**University of Asia Pacific (UAP)**

**Department of Computer Science and Engineering (CSE)**

**BSc in CSE Program**

# Course Outline – Microprocessors and Microcontrollers

## Part A – Introduction

**1. Course No. / Course Code:** CSE 315

**2. Course Title:** Microprocessors and Microcontrollers

**3. Course Type:**

**4. Level/Term and Section:** 2nd Semester (3rd Year)

**5. Academic Session:** Spring 25

**6. Course Instructor:** A S Zaforullah Momtaz, Zaima Sartaj Taheri

**7. Prerequisite (If any):**

**8. Credit Value:** 3.0

**9. Contact Hours:** 3.0

**10. Total Marks:** 100

**11. Course Objectives and Course Summary:**

The objectives of this course are to:

1. Provide a thorough understanding of the architecture and operation of RISC/CISC-based microprocessors/microcontrollers.
2. Familiarize the students with the programming and interfacing of RISC/CISC-based microprocessors/microcontrollers.
3. Provide a strong foundation for designing real world applications usingRISC/CISC-based microprocessors/microcontrollers.

This course introduces the fundamental aspects of microprocessors and microcontrollers. Students will learn the architectural concepts, instruction sets, addressing modes, and assembly programming of RISC and CISC-based systems. Topics include functional units, registers, memory organization, stack operations, and interfacing with I/O devices, sensors, timers, communication modules, and memory.

**12. Course Learning Outcomes: at the end of the Course, the Student will be able to –**

| | |
|---|---|
| **CLO 1** | **Explain** the internal architecture and operational principles of RISC/CISC-based microprocessor/microcontrollers. |
| **CLO 2** | **Explain** the functional units, registers, memory organization, stack operations, instruction sets and addressing modes of RISC and CISC-based microprocessors and microcontrollers. |
| **CLO 3** | **Demonstrate** programming proficiency using the various addressing modes and data transfer instructions of the target RISC/CISC-based microprocessor/microcontrollers |
| **CLO 4** | **Analyze** the standards, performance requirements, and interfacing techniques to select and integrate appropriate RISC/CISC-based microprocessors/microcontrollers with input/output and peripheral devices. |

**13. Mapping / Alignment of CLOs with Program Learning Outcomes (PLO) (Optional):**

| CLO No. | Corresponding PLOs (Appendix-1) | Bloom's taxonomy domain/level (Appendix-2) | Delivery methods and activities | Assessment Tools |
|---|---|---|---|---|
| CLO1 | a | 1/Understand | Live/Recorded video Lecture, multimedia | Assignment, Written exam |
| CLO2 | b | 1/Apply | Live/Recorded video Lecture, multimedia | Quiz, |
| CLO3 | c | 1/Apply | Problem Solving | Quiz, Assignment |
| CLO4 | c | 1/Analyze | Live/Recorded video Lecture, multimedia | Quiz, |

## Part B – Content of the Course

**14. Course Content:**

**15. Alignment of topics of the courses with CLOs:**

| SL. No | Topics / Content | Course Learning Outcome (CLO) |
|---|---|---|
| 1 | **Introduction to Microprocessors and Microcontrollers** | **CLO1** |
| 2 | **Internal Architecture: Functional units, registers, buses, memory organization** | **CLO1, CLO2** |
| 3 | **Instruction Sets and Addressing Modes: Data transfer, arithmetic, logical, control instructions** | **CLO2** |
| 4 | **Assembly Language Programming: Programming using various addressing modes and instructions** | **CLO2, CLO3** |
| 5 | **Interfacing and Applications: I/O ports, timers, ADC/DAC, sensors, communication interfaces, keyboards, displays, actuators, and memory expansion** | **CLO4** |

