

**Pokhara University**  
**Faculty of Science and Technology**

Course No.: CMP 262

Full marks: 100

Course title: Computer Architecture (3-1-1)

Pass marks: 45

Nature of the course: Theory & Practical

Total Lectures: 45 hrs

Level: Bachelor

Program: BE (Computer)

### 1. Course Description

This course is designed to provide the knowledge of the evolution of computer architecture and the factors influencing the design of hardware and software elements of computer systems. It aims to provide an understanding of the design of processing unit and control unit architectures. This course introduces the concepts of instruction set design, processor organization, pipelining, cache and virtual memory organizations, I/O and interrupts, parallel processing and multicore computers.

### 2. General Objectives

- To acquaint the students with the knowledge of computer architecture and associated processing, control unit and ALU unit of very simple central processing unit.
- To provide the knowledge of the functions of each element of memory hierarchy.
- To develop the skills in students to choose the appropriate Memory and Input Output organization used in real world computing systems.
- To acquaint the students with the knowledge of technology behind modern advanced computer architectures for parallel processing and multicore architecture.

### 3. Methods of instructions

Lectures, Tutorials, Case Studies, Discussion, Readings and Practical Works.

### 4. Content in details

Specific objectives	Contents
<p>④ • Understand the concepts of computer architectures, functional units and components of computer systems and various addressing modes.</p> <p><i>XIAS</i></p>	<p><b>Unit 1 Introduction to Architecture [4 Hrs]</b> (12 marks)</p> <p>1.1. Brief overview of Computer organization and Architecture</p> <p>1.2. Hierarchy structure of computer system</p> <p>1.3. Computer evolution and generations</p> <p>1.4. Computer Components and Functions</p> <p>1.5. Future Trends in Computer</p> <p>1.6. Review of Instruction sets, Addressing Modes and Instruction format</p>

⑤	<ul style="list-style-type: none"> <li>Understand the VHDL Programming for simple operations.</li> </ul>	<b>Unit -2: Register Transfer Language and Micro operations [4Hrs] (8 marks)</b> 2.1 Register Transfer and RTL 2.2. Micro Operation 2.3 Data Transfer Micro Operations 2.4 Arithmetic and Logical Operations 2.5 Shift Micro operations 2.6 Introduction to HDL and VHDL 2.7 <u>VHDL</u> programming for <u>Adder, Mux, ALU</u>
③	<ul style="list-style-type: none"> <li>Understand the functional units of CPU and their organization.</li> </ul>	<b>Unit -3: Processor Organization [5 Hrs] (13 marks)</b> 3.1 CPU Organization/Structure 3.2 Register Organization and Data paths 3.3 Instruction Cycle(T states) 3.4 Arithmetic and Logical Unit 3.5 Design Principles for Modern Systems
②	<ul style="list-style-type: none"> <li>Understand the design of Hardwired and microprogrammed control units.</li> </ul>	<b>UNIT 4 Control Unit [5 Hrs] (14 marks)</b> 4.1 Control of the processor 4.2 Hardwired Control Unit(Control unit inputs/logic) 4.3 Microinstruction Format 4.4 Micro Programmed Control Unit 4.5 Architecture of Microprogrammed Control Unit 4.6 Microinstruction Sequencing and Execution 4.7 Application of Hardwired and Micro programmed Control Units 4.8 RISC and CISC Architecture
①	<ul style="list-style-type: none"> <li>Understand the representation of binary numbers in signed and unsigned notation along with the algorithms used for the basic arithmetic operations.</li> </ul>	<b>UNIT 5 Computer Arithmetic [7 Hrs.] (15 marks)</b> 5.1 Integer Representation 5.2 Integer Arithmetic 5.3 Unsigned Binary Addition and Subtraction 5.4 Unsigned Binary Multiplication Algorithm 5.5 Booth Multiplication Algorithm 5.6 Unsigned Binary Division Algorithm 5.7 Floating Point Representation
⑥	<ul style="list-style-type: none"> <li>Understand the concepts of pipelining for better performance.</li> </ul>	<b>Unit 6: Pipelining [4 hrs] (8 marks)</b> 6.1 Pipelining 6.2 Arithmetic Pipeline 6.3 Instruction Pipeline 6.4 Conflicts in Instruction Pipelining and their solutions 6.5 RISC pipeline 6.6 Register Windowing and Register Renaming
	<ul style="list-style-type: none"> <li>Review memory Hierarchy of computer systems and understand the principles of cache memory to increase the performance of CPU</li> </ul>	<b>UNIT 7 Memory Organization [4 Hrs.] (8 marks)</b> 7.1 Memory Hierarchy 7.2 Main Memory and Auxiliary Memory 7.3 Associative Memory and Cache Memory 7.4 Cache mapping techniques- Direct, Associative

Block diagram → pencil scale

	<p>and Set Associative Mapping</p> <p>7.5 Cache Write Policy.</p> <p>7.6 Cache Replacement algorithm (FIFO, LRU, LFU)</p>
<ul style="list-style-type: none"> <li>Familiarize with IO interfaces and introduce various methods for improving I/O performances.</li> </ul>	<p><b>Unit 8: Input-Output Processing [4 Hrs] [7 marks]</b></p> <p>8.1 Peripheral Devices</p> <p>8.2 I/O Modules</p> <p>8.3 I/O Interface and Techniques</p> <p>8.4 Modes of Transfer: Programmed, Interrupt-Driven and DMA</p> <p>8.5 I/O Processor and IO channel</p> <p>8.6 GPU and TPU</p> <p>8.7 External Interfaces: FireWire and Infiniband 244</p>
<ul style="list-style-type: none"> <li>Understand the concept of parallel processing and multi thread architecture in modern processors.</li> </ul>	<p><b>Unit 9: Parallel Processing [4 Hrs] [8 marks]</b></p> <p>9.1 Parallel Processing</p> <p>9.2 Parallelism In Uniprocessor system</p> <p>9.3 Multiprocessor System and their characteristics</p> <p>9.4 Flynn Classification</p> <p>9.5 Interconnection structures in Multiprocessors</p> <p>9.6 Vector processing and Array processing</p> <p>9.7 Introduction to Multithreaded Architecture</p>
<ul style="list-style-type: none"> <li>Prevalent new developments in computer architecture: the use of multiple processors on a single chip</li> </ul>	<p><b>Unit 10: Multi-core computer (4Hrs) [7 marks]</b></p> <p>10.1 Hardware performance issues</p> <p>10.2 Software Performance Issues</p> <p>10.3 Multicore Organization</p> <p>10.4 Dual Core, Quad Core and Octa Core</p> <p>10.5 Power Efficient Processor</p>