IE 455-001: Robotics and Programmable Logic Controllers

Wen Zhu

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BSIE PROGRAM EDUCATIONAL OBJECTIVES

I. Program graduates use the fundamental principles and major areas of Industrial Engineering in their professional practice.

II. Program graduates are life-long learners, pursuing graduate education, and professional growth in Industrial Engineering and related fields.

III. Program graduates pursue diverse career paths and advance in a variety of industries.

BSIE STUDENT OUTCOMES

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social and economic factors

(3) An ability to communicate effectively with a range of audiences

(4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and social contexts

(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

(6) An ability to conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions

(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

IE 455 OUTCOMES OF INSTRUCTION

The students will:

1. Learn to jog the robot (1).

2. Learn to create, modify, and execute a robot program (1).

3. Learn to develop and design PLCs (1).

4. Learn to program in ladder logic (1).

5. Apply Engineering Ethics to actual industrial robot operations and PLC programming (4).
COURSE DESCRIPTION
This course provides a comprehensive description of the concepts of manufacturing systems, manufacturing metrics and economics with variety of examples on them. The objective of this course is to teach students the basics of robot systems and to give hands on experience with robots that are used in current production environments as well as PLC programming. The lab experiments of the course focus on two fundamental objectives: 1) PLCs programming and troubleshooting, using simulator and HMI which train students to execute real world projects; 2) Programming and troubleshooting techniques necessary to run industrial robots. Moreover, during the class students will gain exposure to quantitative methodologies and algorithms to analyze the automated manufacturing systems.

TEACHING ASSISTANT
Zijia Wang  Email: zw392@njit.edu

CANVAS
The course will make extensive use of the Canvas system to optimize student-instructor communication. All course materials including lecture slides and homework etc. will be distributed through Canvas. All submission of homework and other assignments will also be through Canvas. To access the system please go to https://canvas.njit.edu, you will need a valid UCID to login.

ONLINE CLASS SESSIONS & WEBEX: Due to the extraordinary circumstances caused by the COVID-19 outbreak, this course will transition to synchronous online learning mode for this semester. This syllabus lists activities for the whole semester. Most times during the semester we will be having an online class session. During these sessions I will discuss course material, have discussions with students and initiate discussions. These sessions will be conducted through the WebEx platform which is integrated with Canvas. To enter the WebEx class, click on WEBEX CLASSROOM LINK at the top of the course Canvas page.

Specifically, (i) Exams will be done Online (ii) Online Live Lectures and Tutorials are specified by date and (iii) Two face-to-face labs are specified by date and time, others will be completed virtually. Please review the schedule carefully so that you can attend classes through our virtual WebEx classroom.

VIDEO RECORDING OF LECTURES – To maximize the online class experience, each class session will be recorded and archived. You can access these files at your convenience. From the course Canvas page, you will see the archived WEBEX SESSIONS listed in the corresponding topic box and referenced by session date.

COURSE MATERIAL

Provided Material on Moodle: PowerPoint Slides, Videos, Reading Material
GRADING
Based in individual and team performance as follows:

15% Homework #1
15% Homework #2

25% Midterm Exam
25% Final Exam

10% Lab Assignments
10% PLC Project & Report

LAB TEAMS & TEAM PROJECT
The course involves several experiments and PLC project that are to be completed by all students. All experiments and the project will be completed in teams of 2 students. Please select your teams to match your skills. During the lab class the corresponding experiment will be demonstrated by the instructor and the course TA.

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<td><strong>Learning Module 2: Industrial Robotics</strong></td>
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| **Week 6** | **Robotic Lab #1 – Face-to-Face at Lab 2310**  
Lab maximum is 8 students per time slot  

**10/6/2020**  
Team #1, 2, 3  12:30 – 1:45 PM  
Team #4, 5  1:45 – 2:35 PM  

**10/8/2020**  
Team #6, 7  12:30 – 1:30 PM  
Team #8, 9  1:30 – 2:30 PM |
| **Week 7** | **Robotic Lab #2 – FANUC ROBOGUIDE Simulation Software (10/13/2020 & 10/15/2020)**  
Remote Access to Lab Computers |
| **Week 8** | **Midterm Exam Review (10/20/2020)**  
**Online Midterm Exam (10/22/2020)** |
| **Learning Module 3: Programmable Logic Controllers** |
| **Week 9** | **CH8 Industrial Robotics – Robot Accuracy and Repeatability (10/27/2020)**  
| **Week 10** | **PLC Lab #1 – Face-to-Face at Lab 2310**  
Lab maximum is 8 students per time slot  

**11/3/2020**  
Team #1, 2, 3  12:30 – 1:45 PM  
Team #4, 5  1:45 – 2:35 PM  

**11/5/2020**  
Team #6, 7  12:30 – 1:30 PM  
Team #8, 9  1:30 – 2:30 PM |
| Week 11 | PLC Lab #2 (11/10/2020)  
|        | Remote Access to Lab Computers  
|        | 5 Lab Computers Installed IDEC PLC Software  
|        | PLC Lab #3 (11/12/2020)  
|        | Remote Access to Lab Computers  
|        | 5 Lab Computers Installed IDEC PLC Software  

| Week 12 | PLC Term Project Prepare (11/17/2020 &11/19/2020)  
|        | Remote Access to Lab Computers  
|        | 5 Lab Computers Installed IDEC PLC Software  

**HW #2**

| Week 13 | PLC Term Project Prepare (11/24/2020)  
|        | Remote Access to Lab Computers  
|        | 5 Lab Computers Installed IDEC PLC Software  

Thursday, 11/26/2020 – Thanksgiving

| Week 14 | PLC Term Project Prepare (12/1/2020 &12/3/2020)  
|        | Remote Access to Lab Computers  
|        | 5 Lab Computers Installed IDEC PLC Software  

| Week 15 | PLC Term Project Presentation (12/8/2020)  
|        | Remote Access to Lab Computers  
|        | 5 Lab Computers Installed IDEC PLC Software  

Final Exam Review (2020/12/10)

| Week 16 | **Online Final Exam (Date to be announced by Registrar)**

**STATEMENT ON ACADEMIC INTEGRITY**

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: [http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf](http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf).
Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu