INDUSTRIAL ENGINEERING DEPARTMENT

IE 48b
Special Topics: Robotic Manufacturing Systems
Fall 2016

Type: Elective
Credits/ECTS: 3 Credits / 6 ECTS
Class/Laboratory schedule: 2 hrs class/2 hrs lab (to be arranged)
Instructor: Ümit Bilge
Prerequisite(s):   IE 201

Course Description:

This special course focuses on real-time control of robotic manufacturing systems and aims to introduce the third and fourth grade IE students to the state-of the-art issues in the area of advanced manufacturing through hands-on experience in BUFAIM- Flexible Automation and Intelligent Manufacturing Laboratory. After getting introduced to several automation concepts such as industrial robots, 3D printers, automated guided vehicles and RFID, and gaining an understanding of flexible manufacturing and the real-time operational decisions required for controlling such systems, the focus is set on the usage of the robot arms in BUFAIM Model Factory, their controller software, and the interaction between the real-time Shop Floor Control (SFC) system and the robot controllers. During the project, students will design and implement robot control programs and their interface with the existing SFC software in BUFAIM, so that the Model Factory operates seamlessly and enables new directions for potential research within the context of the Industry 4.0 concept. The students (individually or in teams) are expected to analyze the given case, come up with a good design, implement, verify and document their solution, and present it.

Grading:

Grading will be based on attendance / contribution in classes and lab hours / contribution to teamwork / assignments related to the different phases of the project/ and presentations. Attendance and participation is strictly required for passing.

Enrollment:

Registration will be upon consent of the instructor. Please make an appointment and meet the instructor before requesting on-line consent.

Textbook(s) / other required material:

Class notes, assignment information handouts, assignments, and other material will be available as softcopy at the beginning of the term. The following will be reserved at BUFAIM Lab for reference:

- Groover, M.P., "Automation, Production Systems, and Computer Integrated Manufacturing", Prentice Hall, 2008.
- Gibson, Rosen and Stucker, "Additive Manufacturing Technologies", Springer, 2015.

Course objectives (and program outcomes):

This course aims to provide students with the skills and methods for modeling, design, control and simulation of computer integrated automation systems such as Flexible Manufacturing Systems as well as using several automated hardware. By the completion of the course, the students will be able to:

- Discuss history and types of automation
- Discuss the need for integration and flexibility in manufacturing
- Understand basic technological aspects and use correctly the main technical jargon related to several automation entities including additive manufacturing, robotics, automated guided vehicles (AGV) and RFID
- Discuss Shop Floor Control (SFC) and different approaches and issues related to SFC
- Discuss the concept of Industry 4.0
- Use and program robots within cell control and shop floor control (SFC) contexts
- Use 3D printers and appreciate the new opportunities presented by additive manufacturing

Considering these objectives, this course mainly addresses the following student outcomes of the industrial engineering undergraduate program;

- *Student Outcome (c):* An ability to design diverse systems including manufacturing, service, logistics, financial and information, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- *Student Outcome (e):* An ability to identify, model, formulate and solve industrial engineering problems
- *Student Outcome (k):* An ability to use the techniques, skills, and modern engineering tools necessary for industrial engineering practice.
- *Student Outcome (d):* An ability to function in (multi-disciplinary) teams

Tentative schedule:

1. Automation and Computer Integrated Manufacturing (week 1)
2. Flexibility and Flexible Manufacturing Systems (week 2)
3. Shop Floor Control and Shop Floor Control architectures (week 3)
4. The concept of Industry 4.0 (week 4)
5. Additive Manufacturing (3D printing) (weeks 4-5)
6. Industrial Robotics (week 6)
7. Overview of the BUFAIM Model Factory Shop Floor Control software (week 7)
8. Project: Problem definition and requirements analysis (weeks 8)
9. Project: Design and development meetings (weeks 9-12)
10. Project presentation and discussions (week 13)

Prepared by, and date of preparation: Ümit Bilge, August 2016