**Techno India NJR Institute of Technology**



**Course File**

**Computer Architecture (6CS4- 04)**

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**Course Overview:**

To study concepts related to Computer Data Representation, Micro-operations, Instructions, Programming the basic computer, Central Processing Unit, Computer Arithmetic, Memory Organization, Multiprocessors etc. which is vital to excel in the field of Computer Architecture domain.

**Course Outcomes:**

|  |  |  |
| --- | --- | --- |
| **CO. NO.** | **Cognitive Level** | **Course Outcome**  |
| 1 | Synthesis | To Develop a base of Computer Data Representation, Types of Arithmetic, Logical & Relational operations, Insights of Instructions & Microoperations  |
| 2 | Synthesis | To Develop the understanding of Various Computer Architecture Languages, Programming the operations, Microprogrammed Control, Address Sequencing role & Design of Control Unit |
| 3 | Knowledge | To understand the General Register Organization, Stack Organization, Addressing Modes, Instruction Set Codes, Parallel Processing, Pipelining, Vector Processing & Array Processors |
| 4 | Application | To command over Computer Arithmetic Logics like Addition, Subtraction, Mutliplication Algorithms, Floating Point Arithmetic Operations & Input Output Organization |
| 5 | Knowledge | To understand the Memory Organization, Types of Memory, Multiprocessors, Interconnection Structures, Inter-processor Communication & Synchronization |

**Prerequisites:**

1. Elementary knowledge of Digital Electronics
2. Basic Concepts of Number System
3. Good Problem Solving Skills

**Course Outcome Mapping with Program Outcome:**

|  |  |
| --- | --- |
| **Course Outcome**  | **Program Outcomes (PO’s)** |
| **CO. NO.** | **Domain Specific (PSO)** | **Domain Independent (PO)** |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| CO1 | 3 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO2 | 3 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO3 | 2 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO4 | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO5 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)  |

**Course Coverage Module Wise:**

|  |  |  |
| --- | --- | --- |
| **Lecture No.** | **Unit** | **Topic** |
|  | 1 | **Introduction to Objective, Scope & outcome of Computer Architecture and Organization** |
|  | 2 | Basic computer data types, Complements, Fixed point representation |
|  | 2 | Register Transfer and Micro-operations |
|  | 2 | Floating point representation, Register Transfer language |
|  | 2 | Register Transfer, Bus and Memory Transfers (Tree-State Bus Buffers, Memory Transfer) |
|  | 2 | Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logical shift unit |
|  | 2 | Basic Computer Organization and DesignInstruction codes |
|  | 2 | Computer registers, computer instructions |
|  | 2 | Timing and Control, Instruction cycle, Memory-Reference Instructions |
|  | 2 | Input-output and interrupt |
|  | 2 | Complete computer description, Design of Basic computer, design of Accumulator Unit |
|  | 3 | Programming The Basic Computer, Introduction |
|  | 3 | Machine Language |
|  | 3 | Assembly Language, assembler |
|  | 3 | Program loops, Programming Arithmetic and logic operations, subroutines |
|  | 3 | I-O Programming |
|  | 3 | Micro programmed Control, Control Memory |
|  | 3 | Address sequencing, Micro program Example, Design of Control Unit |
|  | 4 | Central Processing Unit - Introduction, General Register Organization |
|  | 4 | Stack Organization, Instruction format, Addressing Modes |
|  | 4 | Data transfer and manipulation, Program Control |
|  | 4 | Reduced Instruction Set Computer (RISC) |
|  | 4 | Pipeline And Vector Processing |
|  | 4 | Flynn's taxonomy, Parallel Processing, Pipelining, Arithmetic |
|  | 4 | Pipeline, Instruction, Pipeline, RISC Pipeline, Vector Processing |
|  | 4 | Array Processors |
|  | 5 | Computer Arithmetic- Introduction, Addition and subtraction |
|  | 5 | Multiplication Algorithms (Booth Multiplication Algorithm) |
|  | 5 | Division Algorithms, Floating Point Arithmetic operations |
|  | 5 | Decimal Arithmetic Unit, Input-Output Organization |
|  | 5 | Input-Output Interface |
|  | 5 | Asynchronous Data Transfer, Modes Of Transfer |
|  | 5 | Priority Interrupt, DMA |
|  | 5 | Input-Output Processor (IOP), CPUIOP Communication, Serial communication |
|  | 6 | Memory Organization, Memory Hierarchy, Main Memory |
|  | 6 | Auxiliary Memory, Associative Memory |
|  | 6 | Cache Memory |
|  | 6 | Virtual Memory |
|  | 6 | Multipreocessors, Characteristics of Multiprocessors |
|  | 6 | Interconnection Structures, Inter-processor Arbitration |
|  | 6 | Interprocessor Communication and Synchronization |
|  | 6 | Cache Coherence, Shared Memory Multiprocessors |

