Tribhuvan University

Institute of Science and Technology

Bachelor Level/Second Year/Third Semester/Science

Computer Science and Information Technology (BSc. CSIT)

Course Title: Computer Architecture

Micro-syllabus

Course No.: CSC 201

Credit hours: 3hrs. **Full Marks**: 80+20

Nature of Course: Theory (3 hrs.) **Pass Marks**: 32+8

Course Synopsis: This course gives the fundamental knowledge concern with the way the hardware components are connected together to form a computer system and how they interact to provide the processing needs of the user.

Goals:

- Introduces the fundamental concepts behind the design working and organization of a computer system.
- Instruction set architecture, memory hierarchies and interconnection.

Unit	Topic	Hrs.
1.	Data representation	5

	• Data representation
	  ➢ Data types – number systems, alphanumeric representation, complements (r's and r-1's)
	• Fixed point representation
	  ➢ Integer representation
	  ➢ Arithmetic addition, subtraction, overflows.
	  ➢ Decimal fixed point representation
	• Floating point representation
	• Binary and decimal codes
	  ➢ Gray, BCD, ASCII, Excess-3
	• Error detection code
	  ➢ Parity bit, parity checker and parity generator
		1.5
		
		1
		
		1
		1
		
		0.5

2.	Micro-operations	5

	• Arithmetic micro-operations
	  ➢ Add micro-operation, subtract micro-operation
	  ➢ Binary adder, binary subtractor, binary adder-subtractor, binary incrementor.
	  ➢ Arithmetic circuit
	• Logic micro-operations
	  ➢ Logic micro-operations
	  ➢ Implementations and applications
	• Shift micro-operations
	  ➢ Logical shift, circular shift, arithmetic shift
	  ➢ Combinational circuit shifter
	• Arithmetic logic shift unit	

3.	Fundamental of Computer Organization and Design	7

	• Computer Register
	  ➢ Registers for the basic computer and common bus system
	• Computer instructions
	  ➢ Instruction format, basic instructions, instruction set completeness, types of instruction (memory reference, register reference, I/O)
	• Instruction cycle
	  ➢ Phases of instruction cycle
	  ➢ Fetch and decodes
	  ➢ Flowchart for instruction cycle
	• Input and Output and Interrupt
	  ➢ I/O configuration, Input-output instruction
	  ➢ Types of interrupt, Program interrupt, Interrupt cycle
	• Basic computer design and accumulator logic
	  ➢ Basic hardware components
	  ➢ Flowchart for computer operation
	  ➢ Control logic gates
	  ➢ Control of register and memory
	  ➢ Control of common bus
	  ➢ Control of flip-flop
	  ➢ Design of accumulator logic (control of AC register, Adder and Logic circuit)
		1
		
		1.5
		
		1
		
		1.5
		
		2

4.	Control Unit	5

	• Control Memory
	  ➢ Control Word, Control memory, Stored program organization
	• Hardwired control
	  ➢ Introduction, Timing and control, Control unit of basic computer, Timing signal
	• Micro-programmed control
	  ➢ Micro-program control organization
	  ➢ Address sequencing
	  ▪ Introduction, Conditional branching, Mapping of instructions, Subroutines
	  ➢ Micro-programs
	  ▪ Micro-instruction and micro-operation format, Symbolic micro-instructions, Symbolic micro-program, Binary micro-program
	• Design of control unit
	  ➢ F-field decoding, Micro-program sequencer	

5.	Central Processing Unit	

	• Register Organization
	  ➢ Bus system of CPU, Control word, ALU and Micro-operation for CPU
	• Register Stack and Memory Stack
	  ➢ LIFO and Stack pointer, Register stack, Memory stack
	• One address and two address instruction
	  ➢ Instruction format, One address instruction, Two address instruction, Three address instruction, and Zero address instruction
	• Addressing modes
	  ➢ Introduction, Implied mode, Immediate mode, Register mode, Register	

	indirect mode, Auto-increment/Auto-decrement mode, Relative address mode, Indexed addressing mode, Base register addressing mode • Data transfer and Manipulation ➢ Basic operations ➢ Data transfer instructions ➢ Data manipulation instructions ▪ Types, Arithmetic instructions, Logical and bit manipulation instruction, Shift instruction • Introduction to RISC and CISC ➢ Introduction to RISC and CISC, Characteristics of RIAC and CISC, Overlapped Register Window	
6.	Fixed Point Computer Architecture	5
	• Addition and Subtraction ➢ Introduction, Addition and Subtraction with signed magnitude, Hardware Implementation, Hardware Algorithm ➢ Addition and Subtraction with signed 2's complement • Multiplication ➢ Introduction, Hardware Implementation and Algorithm, Booth algorithm, Array multiplier • Division Algorithm ➢ Introduction, Hardware implementation, Overflow, Hardware algorithm, Restoring method, Comparison and non-restoring method	1.5 2 1.5
7.	Input and Output Organization	6
	• Introduction to Peripheral Devices ➢ I/O subsystem and peripherals • I/O interface ➢ Interface I/O bus and interface module, Types of I/O commands ➢ I/O and Memory bus, Isolated I/O, Memory mapped I/O, I/O interface unit • Direct Memory Access (DMA) ➢ Types of I/O, DMA, DMA transfer • I/O Processor ➢ I/O processing, CPU-IOP communication • Data Communication Processor ➢ Serial and parallel communication, Data communication processor, Modes of data transfer, Protocol	0.5 1.5 1.5 1 1.5
8.	Memory Organization	6

	• Hierarchy of Memory System ➢ Types of memory, Sequential, Random, Memory hierarchy • Primary and Secondary Memory ➢ Primary memory – RAM, ROM, Bootstrap Loader, RAM and ROM Chips, Memory Address Map, Memory-CPU connection ➢ Auxiliary Memory – Types, Magnetic (Tape, Disk), Optical, Semiconductor • Virtual Memory ➢ Introduction, Address space, Memory space, Address mapping using pages, Associative page table, Page replacement • Memory management hardware ➢ Introduction, Segmented page mapping, Memory protection	1 1.5 2.5 1

Text Books: M. Morris Mano, Computer System Achitecture

References:

M. Morris Mano "Digital Design", Pearson Education, Third Edition

M. Morris Mano "Logic and Computer Design Fundamentals", Pearson Education, 2nd Edition Updated.

Members:

Dr. Subarna Shakya----------Expert/Coordinator

Hari Khadka----------Patan Campus

Bhoj Raj Ghimire----------Amrit Science Campus

A.N. Mishra----------St. Xavier College

Pratima Karki----------Kathford College