INDUSTRIAL ENGINEERING DEPARTMENT

IE 486
Flexible Manufacturıng Systems
Fall 2015

Type:	Elective
Credits/ECTS:	3 Credits / 6 ECTS
Class/Laboratory/PS schedule:	Wednesday 15:00-16:50 (BUFAIM Lab)
	Friday 11:00-12:50 (BUFAIM Lab)
Instructor:	Ümit Bilge
Prerequisite(s):	IE 306 (Systems simulation), or equivalents.

Course Description:
This is a project based course that focuses on modeling, simulation and control of flexible manufacturing systems (FMS) and aims to introduce the students to the research conducted in BUFAIM- Flexible Automation and Intelligent Manufacturing Laboratory. After providing an understanding of the nature and context of FMSs, their components and the real-time operational decisions required for controlling such systems, the focus is set on the FMS simulation and model factory control software developed and used in BUFAIM, together with potential research areas. The software is analyzed using reverse engineering approach and students are asked to design and implement some new features and enhancements that will give the software new directions for potential research using object oriented (OO) methodology. Students are expected to analyze a given problem domain or case, come up with an OO design, implement, verify and document their software, and present it.

Textbook(s) / other required material:
- Selected journal/conference papers
- FMS.NET Documentation, BUFAIM 2008.
- U. Beşikçi. A distributed time-stepped simulation approach for Analysis and comparison of shop floor control architectures, Ms.Sci. Thesis, Boğaziçi University, 2006.
- N.Singh, Systems Approach to Computer Integrated Design and Manufacturing, J.Wiley and Sons, 1996.

Course objectives (and program outcomes):
This course aims to provide students with the skills and methods for modeling, design, control and simulation of complex systems such as Flexible Manufacturing Systems. Facilitating the appreciation of academic research is also aimed by going through all stages of a project through teamwork. By the completion of the course, the students will be able to:
- Discuss flexible manufacturing concepts
- Discuss Shop Floor Control (SFC) and different approaches and issues related to SFC
- Discuss distributed vs. centralized simulation concepts
- Analyze an existing software through its Unified Modeling Language (UML) diagrams
- Reverse engineer an existing software and document it using UML methodology
- Assess shortcomings and requirements for development

- Design new software using UML methodology
- Implement and verify new software using a state of the art programming language (C#)
- Conduct experimentation and report its results

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

Topics covered:

1. Definition of Flexibility and Flexible Manufacturing Systems (2 classes)
2. Programming with C# (6 classes)
3. Shop Floor Control and Shop Floor Control architectures (2 classes)
4. Distributed simulation methodology (2 classes)
5. Software Analysis: Introduction and overview of FMS.NET architecture (2 classes)
6. Software Analysis: FMS.NET Object Model (2 classes)
7. Software Analysis: FMS.NET Sequence diagrams (8 classes)
8. Introduction and overview of the distributed simulation software for BUFAIM Model Factory Shop Floor Control (2 classes)
9. Project: Problem definition and requirements analysis (2 classes)
10. Project: Software analysis through reverse engineering (10 classes)
11. Project: Design and development meetings (12 classes)
12. Project pre-submission and discussions (2 classes)

Grading:

Attendance / contribution in class / contribution to teamwork : 25 %
Assignments / presentations : 20 %
Project content : 35 %
Project documentation : 20 %

Prepared by, and date of preparation: Ümit Bilge, September 2014