**16. Class Schedule/Lesson Plan/Weekly plan:**

| Topics | Specific Outcome(s) | Time Frame | Suggested Activities | Teaching Strategy(s) | Alignment with CLO |
|---|---|---|---|---|---|
| Introduction to Microprocessors and Microcontrollers, RISC vs. CISC Architectures, Applications in Embedded Systems | • Explain the evolution and role of microprocessors and microcontrollers in embedded systems<br>• Differentiate between RISC and CISC architectures<br>• Identify real-world applications of | Week 1 | Case studies, introductory reading, class discussions, architecture | Lecture, multimedia | CLO1 |

| | | | | | |
|---|---|---|---|---|---|
| | microprocessors and microcontrollers | | | | |
| Internal Architecture and Functional Units of RISC/CISC-based Processors (Control Unit, ALU, Buses, etc.) | • Describe the internal architecture and components of microprocessors and microcontrollers<br>• Explain the roles of the Control Unit, ALU, and system buses<br>• Interpret block diagrams of RISC and CISC-based processors | Week 2 | Diagram analysis, class discussions, short explanatory exercises | Lecture, multimedia | CLO1, CLO2 |
| Functional Units and Registers (General-Purpose, Stack, Pointer, and Flag Registers), Memory Organization, Stack Operations, Logical vs. Physical Addressing, Address Translation, and Addressing Modes | • Explain the role of different types of registers in microprocessors and microcontrollers<br>• Describe memory organization, stack structure, and stack operations<br>• Differentiate between logical and physical addressing and explain address translation<br>• Identify and apply various addressing modes used in instruction | Week 3-5 | Problem-solving tasks on register usage and stack operations, address translation exercises, addressing mode identification | Lecture, multimedia ,problem solving, class discussions | CLO2 |

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|---|---|---|---|---|---|
| | execution | | | | |

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| Instruction Set Architecture: Data Transfer, Arithmetic, Logical, Bitwise, and Shift Operations; Instruction Flow Control: Conditional and Unconditional Branches, Loops, Calls, and Returns | • Apply instruction set operations in assembly programming tasks<br>• Develop simple programs combining arithmetic, logical, and control flow instructions | Week 6-7 | Coding exercises, flow control programming tasks, class discussions | Lecture, Problem Solving, Group discussion | CLO2, CLO3 |
| MID-TERM EXAMINATION | | | | | |
| RISC/CISC Microcontroller Architecture and Core Registers: Features, Application Domains, and Roles of General-Purpose and Special Function Registers. | • Explain the architecture and key features of RISC/CISC-based microcontrollers<br>• Identify and describe the roles of general-purpose and special function registers<br>• Relate microcontroller features to practical application domains | Week 8-9 | Diagram analysis, register identification exercises, case studies on applications | Lecture, multimedia | CLO1, CLO2 |

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|---|---|---|---|---|---|
| I/O and Memory Addressing in Microcontrollers: I/O Ports, Data Direction Registers, and Memory Mapping Techniques | • Explain the operation of I/O ports and Data Direction Registers in microcontrollers<br>• Describe memory mapping techniques and how memory and I/O are addressed | Week 10 | Memory mapping tasks | Lecture, multimedia | CLO1,CLO 2 |
| Instruction Set and Addressing Modes in Microcontrollers | • Explain the instruction set of microcontroller s and the function of each instruction type<br>• Identify and apply different addressing modes in programming | Week 11-12 | Addressin g mode identificati on tasks, small assembly programs | Lecture, multimedia | CLO2, CLO3 |
| Sensor and Device Integration in Embedded Systems: Interfacing Microcontrollers with ADCs, LCDs, Keypads, Motors, and Digital/Analog Sensors | Explain techniques for interfacing microcontrollers with various sensors and devices<br>• Demonstrate programming and control of ADCs, LCDs, keypads, motors, and analog/digital sensors | Week 13-14 | Scenario-bas ed tasks involving sensor and device integration | Lecture, multimedia | CLO3, CLO4 |
| FINAL EXAMINATION | | | | | |

