Philadelphia University
Faculty of Engineering & Technology
MSc. Mechatronics Engineering

Second Semester, 2019/2020

Course Syllabus

Course Title: Distributed & Embedded Real-Time Systems	
Course Level: MSc	Course Prerequisite: ---
Class Time: Saturday 15:00-18:00	Credit Hours: 3

Academic Staff Specifics

Name	Rank	Office No.	Office Hours	E-mail Address
Kasim Al-Aubidy	Prof.		15:00-16:00 Weekly	*kma@philadelphia.edu.jo*

Course Description:
Mechatronics is the merger of mechanics, electronics and computer concepts. This course involves computer interfacing and programming to control mechanical objects. In this course we will use a microcontroller or a field programmable chip (computer-on-a-chip) to interface with Mechatronics components such as switches, LED's, DC motors, stepper motors, relays, remote controls, and others. It will also present Personal Computers Interface (PCI) through Data Acquisition Cards (DAQ).

Course Objectives:
The main objective of this course is to cover the principles and design methods of real-time computer systems. It covers the interfacing techniques and microprocessor system realization. The principles of real-time operating systems and real-time software system will be covered in this course.

Course Components:

- **Books (title , author (s), publisher, year of publication):** Real-Time Systems: Design Principles for Distributed Embedded Applications, By: Hermann Kopetz, Springer, 2011, ISBN: 144198237X.
- **Support material(s): (vcs, acs, etc).**
- **Study guide(s) (if applicable)**
- **Homework and laboratory guide(s) if (applicable).**

Teaching Methods:
Lectures, Discussion groups, Tutorials, Problem solving, Projects, Debates, etc.

Learning Outcomes:

On completing the course, students will e able to have to following skills:

- **Knowledge and understanding**
  - **A1-Tell the principles of microcontroller-based systems design**
  - **A2-. Mention the design requirements of embedded systems.**
- **Intellectual skills**
  - **B1. Show improved comprehensive quality and innovative ability**
  - **B2. Design and implement a real system based on a single chip microcontroller**
- **Professional and practical skills**
  - **C1. Implement small mechatronics system considering both H/W and S/W requirements for a single-chip design.**
  - **C2. Work with system design development tools such as MATLAB, LABVIEW, PROTEUS or any other available software.**
- **General and transferrable skills**
  - **D1. Use programmable chip to manage operation of a Mechatronic system**
  - **D2. Choose suitable hardware and software components for a reliable system.**

Assessment Instruments:

- **Short reports and presentations**: Reading related to current topic will be assigned every week. Assignments and other Homework (HW) will be given throughout the semester, focusing on the concepts learned from these readings.
- **Project:** Project is an essential part of this course. Assessment will be based on 3 phases: System Specification, System Design, Hardware and Software Implementation with Project Demonstration. Detailed topics and schedule will be announced in due course.
- **Final examination**: 50 marks

Allocation of Marks	
Assessment Instruments	**Mark**
MID examination	30%
Assignments, Project & Presentation	30%
Final Examination:	40%
Total	100%

Documentation and Academic Honesty:

- **Documentation style (with illustrative examples)**
- **Protection by copyright**
- **Avoiding plagiarism.**
- **Ethics and Disability Act:**
  - **Students may consult with one another on solutions, but copying another student's code is strictly prohibited.**
  - **Students should write their own code. Using code found on books or internet is prohibited.**
  - **The Instructor follows general university "Academic Dishonesty/Cheating Policy".**

Course Academic Calendar:

Week	Basic and support material to be covered	Homework/ reports
1	An introduction to distributed and embedded real-time systems.	
2	Elements and classification of distributed and embedded real-time systems.	
3	Computer control systems; Sequence control, DDC, PID control, Supervisory control, Adaptive control, Intelligent control. Hierarchical and Distributed systems.	Project Selection
4	Real-time environment, Why a distributed solution?	HW1
5	Hardware design requirements; analog, digital, pulse interfacing.	Assignmentn1
6	Embedded system design requirements; single- chip and single-board design.	Project (Phase1)
7	Microcontroller architecture and interfacing.	Mid Exam
8	Microcontroller programming: instruction sets, timing & subroutines.	HW2
9	Realization of real-time algorithms, Hardware and software co-design.	Assignmentn2
10	Stability analysis of real-time systems.	
11	Real-time communications, Wireless sensor networks.	Assignmentn3
12	Real-time operating systems,	
13	Real-time scheduling.	Project (Phase2)
14	Real-time systems design, Testing, Validating & debugging.	
15	Time-triggered systems	Project (Phase3)
16	Mini Projects of DERTS	Final Exam

Expected workload:
On average students need to spend 3 hours of study and preparation for each 50-minute class.

Significance of the mark for the final score: 70%
Attendance policy:
Absence from classes and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse acceptable to and approved by the Dean of the relevant college/faculty shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

The student is responsible for all assignments on a weekly basis.
No make-up will be given for missed quizzes, tests or assignments, unless a case is made in advance with Instructor's approval.

Course References:

Books:

1. J. Cooling, Software Engineering for Real-Time Systems, Addison Wesley, UK 2003. www.pearsopneduc.com.
2. Timothy D. Green, EMBEDDED SYSTEMS PROGRAMMING WITH THE PIC16F877, Second Edition, 2008.
3. J.W.S. LIN, Real-Time Systems, Prentice Hall, 2000.
4. N. NISSANKE, Real-Time Systems, Prentice Hall, 1997.
5. R.J.A. BUHR & D.L. BAILEY, An Introduction to Real-Time Systems, Prentice Hall, 1999.
6. Stuart Bennett, Real-Time Computer Control, By: Prentice-Hall, 2nd edition, 1994.
7. S. BENNETT & G.S. VIRK, Computer Control of Real-Time Processes, IEE 1990.
8. J. Cooling, Software Engineering for Real-Time Systems, Addison Wesley, UK 2003.
9. W. VALVANO, Embedded Microcomputer Systems: Real-Time Interfacing, Brooks-Cole Publisher, 2000

Journals:

Websites:
