COMSATS University Islamabad, Lahore Campus
Department of Electrical Engineering
1.5 KM Defence Road, Off Raiwind Road, Lahore

Version: v.4.0

Course Descriptive File

Course Code and Title	CPE342 - Microprocessor Systems and Interfacing		
Credit Hours	4 (3,1)	**Semester**	6th
Prerequisites	CPE241	**Co requisites**	N/A
WK		**SDG**	
Course Type	☐ CEP		

1 Course Outline as per SoS

Introduction to Microprocessors and Microcontrollers, Overview of a Microprocessor Family, Microprocessor Architecture and Programming, Hardware Specifications, Data Formats & Arithmetic Operations, Instruction Set Summary, Assembly Language Programming, Addressing Modes, Memory Interface, Basic WO interface, Serial and Parallel Interfacing, Polling and Interrupts, Counters and Interval Timers, A/D and D/A Conversion, Microprocessor Programming and Microprocessor Based System Design, Implementing & Testing the Design.

Lab work:
Syntax of microprocessor CPU Assembly Language, Data transfer instructions, Arithmetic and logical instructions, Control instructions, BIOS Interrupt programming Introduction to advance microcontroller and software environment, Interfacing of Switches, LED, Seven Segment, Keypad, LCD, Stepper motor, DC motor, Temperature sensor, LDR, ADC and Serial/Parallel Interfacing with an advanced Microcontroller Programming using Assembly and C.

2 Course Objectives as per SoS

The main objective of this course is to develop an understanding of microprocessors and microcontroller-based systems and their applications. This includes enabling a student to design and use microprocessor-based systems for a variety of purposes such as control, telemetry, digital systems etc. The course focuses on the study of microprocessors and microcontrollers; and their basic support components including architecture, memory interfaces, processor bus concepts, serial I/O devices, and interrupt control devices. Laboratories directly related to microprocessor/microcontroller functions and their interfaces.

3 Suggested Books

Textbook

1. The Intel Microprocessors by Barry B. Brey, 8th Edition, Pearson
2. Assembly Language Programming and Organization of the IBM PC by Ytha Yu and Charles Marut, 1992, 1st Edition, McGraw-Hill
3. Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers, by Jonathan W Valvano, Vol 1, 5th Edition, 2019, CreateSpace

Reference Books

4. The Intel Microprocessor Family Hardware and Software Principles and Applications By James L. Antonakos, 1st Edition, 2006, Delmar Cengage Learning

4 Course Learning Outcomes (CLOs)

After the successful completion of this module, you will be able to:

Theory CLOs:

1. **Describe** the architecture, operation, and components of microprocessor systems, including their hardware specifications and Produce the Intel-assembly code using knowledge of programmer model, addressing mode and assembly language programming concepts. (PLO1-C3).
2. To **integrate** the memory, timer, I/O and PPI with microprocessor using address decoding techniques and **design** digital system using microprocessor by applying knowledge of architecture, memory, timers, and I/O interfacing, including PPI, to develop practical and efficient solutions for real-world applications. (PLO3-C5)

Lab CLOs:

3. To explain and reproduce the Intel-assembly and microcontroller C-Programming codes using software and hardware platforms. (P3-PLO5).
4. Design a digital system for devices using the knowledge of microprocessor and peripherals ensuring the system meets technical requirements. (C5-PLO3).
5. **Write** clear and well-organized technical report(s) documenting the result and analysis of digital system. (A2-PLO10).
6. Evaluate the societal and environmental impact of microcontroller-based systems by analyzing their applications in contemporary industries and standards. (C6-PLO7).
7. Justify the significance of a designed microprocessor-based project in terms of societal benefits and professional engineering practices. (C6-PLO6).

