Soran University
Course Book Microcontroller

1. Module Title: Microcontroller

2. Module Code: CS305HMC

3. Module Level: 3.ed Stage (Software)

4. Module Leader: Faxir Abdulakarem Muhammed

5. Teaching Semester: first and second semester

6. Credit Rating for the module: 4

7. Prerequisites and co-requisites: Digital Logics & programming in general

8. Module Summary

Topics	**Assessment**
Introduction	**-**
Numbering systems	**-**
Microcontroller Architecture	-
Introduction to Assembler	-
Assembler Basics & Status Register	**-**
Arithmetic and Logic Instructions	**-**
Branch instructions & Loops	-
I/O Port Programming	Writing a program to blink 8 LEDs from left to right and vise versa
Stack Memory & Subroutines	-
Interrupts mechanism	-
Timers in Normal Mode	Developing a program to move the servo by specific angle
Serial Port	-
Pulse Generation & PWM Signals	Developing a system to control the motor speed using PC (C#.net program)
Timer: Input Capture Programming	**-**
Analog Digital Converter ADC & DAC	Writing a program for Atmega8 microcontroller to select specific menus using on board potentiometers
Watch dog timer	**-**

9. Module Aims

Embedded system is a control system or a computer system which perform a specific task. It will have few resources compared with personal computer. The memory capacity and processor speed is limited.
The major component of an embedded system is a microcontroller so programming microcontroller will take most of the course time. The architecture and instruction set of a very popular microcontroller (ATMEL ATmega Family ATmega8 & AT90CAN128) will be discussed.

Students will use myAvr Board to program atmel-microcontroller in the laboratory session. Students will have the opportunity to apply the concepts covered during the lectures in the laboratory sessions, by programming a given myAvr Board with ATmega8 microcontroller as well as DVK90CAN1 Board with the more advanced AT90CAN128 microcontroller. Laboratory experiments will require students to build simple embedded systems like blinking light, controlling a DC motor and a servo motor using PC. The last weeks of the lab will be spent in applying the learned material to a final project, in which the students will design and build a final embedded system with a microcontroller.

10. Learning Outcomes

On successful completion of this module students will:

- Know the basic concepts of a microcontroller
- To be able to know different components (timer, ADC etc.) of microcontroller and to program theme.
- know how to program Atmel Microcontroller in Assembler
- Be able to design and implement control systems like light and speed control.
- Know how to connect microcontroller with PC and using PC as control interface.

11. Syllabus

- Introduction [1. Session]
  - Hardware & Software Definitions
  - Chips & transistors
  - Moore's Law
  - Microprocessor vs. Microcontroller
  - Main Parts of microcontroller
- Numbering systems [1. Session]
  - Number Systems: Decimal, Binary, Octal and Hexadecimal.
  - Conversion between numbering Systems.
  - Fixed Precision and Overflow
  - Signed and Unsigned Numbers.
  - ASCII Character Encoding
- Microcontroller Architecture [1. Session]
  - Von Neumann & Havard Architecture
  - Von Neumann bottleneck
  - AVR Microcontroller Architecture

- Assembler [2. Session]
    - Basics
    - Status Register
    - Arithmetic and Logic Instructions
- Branch instructions & Loops [2. Session]
- I/O Port Programming [1. Session]
- Stack Memory & Subroutines [2. Session]
- Interrupts mechanism [2. Session]
    - Interrupt vs. Polling mechanism
    - Steps in executing interrupts
    - External Interrupts (INT0, INT1)
    - Edge-triggered vs. level-triggered external interrupts
- Timers in Normal Mode [2. Session]
    - 8 Bit Timers, 16 Bit Timers
    - Timer with polling Mechanism
    - Timer with Interrupt Mechanism
    - Time delays with timers.
- Serial Port [1. Session]
    - Programming serial port in Polling mechanism
    - Programming serial port in interrupt mechanism
- Pulse Generation & PWM Signals [2. Session]
    - DC motor speed control
    - PWM frequency and current percentage calculation
    - PWM modes: Fast PWM, Fast Correct
    - PWM with 8 Bit & 16 Bit Timers
- Timer: Input Capture Programming [1. Session]
- Analog Digital Converter ADC & DAC [1. Session]
- Watch dog timer [1. Session]

12. Assessment Strategy

The Assessments will be by doing theoretical and practical exams as well as working on small microcontroller projects in group.
By working on small projects, the students gain more programming experience especially in hardware-oriented programming.

13. Summary description of assessment items

Assessment Type	Description of Item	Grading (total 40 point)	Week due
Theory exam	Closed book exam on paper	20 points	Every 5 weeks
Lab exam	Open book exam in the lab	10 points	Every 5 weeks
group work	Developing different system in groups	10 points	4-6 group projects

14. Learning Session Structure
Every day there will be 2 hour theory and 2 hours lab.

15. Learning and Teaching Methods
Every week there will be 1 hours and 45 minutes theory. The first 15 minutes will be a review of last lecture by asking them some questions. To know how much the students understand the new topic there will be a discussion in term of questions and answers in the last 15 minutes.

16. Bibliography
1- AVR Microcontroller and Embedded Systems: Using Assembly and C (Pearson Custom Electronics Technology) by Muhammad Ali Mazidi

2- www.atmel.com
www.myavr.de

17. Authored by
Fakher Abdulkarim Mohammad, 21/09/2014