University of Asia Pacific (UAP)
Department of Computer Science and Engineering (CSE)

Course Outline

Program:	Computer Science and Engineering (CSE)
Course Title:	Computer Architecture I
Course Code:	CSE 331
Semester:	Spring-2018
Level:	3rd Year 1st Semester
Credit Hour:	3.0
Name & Designation of Teacher:	Dr. Md. Rajibul Islam, Jahir Ibna Rafiq
Office/Room:	7th Floor, Teacher's Compound
Consultation Hours:	9.30-11am (Section C), 2-3.30pm (Section D)
E-mail:	md.rajibul.islam@uap-bd.edu, Jahir@uap-bd.edu
Mobile:	**01835022398, 01987860616**
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 231: Digital Logic 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.

Course Objectives (CO):

The objectives of this course are:

1. To **provide** a thorough understanding of the basic structure and operation of a digital computer.
2. To **introduce** the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division in detail.
3. To **deliver** the basic concepts of pipelining and datapath.
4. To **emphasize** the hierarchical memory system including cache memories and virtual memory.
5. To **discuss** different ways of communicating with I/O devices and standard I/O interfaces.

Learning Outcomes (LO):

Upon completion of the course, the students will be able to:

1. **Use** various metrics to calculate the performance of a computer system
2. **Identify** the addressing mode of instructions
3. Determine which hardware blocks and control lines are used for specific instructions
4. **Demonstrate** how to add and multiply integers and floating-point numbers using two's complement and IEEE floating point representation
5. **Analyze** clock periods, performance, and instruction throughput of single-cycle, multi-cycle, and pipelined implementations of a simple instruction set
6. **Detect** pipeline hazards and identify possible solutions to those hazards
7. **Show** how cache design parameters affect cache hit rate

Teaching-learning and Assessment Strategy: Lectures, assignments, quizzes, exams

Linkage of LO with Assessment Methods & their Weights:

LO	Assessment Method	(%)
1 – 3	Quiz	10
1 – 6	Class attendance	10
4,5,6	Assignment	10
1– 4	Midterm Exam	20
1 – 6	Final Exam	50

Minimum attendance: 70% class attendance is mandatory for a student in order to appear at the final examination.

Mapping of Course LO and Generic Skills:

Learning Outcome (LO) of the Course	Generic Skills* (Appendix-1)											
	1	2	3	4	5	6	7	8	9	10	11	12
Describe the objective of DBMS, database concept, and structure.	√											
Explain terms related to database design and management	√											
Understand and apply normalized concept of data modeling and database development process knowledge.		√	√	√								
Use different DBMS and the database language (SQL) for managing database of industry.		√	√		√							
Analyze and enhance database design performance.		√		√	√							
Design and develop logical database design for big industrial and business process.			√	√	√				√	√		

Lecture Schedule

Week	Topics	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.	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.	Chap: 2, Computer Organization and Design: The Hardware/Software Interface (5^{th} Edition) and lecture slides
	CT-1	
6-7	Topic 3: Arithmetic for Computers Arithmetic Operations (Addition, Subtraction, Multiplication and Division), Floating Point Representation, Floating Point Operations (Addition and Multiplication).	Chap: 3, Computer Organization and Design: The Hardware/Software Interface (5^{th} 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	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	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).	Chap: 6, Computer Organization and Design: The Hardware/Software Interface (3rd Edition) and lecture slides
14	Presentations Review	
	Final Exam	

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)

Grading System: As per the approved grading scale of University of Asia Pacific (Appendix-2).

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.

Appendix-1: Generic Skills

No.	Generic Skills
1.	**Engineering Knowledge**
2.	**Problem Analysis**
3.	**Design/Development of Solutions**
4.	**Investigation**
5.	**Modern Tool Usage**
6.	**The Engineer and Society**
7.	**Environment and Sustainability**
8.	**Ethics**
9.	**Communication**
10.	**Individual and Team Work**
11.	**Life Long Learning**
12.	**Project Management and Finance**

Generic Skills (Detailed):

1. **Engineering Knowledge (T)** -Apply knowledge of mathematics, sciences, engineering fundamentals and manufacturing engineering to the solution of complex engineering problems;
2. **Problem Analysis (T)** – Identify, formulate, research relevant literature and analyze complex engineering problems, and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;
3. **Design/Development of Solutions (A)** –Design solutions, exhibiting innovativeness, for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, economical, ethical, environmental and sustainability issues.
4. **Investigation (D)** Conduct investigation into complex problems, displaying creativeness, using research-based knowledge, and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;
5. **Modern Tool Usage (A & D)** -Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations;
6. **The Engineer and Society (ESSE)** -Apply reasoning based on contextual knowledge to assess societal, health, safety, legal, cultural, contemporary issues, and the consequent responsibilities relevant to professional engineering practices.
7. **Environment and Sustainability (ESSE)** -Understand the impact of professional engineering solutions in societal, global, and environmental contexts and demonstrate knowledge of and need for sustainable development;
8. **Ethics (ESSE)** –Apply professional ethics with Islamic values and commit to responsibilities and norms of professional engineering code of practices.
9. **Communication (S)** -Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions;
10. **Individual and Team Work (S)** -Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
11. **Life Long Learning (S)** -Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
12. **Project Management and Finance (S)** -Demonstrate knowledge and understanding of engineering management and financial principles and apply these to one's own work, as a

member and/or leader in a team, to manage projects in multidisciplinary settings, and identify opportunities of entrepreneurship.

Appendix-2: 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

Prepared by:	Checked by:	Approved by: (Head of the Detp.)
----------	----------	----------