ECE 4510 Microcontroller Applications
Required Course

2008-2009 Catalog Data:

ECE 4510: Microcontroller Applications
Analysis and design of microcomputer-based digital systems.
Credit: 4 hours
Prerequisites: ECE 2210, ECE 2510

Textbook(s) and/or Required Materials:

1. Han-Way Huang, The HCS12/9S12: An Introduction to Software and Hardware Interfacing, Thompson, 2006, ISBN # 1-4018-9812-2, available in the University Bookstore, Bernhard Center
2. Materials disseminated using the ECE 451Class Web Page (the official media for the class). They include the Instructor's Lecture Notes.
3. ECE 4510 Parts Kit
4. Adapt9S12DP512 Evaluation Board by Technological Arts
5. ICC12 IDE software by ImageCraft
6. MC9S12DP512 Device User Guide by Motorola
7. CPU12 Reference Manual by Motorola

Recommended Materials:

1. Jean L. Labrosse, *MicroC/OS – II The Real Time Kernel*, 2nd Ed., CMP Books, ISBN 1-57820-103-9, available through amazon.com, or from the publisher
2. Jonathan W. Valvano, *Introduction to Embedded Microcomputer Systems: Motorola 6811 and 6812 Simulation*, Thomson, 2003, ISBN 0-534-39177-x

References: Data Sheets of selected devices

Coordinator: Dr. Janos L. Grantner, Professor of ECE
Instructor in the Fall 2008 Semester: Dr. Janos L. Grantner

Prerequisites by topic:

1. Basic level digital logic design
2. Basic level analog circuit design
3. Assembly and C language programming

Course Objectives: (ABET Learning Outcomes)

1. To provide experience to design digital and analog hardware interface for microcontroller-based systems (a, b, c, e).
2. To provide experience to integrate hardware and software for microcontroller applications systems (k).
3. To provide experience to debug a microcontroller-based system and to analyze its performance using advanced debug tools and electronic test instrumentation (b, k).
4. To provide experience develop, run, and experimentally validate code written in a high-level language for a microcontroller system (b, k).
5. To develop skills to prepare effective written technical communications for engineering analysis and design work through project reports (g)
6. To provide experience to work in a multi-disciplinary team (d)
7. To assess the students' ability to design, conduct experiments, and interpret data (b)
8. To assess the students' ability to function in a multi-disciplinary team (d).
9. To assess the students' skills to use modern tools of engineering practice (k)

Topics:

1. Course overview, introduction to the Motorola HC12/HS12 Microcontroller Families (2 classes)
2. MC9S12DP256 architecture and memory map (1 class)
3. CPU12 Programmer's Model and assembly language programming (3 classes)
4. Development of C programs for the MC9S12DP256 (2 classes)
5. Interfacing to the Parallel I/O Ports, MC9S12DP256 Interrupts (2 classes)
6. Programming the Main Timer, Input Capture and Output Compare (4 classes)
7. Programming the PWM Module (1 class)
8. Analog Input and Output Interface (3 classes)
9. Serial Communications Interface Design (3 classes)
10. SPI Interface (1 class)
11. CAN Interface (3 classes)
12. Interfacing Static Memory to the MC9S12DP256 External Bus (2 classes)
13. 8 or 16-Bit Memory Modules, Critical Timing Analysis (2 classes)
14. Test (1 class)

Course/Laboratory Schedule: 3 one-hour lectures, one 3-hour laboratory

Evaluation:

1. Examinations (50%) 2. Lab work (30%) 3. Design Project (10%) 4. Homework (10%)

Laboratory Experiments:

1. Introduction to the 9S12DP256 Program Development Environment (1 session)
2. Elementary Programming for the 9S12DP256 Microcontroller (1 session)
3. Basic Parallel Output and Software Delay Loops (1 session)
4. Parallel Input/Output, External Interrupt, and Programming the Flash memory (1 session)
5. Programmable Timer, Output Compare, and Non-TTL Output Interface (1 session)
6. Input Capture and Pulse Width Modulation (PWM) (1 session)
7. Analog Input/Output Interface and Simple Digital Signal Processing (1 session)
8. Asynchronous Communications Interface (1 session)
9. SPI Bus Interface (1 session)
10. Control Area Network (CAN) Interface (2 sessions)
11. Lab Final (1 session)

Design Project:

Design, implementation, and demonstration of a model of a conveyor control system. It includes frequency measurement and motor control using PWM technique (4 weeks). A report is required.

Computer Usage:

ICC12 IDE software by ImageCraft and NoICE Debugger by NOICE are used to carry out the design, debug and verification tasks for labs, the project and most of the homework assignments.

Contribution to Professional Component:

ABET professional component content as estimated by faculty member who prepared this course description:

Engineering sciences: 1 credit or 25% Engineering design: 3 credits or 75%

Relation of Course to Program Outcomes:

This course provides significant support for the CE program objective Depth along with learning outcomes a, b, c, d, e, g and k.

Prepared by: Dr. Janos L. Grantner Date: September 2, 2008