**Course Number: EE 390**
**Course Title:** Digital System Engineering (Required Course)

**Course Description :**

Microprocessor hardware and software Models. Instruction sets. Assembly language programming and debugging. Memory mapping. Input and output instructions. Input/output Interfacing. Introduction to interrupts. Basic Microcontroller programming.

**Prerequisites :**

EE-200 and ICS 103

**Textbook :**

Digital System Engineering, 4th Edition, Prentice Hall, ISBN 0-13-093081-4

**Other useful references and material :**

- Y. Liu and G. A. Gibson, Microcomputer Systems: The 8086/8088 Family. Prentice Hall.
- John Uffenbeck, The 80x86 Family Design, Programming and Interfacing. Prentice Hall.

**Course objectives:**

After successfully completing the course, the students will be able to

- Develop an understanding of basic computer organization
- Provide comprehensive understanding of software and hardware models of 8086 and 8088 microprocessors and related Assembly language programming
- Carry out (theoretically and experimentally) basic Memory Mapping, Input-output interfacing and Microcontroller programming.
- Train engineers how to practice and apply their electrical engineering knowledge in a professional, ethical and safe manner.

**Topics Covered :**

- 8086/8088 Microprocessor internal architecture
- Software model and memory organization.
- Addressing modes
- Program Debugging tools (DEBUG and Turbo-DEBUG)
- Assembly Language instruction set of 8086/8088
- Assemblers (TASM or MASM)
- Assembly Language Directives
- 8086 and 8088 hardware architecture
- Memory Interface circuits
- Memory Devices
- Input/output interface circuits
- Introduction to Interrupt interface and Microcontrollers basics

**Class/Laboratory Schedule :.**

3 lectures per week (50 minutes each) and 3 hours lab per week.

**Contribution of course to Meeting the professional component :**

The students will learn software and hardware models of basic 80x86 microprocessors and how to program them using assembly language. The course will emphasize on the use of professional emulators and software's, such as, debugging tools (DEBUG or TD) and assemblers (TASM or MASM). Laboratory classes are designed to promote and strengthen the knowledge acquired in this course. The course project is intended to test the innovativeness and competency in programming and interfacing techniques. Basic Microcontroller programming are also introduced in this course.

**Course Outcomes:**

- Ability to use software development tools to assemble, test and debug the programs by using breakpoints, single-stepping, monitoring the changes in register/memory contents, on a hardware platform or on an emulator.
- Ability to apply assembly directives to initialize memory for global variables and use assembly language to implement flow control (sequential, conditional and iterative)
- Ability to write assembly language programs for 8088/8086 microprocessors to read and write the registers in an I/O adapter that control the communication with I/O devices. Write basic programs for 8051 microcontroller.
- Understand how the 8086 and 8088 microprocessors identify different sources of interrupts and exceptions, and invokes the corresponding handler to deal with the interrupt and exception.

