Course: Advance Microprocessor and Microcontroller
Code: EI 603

Program: Applied Electronics and Instrumentation Engineering

Course coordinator:

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Course Objective:

This course aims at teaching primary concept of programing with machine language. It also aims to train the student for automated system design with the programing intelligence. The objective of this course is to become familiar with the architecture and the instruction set of an Intel microprocessor. Assembly language programming will be studied as well as the design of various types of digital and analog interfaces. The accompanying lab is designed to provide practical hands-on experience with microprocessor software applications and interfacing techniques

Course Outcome (COs)

At the end of the course, a student will be able to:

1. **Understand and State** the internal organization of some popular microprocessors (8086, 8088)/microcontrollers (8051, PIC).
2. **Apply** the fundamental of assembly level programming of 8086 microprocessors family and 8051 microcontroller.
3. **Understand and design** the interfacing circuits of microprocessor and microcontroller with memory and peripheral devices.
4. **State** the pipe lining architecture of advance microprocessor with the use of segment register and register queue.
5. **Demonstrate** the concept of timer, counter and internal and external interrupt of microprocessor and microcontroller.
6. **Design** electrical circuitry for the Microprocessor I/O ports in order to interface the processor to external devices real-world control problems such as fluid level control, temperature control, and batch processes.

PREREQUISITES

Knowledge of digital electronics.
Knowledge of 8085 microprocessor.

CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EI603.	**1**	2	3	2	2	-		-	-	-		-	1
EI603.	**2**	2	3	3	2	-		-	-	-		-	1
EI603.	**3**	3	2	3	2			-	-			-	1
EI603.	**4**	2	2	2	-	-		-	-	-		-	1
EI603.	**5**	2	2	3	2			-		-		-	1
EI603.	**6**	3	2	2	3	1	3	1	1	1	1	1	2

Unit plan of Advance Microprocessor and Microcontroller

Unit	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Title	**ARCHITECTURE AND PROGRAMING (CO1, CO2, CO4)**	**INTERFACING WITH MEMORY (CO1, CO2, CO3)**	**Stack and Interrupt (CO1, CO2, CO5)**	**INTERFACING WITH PERIPHERAL DEVICE (CO1, CO2, CO3)**	**MICROCONTTROLLER AND INTERFACING (CO1, CO2, CO3)**
Duration* (no .of period)	13	4	4	10	14
Session 1	Introduction to microprocessor based system and history microprocessor	Interfacing Memory: Static RAM, Dynamic RAM	Stack and Interrupts	Interfacing of switches and LEDs	Introduction to single chip microcontrollers:
Session 2	Review of 8085 microprocessor	Interfacing Memory: Static RAM, Dynamic RAM	Interrupts controller IC 8259	Interfacing of 8255	8051/8031 architecture
Session 3	Intel 8086/8088 Microprocessor: Architecture	Interfacing Memory: Static RAM, Dynamic RAM	Interrupts controller IC 8259	Interfacing of 8255	8051/8031 architecture
Session 4	Intel 8086/8088 Microprocessor: Architecture	Interfacing of IO devices	Tutorial	Interfacing of Keyboard	I/O ports and Memory organization.
Session 5	Addressing modes of 8086	Interfacing of IO devices		Interfacing of 7-segment display	Instruction set and basic assembly language programming
Session 6	Instruction sets of 8086	Tutorial		8237 DMA controller	Interrupts, Timer/Counter
					Tutorial
Session 7	Programming with assembly language			8237 DMA controller	Serial Communication
Session 8	Programming with assembly language			Intel 8251 USART	MCS-51 applications: Square wave and pulse wave generation, LED,
	Tutorial				
Session 9	Clock Generator (8284), Bus Buffering (8288)			Intel 8251 USART	A/D Converter interfacing to 8051
Session 10				Tutorial	D/A Converter interfacing to 8051
Session 11					Introduction to PIC micro-controller
Session 12					Introduction to PIC micro-controller
Session 13					Tutorial

Books:

1. *Douglas V. Hall – Microprocessors & Interfacing, Tata McGraw-Hill*

2. Ray & Bhurchandi – Advanced Microprocessors & Peripherals, Tata McGraw-Hill

3. Walter A. Tribel – The 8088 and 8086 Microprocessors, Pearson Education

4. Barry B. Brey – The Intel Microprocessors, PHI/Pearson Ed. Asia

5. **Muhammed Ali Mazidi and Janice Gillispie Mazidi – The 8051 Microcontroller and Embedded Systems, Pearson Education Inc.**

6. *Ajay V Deshmukh – Microcontrollers Theory and Applications, Tata McGraw-Hill*
7. Kenneth J. Ayala – The 8086 Microprocessor, Cengage Learnin

Unit Plan/ Execution Details

Advance Microprocessor and Microcontroller

Unit	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
Title	**ARCHITECTURE AND PROGRAMING**	**INTERFACING WITH MEMORY**	**Stack and Interrupt**	**INTERFACING WITH PERIPHERAL DEVICE**	**MICROCONTTROLLER AND INTERFACING**
Duration* (no .of period)	13	4	4	10	14
Session 1	Introduction to microprocessor based system and history microprocessor	Interfacing Memory: Static RAM, Dynamic RAM	Stack and Interrupts	Interfacing of switches and LEDs	Introduction to single chip microcontrollers:
Execution Details					
Session 2	Review of 8085 microprocessor	Interfacing Memory: Static RAM, Dynamic RAM	Interrupts controller IC 8259	Interfacing of 8255	8051/8031 architecture
Execution Details					
Session 3	Intel 8086/8088 Microprocessor: Architecture	Interfacing Memory: Static RAM, Dynamic RAM	Interrupts controller IC 8259	Interfacing of 8255	8051/8031 architecture
Execution Details					
Session 4	Intel 8086/8088 Microprocessor: Architecture	Interfacing of IO devices	Tutorial	Interfacing of Keyboard	I/O ports and Memory organization.
Execution Details					
Session 5	Addressing modes of 8086	Interfacing of IO devices		Interfacing of 7-segment display	Instruction set and basic assembly language programming
Execution Details					
Session 6	Instruction sets of 8086	Tutorial		8237 DMA controller	Interrupts, Timer/Counter
Execution Details					
					Tutorial
Execution Details					
Session 7	Programming with assembly language			8237 DMA controller	Serial Communication