**TEXT/REFERENCE BOOKS**

1. M Morris Mano: Computer System Architecture, Pearson Education India
2. John L. Hennessy, David A Patterson: Computer Architecture, A Quantitative Appproach
3. Sajjan G. Shiva: Computer Organization, Design, and Architecture, Fifth Edition, CRC Press

|  |  |
| --- | --- |
| **CO.NO.** | **Problem description** |
| **1** | 1. Understanding the introductory concepts of Data Representation & Microoperations
2. Understanding the Concepts of Basic Computer Organization & Types of Instructions
 |
| **2** | 1. Understanding the programming of basic computer, Machine Language & Assembly Language
2. Conceptualizing the Arithmetic & Logic Operations & Micro Programmed Control
 |
| **3** | 1. Learning the principles of Central Processing Unit (CPU), Instruction formats & Addressing Modes
2. Understanding the concepts of Parallel Processing & Various Pipelines
 |
| **4** | 1. Conceptualizing the logics of Arithmetic Operations & Input Output Organization
 |
| **5** | 1. Understanding the concepts of Memory Organization & types of memory
2. Visualizing the concepts of Multiprocessors including Characteristics, Interconnection Structure, Interprocess Communication & Synchronization & Shared Memory Multiprocessors
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**Assessment Methodology:**

1. Assignments one from each unit.
2. Final paper at the end of the semester subjective.

**Teaching and Learning resources unit-wise:**

**Unit-1**

A. Introduction to Computer Architecture

Video Tutorials: <https://www.youtube.com/watch?v=HEjPop-aK_w&ab_channel=KarBytesCS>

Theory concepts: [https://www.oreilly.com/library/view/designing-embedded-hardware/0596007558/ch01.html](https://www.oreilly.com/library/view/designing-embedded-hardware/0596007558/ch01.html%20)

Sample Quiz[: https://mcqslearn.com/cs/computer-basics/introduction-to-computer-architecture-multiple-choice-questions.php](%3A%20https%3A/mcqslearn.com/cs/computer-basics/introduction-to-computer-architecture-multiple-choice-questions.php)

**Unit-2**

1. Data Representation & Microoperations

Video Tutorials: <https://www.youtube.com/watch?v=Q2QCmCPQOtw&ab_channel=SabaqFoundation-FreeVideos%26Tests%2CGradesK-14>

Theory concepts: [https://mrcet.com/downloads/digital\_notes/ECE/III%20Year/COMPUTER%20ORGANIZATION%20&%20OPERATING%20SYSTEMS.pdf](https://mrcet.com/downloads/digital_notes/ECE/III%20Year/COMPUTER%20ORGANIZATION%20%26%20OPERATING%20SYSTEMS.pdf)

Sample Quiz: <https://www.javatpoint.com/computer-architecture-mcq>

1. Basic Computer Organization & Types of Instruction

Video Tutorials: <https://www.youtube.com/watch?v=BKUkIGc9JsE&ab_channel=Education4u>

Theory concepts: <https://www.geeksforgeeks.org/computer-organization-basic-computer-instructions/>