CLO	PLO	Bloom Taxonomy Domain	Bloom Taxonomy Level
1	PLO1: Engineering Knowledge	Cognitive	C1 – Knowledge
2	PLO3: Design/Development of Solutions	Cognitive	C5 – Evaluate
3	PLO5: Modern Tool Usage	Psychomotor	P3 – Precision
4	PLO3: Design/Development of Solutions	Cognitive	C5 – Evaluate
5	PLO10: Communication	Affective	A2 – Responding
6	PLO7: Environment and Sustainability	Cognitive	C6 – Create
7	PLO6: Engineer and Society	Cognitive	C6 - Create

PLOs Coverage Explanation

PLO1 - Engineering Knowledge This is crucial for developing assembly language programs, as students must apply their foundational knowledge of engineering and computing to solve problems.

PLO3 - Design/Development of Solutions Central to this course, PLO3 involves designing and developing digital systems using microprocessors and microcontrollers, which is a significant component of both theoretical and lab work.

PLO5 - Modern Tool Usage In a course focused on microprocessor programming and interfacing, students must use modern simulation and hardware tools, linking strongly with PLO5.

PLO6 - The Engineer and Society It is essential for students to consider the societal implications of their designs, making PLO6 relevant when evaluating and justifying their projects.

PLO7 - Environment and Sustainability Engineering solutions should consider their environmental and societal impact, making this PLO critical in understanding the broader consequences of digital systems.

PLO10 - Communication Writing clear and effective reports is a key skill for engineers, so PLO10 is essential for the lab component of this course, ensuring students can document and present their findings.

5	**Marks Breakup**

Theory

Quizzes	15%
Assignments	10%
Midterm Exam	25%
Terminal Exam	50%
Total (theory)	**100%**

Lab

Lab Assignments: i. Lab Assignment 1 Marks (Lab marks from Labs 1-3) ii. Lab Assignment 2 Marks (Lab marks from Labs 4-6) iii. Lab Assignment 3 Marks (Lab marks from Labs 7-9) iv. Lab Assignment 4 Marks (Lab marks from Labs 10-12)	25%
Lab Mid Term = 0.5 × (Lab Mid Term exam) + 0.5× (average of lab evaluation of Lab 1-6)	25%
Lab Terminal	50%

✓☐ **CEA**	0.5*(Complex Engineering Problem) +0.375*(average of lab evaluation of Lab 7-12) + 0.125*(average of lab evaluation of Lab 1-6)
☐ **OEL**	0.1*(Open Ended Lab) +0.4*(Lab Terminal Exam) +0.375 *(average of lab evaluation of Lab 7-12) + 0.125*(average of lab evaluation of Lab 1-6)
☐ **Project Based**	0.2*(Lab Project) +0.3*(Lab Terminal Exam) +0.375*(average of lab evaluation of Lab 7-12) + 0.125*(average of lab evaluation of Lab 1-6)
☐ **Conventional**	0.5*(Lab Terminal Exam) +0.375*(average of lab evaluation of Lab 7-12) + 0.125*(average of lab evaluation of Lab 1-6)

Total (lab) **100%**

Final marks	**Theory marks × 0.75 + Lab marks ×0.25**

Version No.	Fall-2024/01
Revision Date	10/2/2025
Last Modification Date	
Modification Details	
Recommended by	Dr. Abbas Javed
Approved by	