Execution Details					
Session 8	Programming with assembly language			Intel 8251 USART	MCS-51 applications: Square wave and pulse wave generation, LED,
Execution Details					
	Tutorial				
Execution Details					
Session 9	Clock Generator (8284), Bus Buffering (8288)			Intel 8251 USART	A/D Converter interfacing to 8051
Execution Details					
Session 10				Tutorial	D/A Converter interfacing to 8051
Execution Details					
Session 11					Introduction to PIC micro-controller
Execution Details					
Session 12					Introduction to PIC micro-controller
Execution Details					
Session 13					Tutorial
Execution Details					

Notes:

Unit Rationale

UNIT 1: 8086 microprocessor architecture

Rationale:

The microprocessor plays a significant role in the everyday functioning of industrialized societies. The microprocessor can be viewed as a programmable logic device. This section introduces the basic structure of a microprocessor based product and shows how the same structure is applicable to micro-computers.

At the end of this unit, the learner will be able to

- **State** the different blocks like ALU, Register, Instruction decoder etc. and function of each pin of 8086 microprocessor.
- **Explain** the organization of system buses.
- **Explain pipelining** processing of 8086 microprocessor
- **Draw** the timing diagram of 8086 instruction.
- **State** different types of addressing modes
- **Describe** the minimum and maximum mode function of 8086 processor.
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Session Objectives:

- Session 1: To introduce with microprocessor based system and advancement of microprocessor.
- **Session 2:** To review the architecture of 8085 microprocessor.
- **Session 3 & 4:** To familiar with the architecture of 8086 microprocessor.
- **Session 5:** To introduce with addressing modes of 8086 microprocessor.
- **Session 6 to 8:** To familiar with the instruction sets and programming techniques of 8086 microprocessor.
- **Session 9:** To introduce with clock generator (8284) and bus controller (8288) IC.
- **Session 10:** Tutorial

Unit Rationale

UNIT 2: Interfacing of Memory and IO devices

Rationale: It is often required to store the some registers content temporarily like the situations: microprocessor has to execute subroutines, less no. of required registers, etc., an auxiliary memory segment is used for that purpose, called stack.

Effective communication with the external devices can be possible without wasting much time of microprocessor by interrupt driven IO: ask for the service whenever required.

At the end of this unit, the learner will be able to

- **State** the fundamentals of even and odd banks.
- **Explain** the required specification of memory devices.
- **Describe** the requirement and effect of memory segmentation.
- **Differentiate** between static and dynamic memory.
- **Draw** the interfacing circuit of memory and IO devices.
- **Interface** microprocessor with memory and IO devices.

Session Objectives:

- Session 1: Introduction to memory devices: concept of memory bank and memory segment.
- Section 2 - 3: To introduce with the memory interfacing techniques with 8086 and 8088 microprocessor.
- Section 4 & 5: To introduce with IO interfacing techniques with examples like – switches, LED, 7-segments etc.
- Session 6: Tutorial: class for additional problems (if required).

Unit Rationale

UNIT 3: Stack and Interrupt

Rationale: Microprocessor requires memory devices to store the program code and data to be processed by it. Thus interfacing techniques of microprocessor with memory devices is an important issue. Moreover communication of microprocessor with IO devices is required to receive and transfer the data with peripherals.

At the end of this unit, the learner will be able to

- **Define** the stack, stack pointer and describe their uses.
- **Explain** how information is stored and retrieved from stack.
- **Define** a subroutine and explain its uses.
- **Explain** the sequence of a program execution when a subroutine is called.
- **List** and **explain** conditional Call and Return instructions.
- **Compare** similarities and differences between PUSH/POP and CALL/RET instructions.
- **Explain** an interrupt process and the difference between a non-maskable and maskable interrupt.
- **List** the steps to initiate and implement the 8085 interrupt.
- **Design** and implement an interrupt with a given INT instructions.

Session Objectives:

- Session 1: To introduce with the stack and interrupt of 8086 processor.
- Section 2 - 3: To introduce with the 8259 interrupt controller.
- Session 4: Tutorial: class for additional problems (if required).

Unit Rationale

UNIT 4: Peripheral Devices

Rationale:

The primary function of a microprocessor is to accept data from input devices such as key boards ADC etc. read instruction from memory, process data according to the instructions and send the results to output devices such as LEDs, printers and monitor. These input and output devices are called either peripheral. Designing logic circuits and writing instructions to enable the microprocessor to communicate with these peripherals is called interfacing.

At the end of this unit, the learner will be able to

- **List** the elements and characteristics of atypical programmable device.
- **Explain** the function of handshake signals
- **Explain** the block diagram of the 8255 IO device.
- **Design** an interfacing circuit for the 8255 PPI
- **Explain** the communication techniques of Keyboard, display device, printer and two microprocessors.

Session Objectives:

- Session 1-3: To review the structure and operations of 8255 PPI with examples: interfacing of LED, Switch and multiplexed 7-segments.
- Session 4 &5: To introduce the structure of matrix keyboard and its interfacing technique.
- Session 6: To introduce the interfacing technique of printer.
- Session 7: To introduce the communication between two microprocessors.