming and Trajectory Control, Mini-Project of Robotic Control Automation</td>
<td>Chapt. 8, Chapt. 7</td>
<td>HW#4, Min.Pjt.#C</td>
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<tr>
<td>12</td>
<td>Tu. 3/24, Th. 3/26</td>
<td>Numerical Control (NC) for Automation, 2D Numerical Control Part Programming</td>
<td>NC_Note1, NC_Note2</td>
<td>HW#5</td>
</tr>
<tr>
<td>13</td>
<td>Tu. 3/31, Th. 4/2*</td>
<td>Automated Programming Tool (APT), (No class --- Spring Holiday)</td>
<td>NC_Note3</td>
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<tr>
<td>14</td>
<td>Tu. 4/7, Th. 4/9</td>
<td>Computer-Aided Manufacturing (CAM), Mini-Project of Numerical Controls and CAM</td>
<td>NC_Note 4</td>
<td>Min.Pjt.#D</td>
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<td>15</td>
<td>Tu. 4/14, Th. 4/16</td>
<td>Automation of Cellular Manufacturing Systems, Automatic Identification &amp; RFID for Automation</td>
<td>Chapt. 18, Chapt. 12</td>
<td>HW#6</td>
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<td>16</td>
<td>Tu. 4/21, Th. 4/23</td>
<td>Automated Production Lines &amp;Assembly Systems, Lab on semester final project prototyping</td>
<td>Chapt. 16&amp;17</td>
<td>FN.Project</td>
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<tr>
<td>17</td>
<td>Th. 5/7</td>
<td>Exam 2 (1:00 PM scheduled by the University)</td>
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