Sample Quiz: <https://letsfindcourse.com/computer-organization-and-architecture/mcq-questions>

**Unit-3**

1. Programming of basic computer, Machine Language & Assembly Language

Video Tutorials: [https://www.youtube.com/watch?v=cTaWkhHChaY&ab\_channel=SundeepSaradhiKanthety](https://www.youtube.com/watch?v=cTaWkhHChaY&ab_channel=SundeepSaradhiKanthety%20)

Theory concepts: [https://www.sciencedirect.com/topics/engineering/machine-language](https://www.sciencedirect.com/topics/engineering/machine-language%20)

Sample Quiz: <https://www.sanfoundry.com/computer-organization-mcqs-assembly-language/>

1. Arithmetic & Logic Operations & Micro Programmed Control

Video Tutorials: [https://www.youtube.com/watch?v=MxvZQLR6zqM&ab\_channel=Education4u](https://www.youtube.com/watch?v=MxvZQLR6zqM&ab_channel=Education4u%20) Theory concepts: <https://www.geeksforgeeks.org/computer-organization-hardwired-vs-micro-programmed-control-unit/>

Sample Quiz: <https://knreddycse.weebly.com/uploads/5/7/2/0/57207825/coa_mcq.pdf>

**Unit-4**

1. Central Processing Unit (CPU), Instruction formats & Addressing Modes

Video Tutorials: <https://www.learncomputerscienceonline.com/instruction-cycle/>

Theory concepts: <https://www.geeksforgeeks.org/computer-organization-instruction-formats-zero-one-two-three-address-instruction/>

Sample Quiz: <https://nptel.ac.in/content/storage2/courses/downloads_new/106103180/noc19_cs04_Assignment5.pdf>

1. Concepts of Parallel Processing & Various Pipelines

Video Tutorials: <https://www.youtube.com/watch?v=He3vckYRV2s&ab_channel=IITKharagpurJuly2018>

Theory concepts: <http://www.nitjsr.ac.in/course_assignment/CS16CS601PARALLEL%20COMPUTER%20ARCHITECTURE.pdf>

Sample Quiz: <https://www.objectivequiz.com/objective-questions/electronics/parallel-processing>

**Unit-5**

1. Logics of Arithmetic Operations & Input Output Organization

Video Tutorials: [https://www.youtube.com/watch?v=GsL4jeKqerk&ab\_channel=SudhakarAtchala](https://www.youtube.com/watch?v=GsL4jeKqerk&ab_channel=SudhakarAtchala%20)

Theory concepts <http://www.ee.ncu.edu.tw/~jfli/computer/lecture/ch05.pdf>

Sample Quiz: [https://www.mcqsmentor.com/computer-science/organization-and-architecture/input-output-organization-mcqs/](https://www.mcqsmentor.com/computer-science/organization-and-architecture/input-output-organization-mcqs/%20)

**Unit-6**

1. Memory Organization & types of memory

Video Tutorials: [https://www.youtube.com/watch?v=YVObWiciVgw&ab\_channel=Education4u](https://www.youtube.com/watch?v=YVObWiciVgw&ab_channel=Education4u%20)

Theory concepts: [http://www.cs.uwm.edu/classes/cs458/Lecture/HTML/ch12.html](http://www.cs.uwm.edu/classes/cs458/Lecture/HTML/ch12.html%20)

Sample Quiz: <https://www.sanfoundry.com/computer-fundamentals-questions-answers-main-memory-organisation/>

1. Multiprocessors including Characteristics, Interconnection Structure, Interprocess Communication & Synchronization & Shared Memory Multiprocessors

Video Tutorials: <https://slideplayer.com/slide/3612016/>

Theory concepts: <https://lnct.ac.in/wp-content/uploads/2020/04/CSO-Notes-unit-5-Multiprocessor.pdf>

Sample Quiz: <https://nptel.ac.in/content/storage2/courses/106108101/pdf/Multiple_Choice_Questions/Mod_7.pdf>

Previous Year Question Papers:







