**University of Asia Pacific (UAP)**

**Department of Computer Science**

**Course Outline**

**Program:** Computer Science and Engineering (CSE) Course **Title:** Computer Architecture

**Course Code:** CSE 317

**Semester: Fall** 2022

**Level:** 6th Semester

**Credit Hour:** 3.0

**Name & Designation of Teacher:** Shammi Akhtar, Assistant Professor

**Office/Room: level &**

**Class Hours: as per class routine**

**Consultation Hours: as per office time document**

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**Rationale:** Required course and a pre-requisite for Digital System Design, Microprocessor and Operating System in the CSE program. The

knowledge of this course is very important for the field of

Hardware Design and Implementation.

**Pre-requisite** (if any)**:** CSE 209: Digital Logic & System Design

**Course Synopsis:**

Introduction: Computer Architecture and Organization. Instruction set architecture: Overview of MIPS, basic instruction, high level to MIPS conversion of instruction, MIPS control and data path design. Computer arithmetic and number system: Binary review; floating point number representation; basic addition and multiplication algorithm and hardware. Advanced computer arithmetic: Booth multiplication scheme, recoding process, best and worst multiplier, average gain. Computer system performance and performance matrices: Execution time, clock rate, processor speed, CPI-clock per instruction, mathematical problems. Memory and cache hierarchy: Primary memory, secondary memory, memory hierarchy, virtual memory, caching scheme: direct addressed caching, other policies, Control design: Processor control Unit design and data path analysis, Pipelining: Pipelined data path and control, super scalar and dynamic pipelining. I/O organization: Introduction, bus control, I/O systems, programmed IO, DMA and interrupts, I/O processors, multiprocessor system: UMA, NUMA etc.

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**Course Objectives:** The objectives of this course are to:

1. **Explain** the layers of computer organization.

2. **Explain** terms related to computer organization.

**3. Introduce** with clock cycle, instruction cycle, performance,

instruction format, addressing mode and instruction throughput of

single-cycle, multi-cycle, and pipelined implementations of a simple

instruction set and pipeline hazard.

4. **Provide** the knowledge **of** computer hardware, memory hierarchy,

cache configurations, identification, placement, replacement Strategy

and Show how cache design parameters affect cache hit rate.

**Course Outcomes (CO) and their mapping with Program outcomes (PO) and Teaching-Learning Assessment methods:**

| **CO**  **No.** | **CO Statements:**  Upon successful completion of the course, students  should be able to: | **Corresponding POs**  **(Appendix-1)** | **Bloom’s**  **taxonomy**  **domain/level (Appendix**  **2)** | **Delivery**  **methods**  **and**  **activities** | **Assessment**  **Tools** |
| --- | --- | --- | --- | --- | --- |
| CO1 | **explain and apply**  knowledge related to the layers of computer  organization. | 1 | 1/Apply | Lecture,  multimedia. | Quiz,  Presentation  Class Test |
| CO2 | **Analyze** clock cycle,  instruction cycle,  performance, instruction format, addressing mode and instruction throughput of single-cycle, multi-cycle, and pipelined  implementations of a  simple instruction**.** | 2 | 1/Analyze | Lecture,  Example  from MIPS  Instruction  set | Class Tests,  Class Works |
| CO3 | **Design and implement** computer hardware,  memory hierarchy, cache configurations,  identification, placement, replacement Strategy and Show how cache design parameters affect cache hit rate. | 3 | 1/Evaluate | Problem  Exercise | Assignment,  Project  Planning  Exercise |

**Weighting COs with Assessment methods:**

| **Assessment**  **Type** | **% weight** | **CO1** | **CO2** | **CO3** |
| --- | --- | --- | --- | --- |
| Final Exam | **50%** | 10 | 60 | 50 |
| Mid Term | **20%** | **5** | **10** | 5 |
| Class  performance, Class Tests,  Case study,  Assignment,  Project, On  Spot Exercises | **30%** | 6 | 12 | 12 |
| **Total** | **100%** | 26 | 37 | 37 |

**Grading Policy:** As per the approved grading policy of UAP (Appendix-3)

**Course Content Outline and mapping with COs**

| Week | Topics | Course Outcome | Delivery methods and activities | Reading Materials |
| --- | --- | --- | --- | --- |
| 1-2 | Topic 1: Computer Abstraction and Technology Introduction to computer architecture, processor and memory technologies, performance and power wall, switching from uniprocessor to multiprocessor. | CO1,CO2 | Lecture, Multimedia | Chap: 1, Computer Organization and Design: The Hardware/Software Interface (5th Edition) and lecture slides |
| 3-5 | Topic 2: Instructions: Language of the Computer Classifying instructions set architecture, types and size of operands, operations in the instruction set, Instruction for flow control, Instructions format, Addressing modes, MIPS Assembly Language. | CO1, CO2,CO3, | Lecture, Multimedia | Chap: 2, Computer Organization and Design: The Hardware/Software Interface (5th Edition) and lecture slides |
|  | CT-1 |  |  |  |
| 6-7 | Topic 3: Arithmetic for Computers Arithmetic | CO1, CO2,CO3 | Lecture, Multimedia | Chap: 3, Computer Organization and Design: |

|  | Operations (Addition, Subtraction, Multiplication and Division), Floating Point Representation, Floating Point Operations (Addition and Multiplication). |  |  | The Hardware/Software Interface (5th Edition) and lecture slides |
| --- | --- | --- | --- | --- |
|  | CT-2 |  |  |  |
| 8 | **Midterm Exam** |  |  |  |
| 9-10 | Topic 4 : CPU Organization and Design  Datapath, pipelining,  pipelined datapath and  control, instruction-level parallelism | CO1, CO3 | Lecture, Multimedia Lecture, Example  Problem | Chap: 4, Computer Organization and Design: The Hardware/Software Interface (5th Edition) and lecture slides |
|  | CT 3 |  |  |  |
| 11-12 | Topic 5: Cache Hierarchies Memory hierarchies, Cache policies, Memory system, RAMs, ROMs – Speed, size and cost Performance  consideration – Virtual  memory | C01, CO2,CO3 | Lecture, Multimedia Lecture, Example  Problem | Chap: 5, Computer  Organization and Design: The Hardware/Software Interface (5th Edition) and lecture slides |
|  | CT 4 |  |  |  |
| 13 | Topic 6: Storage, Networks, and Other Peripherals  Accessing I/O devices, Interrupts, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces (PCI, SCSI, USB). | CO1,CO2,CO3 | Lecture, Multimedia Lecture, Example  Problem | Chap: 6, Computer  Organization and Design: The Hardware/Software Interface (3rd Edition) and lecture slides |
| 14 | Presentations  Review |  |  |  |
|  | **Final Exam** | C01,  CO2,CO2,CO3. |  |  |

**Required References:** Computer Organization and Design: The Hardware/Software Interface -David A. Patterson, John L. Hennessy (5th Edition)

**Recommended References:** Computer Organization & Architecture-Designing for Performance **-** William Stallings (6th Edition, Pearson Education, 2003 reprint)

**Student’s responsibilities:** Students must come to the class prepared for the course material covered in the previous class (es).

They must submit their assignments on time.

No late or partial assignments will be acceptable. There will be no make

up quizzes/class tests.

**Special Instructions:**

• Minimum 70% attendance is required for a student to appear in the final exams • Late presence Any student coming after 20 minutes will miss the attendance

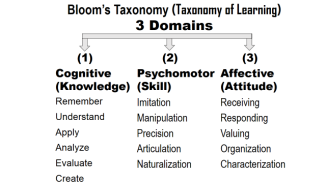
| **Prepared by** | **Checked by** | **Approved by** |
| --- | --- | --- |
| SHAMMI AKHTAR | Chairman, PSAC committee | Head of the Department |

**Appendix-1:**

**Washington Accord Program Outcomes (PO) for engineering programs:**

| **No.** | **PO** | **Differentiating Characteristic** |
| --- | --- | --- |
| 1 | Engineering Knowledge | Breadth and depth of education and type of knowledge, both theoretical and practical |
| 2 | Problem Analysis | Complexity of analysis |
| 3 | Design/ development of solutions | Breadth and uniqueness of engineering problems i.e. the extent to which problems are original and to which solutions have previously been identified or codified |
| 4 | Investigation | Breadth and depth of investigation and experimentation |
| 5 | Modern Tool Usage | Level of understanding of the appropriateness of the tool |
| 6 | The Engineer and Society | Level of knowledge and responsibility |
| 7 | Environment and Sustainability | Type of solutions. |
| 8 | Ethics | Understanding and level of practice |
| 9 | Individual and Team work | Role in and diversity of team |
| 10 | Communication | Level of communication according to type of activities performed |
| 11 | Project Management and Finance | Level of management required  for differing types of activity |
| 12 | Lifelong learning | Preparation for and depth of Continuing learning. |

**Appendix-2**

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**Appendix-3**

**UAP Grading Policy:**

| **Numeric Grade** | **Letter Grade** | **Grade Point** |
| --- | --- | --- |
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