**17. Teaching-Learning Strategies:** Interactive Lectures, Google Classroom

**18. Assessment Techniques of each topic of the course:**

| SL. No | Topics / Content | Assessment Techniques |
|---|---|---|
| 1 | **Introduction to Microprocessors and Microcontrollers** | Class Test, Assignment |
| 2 | **Internal Architecture: Functional units, registers, buses, memory organization** | Class Test, Written Exam |
| 3 | **Instruction Sets and Addressing Modes: Data transfer, arithmetic, logical, control instructions** | Class Test, Written Exam |
| 4 | **Assembly Language Programming: Programming using various addressing modes and instructions** | Class Test, Assignment,Written Exam |
| 5 | **Interfacing and Applications: I/O ports, timers, ADC/DAC, sensors, communication interfaces, keyboards, displays, actuators, and memory expansion** | Class Test, Written Exam |

## Part C – Assessment and Evaluation

**19. Assessment Strategy**

**Class Tests:** Altogether 3 class tests may be taken during the semester,1 class tests will be taken for midterm and 2 class tests will be taken for final term. 2 out of 3 class tests will be considered. CT1, best of CT2 & CT3 will be considered. No makeup class tests will be taken. Students are strongly recommended not to miss any class tests.

**Assignment:** Assignment (Written and/or presentation.) will be given throughout the semester. Late submission will result in a 50% deduction in score. Students will have to do the presentation on the given topic as an assignment.

**CIE- Continuous Internal Evaluation (30 Marks)**

| **Bloom's Category Marks (out of 30)** | **Tests (20)** | **Assignments (10)** |
|---|---|---|
| Remember | | |

| | | |
|---|---|---|
| Understand | | |
| Apply | | |
| Analyze | | |

| | | |
|---|---|---|
| Evaluate | | |
| Create | | |

**SMEB- Semester Mid & End Examination (70 Marks)**

| **Bloom's Category** | **Test** |
|---|---|
| Remember | |
| Understand | |
| Apply | |
| Analyze | |
| Evaluate | |
| Create | |

**Weighting COs with Assessment methods:**

| **Assessment Type** | | **Marks Distribution (%)** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
|---|---|---|---|---|---|---|---|
| | | | **PO1** | **PO3** | **PO3** | **PO2** | **PO3** |
| **Final Exam (50%)** | **Written Exam** | **50** | | | | | |
| **Mid Term (20%)** | **Written Exam** | **20** | | 15 | 5 | | |
| **Assessment (30%)** | **Assignment/ Presentation/Viva** | **10** | | | | | |

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|---|---|---|---|---|---|---|---|
| | **Quiz** | **20** | | | | | |
| **Total** | | **100%** | | | | | |

**20. Evaluation Policy**

Grades will be calculated as per the university grading structure and individual students will be evaluated based on the following criteria with respective weights.

1. Assessment 30%
2. Term Examination 50%
3. Mid-Term Examination 20%

**UAP Grading Policy**

| Numeric Grade | Letter Grade | Grade Point |
|---|---|---|
| 80% and above | A+ | 4.00 |
| 75% to less than 80% | A | 3.75 |
| 70% to less than 75% | A- | 3.50 |
| 65% to less than 70% | B+ | 3.25 |
| 60% to less than 65% | B | 3.00 |
| 55% to less than 60% | B- | 2.75 |
| 50% to less than 55% | C+ | 2.50 |
| 45% to less than 50% | C | 2.25 |
| 40% to less than 45% | D | 2.00 |
| Less than 40% | F | 0.00 |

## Part D – Learning Resources

**21. Text Book**

1. Barry B. Brey, The Intel Microprocessors, Processor Architecture, Programming, and Interfacing, Eighth Edition, 2009, Prentice Hall

**Reference Books & Materials**

1. Assembly Language Programming and Organization of the IBM PC by Ytha Yu and Charles Marut.
2. C the complete reference by Herbert Schildt (4th edition)
3. Getting Started with Arduino" by Massimo Banzi 4th edition

4. Programming the ESP8266 with the Arduino IDE by Espressif Systems