**Prepared by** Dr. Sheikh Sharif Iqbal, February, 2012.

# *KFUPM* : EE 390-Digital System Engineering : *Term 112*

**Instructor:** Dr. Sheikh Sharif Iqbal **Subject** : EE 390-2/4 **Room**: **59-2025/2021**

**Office** : **Room: 59 – 1075**. **Tel. 2818** **Email** : sheikhsi@kfupm.edu.sa

**Office Hour**: ***SMW* 10:10 - 10:40 AM** and ***UT* 10:05-10:50 AM** OR by appointment

| TOPICS | Week | DATE | Laboratory | Book Assignments |
|---|---|---|---|---|
| **Ch 1: Overview of µC/µP systems; 8086/8088 µP internal architechture, Ch 2: Software model; memory addreses;** | 1 | Jan 28 – Feb 1 | *No Lab.* | ***Ch1 Problems:** 5 - 15, 28, 32, 33, 37, 40, 42, 43, 47, 48,* |
| Data types, Memory segments; Internal registers and Flags; Memory address and Stack (briefly); | 2 | February 4–8 | *Experiment **0**: PC Hardware...* | ***Ch2:** 2.3,2.4, 2.9, 2.10 - 2.19, 2.23 - 2.27, 2.34, 2.37, 2.41, 2.46, 2.53 - 2.60, 2.64- 2.66* |
| ***Ch 4.1-4.3: Machine code, Brief discussion on DEBUG commands* *Ch 3:*Addressing modes and MOV ins.** | 3 | February 11–15 | ***1.** Introduction to Debug & Turbo..* | ***Ch4 Problems:** 4.8 – 4.17, 4.27* ***Ch3 Problems:** 3.3 – 3.11* |
| Ch 7: Introduction to Directives (DB, DW…..) ; EDIT, TASM, TLINK programs Ch 5: Data transfer instructions; INT 21; | 4 | February 18–22 | *Help session on TD, Emulator* | ***Ch7 Problems:** 7.3 – 7.6 , 7.10 – 7.16 ,* ***Ch5 Problems:** 5.1 – 5.5* |
| **Ch 5: Arithmetic instructions; Ch 5: Logical instructions;** - - - - - - - | 5 | February 25–29 | ***2.** Addressing modes and data* | ***Ch5 Problem:** 5.5– 5.10 – 5.17, 5.20– 5.25, 5.26 – 5.35, 5.39, 5.47* |
| **Ch 5: Shift and Rotate instructions; Ch 6: Flag control, Compare instruction; Ch 6: Jump Instructions;** | 6 | March 3 - 7 | ***3.** Arithmetic instructions ...* | ***Ch5 Problems:** 5.39, 5.43, 5.47, 5.49* ***Ch6 Problem:** 6. – 6.5, 6.8, 6.15, 6.21, 6.22* |
| Ch 6: Stack instructions and Subroutines; Ch 6: Loop and Strings instructions; BIOS & DOS Intrrupts (INT-10, INT-21) | 7 | March 10 – 14 | *Problem session* | ***Ch6 Problem:** 6.25, 6.29, 6.31, 6.39, 6.43, 6.45, 6.48* |
| **Useful Assambly language programs Ch 8.1-8.4: Memory Interface; Minimum & Maximum mode of memory interface;** | 8 | March 17 – 21 **(Exam 1=Mar 17)** | ***4.** Shift and rotate …..* | **** Ass. Lang. Programs** ***Ch8 Problems:** 8.7, 8.11, 8.16, 8.19,* |
| Mid Semester Break : March 24 - 28 | | | | |
| **Ch 8.10, Ch 8.14-8:18: I/O Data Tranfer Instructins, Ch 10.1-10:4: Isolated Bytewide I/O Ports and handshaking …..** | 9 | March 31 – April 4 | ***5.** Using BIOS Services (Part 1)* | ***Ch8 Problems:** 8.83 – 8.87, 8.89, 8.91, 8.93, 8.96, 8.99, 8.100, 8.101, 8.103, 8.105* |
| **Ch 10.5- 10.6:** The 82C55A (PPI) I/O interface chip; 8255A parallel I/O ports; | 10 | April 7 - 11 | ***6.** Using BIOS Services (Part II)* | ***Ch10 Problems:** 10.3, 10.5, 10.8 – 10.10, 10.12 10.14, 10.17, 10.23, 10.25, 10.26* |
| **Ch 10.7: Memory mapped I/O Interface; Ch 8.5-8:9: Bus Cycle, Mem organization, Ch 8.11-8.12 Memory Read/Write bus cycle and interface circuits,** | 11 | April 14 – 18 | ***7.** Introduction to Flight86...* | ***Ch10 Problems:** 10.31 – 10.35, 10.37* ***Ch8 Problems:** 8.57, 8.63, 8.64, 8.108* |
| **Ch 9.1- 9:3:** ROM, PROM, EPROM RAM, SRAM, DRAM and other types of RAM (for prog. and data storage) | 12 | April 21 – 25 | ***8.** Flight86 - I: Traffic Lights* | ***Ch9 Problems:** 9.2, 9.6 9.8, 9.11, 9.14, 9.16, 9.17, 9.21, 9.28, 9.29* |
| **Ch 9.5:** Introduction to Flash **Introduction to the 8051 Microcontroller,** | 13 | April 28 – May 2 **(Exam 2=April 29)** | ***9.** Flight86 - II: Motor Control* | |
| **Basic Microcontroller Programming** | 14 | May 5 – May 7 | ***10.** Introduction to the 8051 Microcontroller -- **important*** | |
| **Review** | 15 | May 12 – May 16 | ***LAB FINAL*** | |

**Textbook** : 'The 8088 and 8086 Microprocessors' by Triebel and Singh latest edition.

**Grading:** Quiz+Project+HW (13+5+2)**%** ; Major-1 **15%** ; Major-2 **15%** ; Final-exam **30%** ; Lab **20%**

**Major Exams**: **Exam 1; Saturday; 17th March ; 8:00 –9:00 PM ; Room: 59 - 1001**

**Exam 2; sunday; 29th April ; 7:30 – 9:00 PM ; Room: 59 - 1001**

**Absences:** University rules: -- 4 unexcused absences ➔ **Warning ;** -- 6 unexcused absences ➔ **DN**.

**Reference Books:** 'Introduction to 80x86 assembly language and computer architectur' by Detmer, Richard C