Annexure – I: Lecture Plan

Lec. No	Topics Covered	CLO	Bloom Taxonomy	Contact Hours	Student Learning Hours	Assessment
1	Number Systems Conversions	CLO1	C1	1.5	2	Assignment 1 & 2 Quiz 1 & 2 Midterm , Terminal
2	Introduction to microprocessor and microcontroller	CLO1	C1	1.5	2	
3	Basic concepts and definitions of computer architecture and organizations	CLO1	C1	1.5	2	
4	Introduction to Programmers model of 8086/88	CLO1	C1	1.5	2	
5	Addressing Modes	CLO1	C1	1.5	2	
6	Assembly Language Programming for 8086/88 Architecture	CLO1	C3	1.5	2	
7	Assembly Language Programming for 8086/88 Architecture	CLO1	C3	1.5	2	
8	Assembly Language Programming for 8086/88 Architecture	CLO1	C3	1.5	2	
9.	Interfacing of RAM/ROM with 8088 microprocessors	CLO2	C5	1.5	2	
10	Interfacing of RAM/ROM with 8088 microprocessors	CLO2	C5	1.5	2	
11	Interfacing of RAM/ROM with 8088 microprocessors	CLO2	C5	1.5	2	
12	Interfacing of RAM/ROM with 8086 microprocessors	CLO2	C5	1.5	2	
13	Interfacing of RAM/ROM with 8086 microprocessors	CLO2	C5	1.5	2	
14	Interfacing of RAM/ROM with 8086 microprocessors	CLO2	C5	1.5	2	
15	Introduction to Microcontroller (STM32F407VG)	CLO1	C1	1.5	2	
16	Introduction to Microcontroller (STM32F407VG)	CLO1	C1	1.5	2	
17	Stack programming and memory mapping	CLO2	C5	1.5	2	
18	Stack programming and memory mapping	CLO2	C5	1.5	2	
19	8254 timer/counter interfacing with 8088 microprocessors	CLO2	C5	1.5	2	

20	8254 timer/counter interfacing with 8088 microprocessors	CLO2	C5	1.5	2	Assignment 3,4, Quiz3, 4 Terminal Exam
21	8254 timer/counter interfacing with 8088 microprocessors	CLO2	C5	1.5	2	
22	I/O interfacing (isolated and memory-mapped) with 8088 microprocessors	CLO2	C5	1.5	2	
23	8255 PPI interfacing with 8088 microprocessors	CLO2	C5	1.5	2	
24	Interfacing input devices with 8088 microprocessors using PPI	CLO2	C5	1.5	2	
25	Interfacing input devices with 8088 microprocessors using PPI	CLO2	C5	1.5	2	
26	A/D and D/A Conversion	CLO2	C5	1.5	2	
27	Hardware Interrupts	CLO2	C5	1.5	2	
28	Interfacing output devices with 8088 microprocessors using PPI	CLO2	C5	1.5	2	

Annexure – I: List of Experiments 2

Sr. No.	Topics Covered	CLO	Bloom Taxonomy
1	To Explain the Syntax of 8086-8088 and Show the Output of Data Transfer Instructions using EMU8086 Software Tool.	**CLO5**	**P3**
2	To Explain and Show the Output of Arithmetic Instructions using EMU8086 Software Tool.	**CLO5**	**P3**
3	To Explain and Show the Output of Logical Instructions using EMU8086 Software Tool.	**CLO5**	**P3**
4	To Explain and Show the Output of Jump and Control Instructions using EMU8086 Software Tool	**CLO5**	**P3**
5	To Explain and Show the Output of BIOS Interrupt Programming using EMU8086 Software Tool	**CLO5**	**P3**
6	To Explain the Procedure for Using STM32F407, Keil™, MDK-ARM and STM32F407 Trainer Board.	**CLO5**	**P3**
7	To Explain and Reproduce the Working of Switches and LED's on STM32F407 Trainer Board using C Programming.	**CLO5**	**P3**
8	To Explain and Reproduce the Working of 7- Segment on STM32F407 Trainer Board using C Programming.	**CLO5**	**P3**

9	To Explain and Reproduce the Working of 16x2 LCD on STM32F407 Trainer Board using C Programming.	**CLO5**	**P3**
10	To Explain and Reproduce the Working of 4x3 Keypad on STM32F407 Trainer Board using C Programming.	**CLO5**	**P3**
11	To Explain and Reproduce the Working of Stepper and DC motor on STM32F407 Trainer Board using C Programming.	**CLO5**	**P3**
12	To Explain and Reproduce the Working of Temperature Sensor and LDR on STM32F407 Trainer Board using C Programming.	**CLO5**	**P3**