GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE04000251

Subject Name: Computer Organization & Architecture

w.e.f. Academic Year:	A.Y.2024-25
Semester:	4
Categor of the Course:	PCC

Prerequisite:	Basic understanding of computer and programming
Rationale:	This subject helps students to understand the internal architecture and working of computers. Basically, how computers evolved, how does it represent any type of data, how does it conduct arithmetic, logic, storage operations. The process computer follows when it executes a program starting from writing a program to machine codes and its execution. The understanding of these aspects of computers is really essential to understand the power as well as limitations of computers which is important to be a good computer engineer and/or scientist.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
1	Identify and explain the basic structure and functional units of a digital computer.	R, U
2	Write assembly language programs and identify the role and working of various functional units of a computer for executing instructions.	R, A
3	Design processing unit using the concepts of ALU and control logic design.	U, A
4	Design circuits for interfacing memory and I/O with processors.	U, A
5	Comprehend the features and performance parameters of different types of computer architectures.	R, U

**Revised Bloom's Taxonomy(RBT)*

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	0	30	15	90	03	70	30	20	30	50	200

*** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Structure of Computers: Computer types, Functional units, Basic operational concepts, Von Neumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Error detection and correction codes.	**2**	**5**
2.	Register Transfer and Micro-operations: Register Transfer language, Register Transfer, Bus and Memory Transfers (Tree-State Bus Buffers, Memory Transfer), Arithmetic Micro Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logical shift unit	6	10
3.	Basic Computer Organization and Design Instruction codes, Computer registers, computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input-output and interrupt, Complete computer description, Design of Basic computer, Design of Accumulator Unit.	4	15
4.	Assembly Language Programming Introduction, Machine Language, Assembly Language Programming: Arithmetic and logic operations, looping constructs, Subroutines, I-O Programming.	6	10
5.	Micro programmed Control Organization: Control Memory, Address sequencing, Micro program example, Design of Control Unit	2	5
6.	Central Processing Unit Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, Data transfer and manipulation, Program control, Reduced Instruction Set Computer (RISC) & Complex Instruction Set Computer (CISC)	6	15
7.	Pipeline And Vector Processing Flynn's taxonomy, Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction, Pipeline, RISC Pipeline, Vector Processing, Array Processors	3	5
8.	Input-Output Organization Input-Output Interface, Asynchronous Data Transfer, Modes Of Transfer, Priority Interrupt, DMA, Input-Output Processor (IOP), CPUIOP Communication, Serial communication.	4	10
9.	Memory Organization Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.	4	10
10.	Computer Arithmetic Introduction, Addition and subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic operations, Decimal Arithmetic Unit.	4	10
11.	Multiprocessors Characteristics of Multiprocessors, Interconnection Structures, Inter-processor Arbitration, Inter-processor Communication and Synchronization, Cache Coherence, Shared Memory Multiprocessors.	4	5

Suggested Specification Table with Marks(Theory):

Distribution of Theory Marks (in%)					
RLevel	**ULevel**	**ALevel**	**NLevel**	**E Level**	**CLevel**
20	**40**	**20**	**20**	**--**	**-**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. M. Morris Mano, "Computer System Architecture", Pearson Education
2. Yale N. Patt, Sanjay J. Patel, "Introduction to Computing Systems" McGraw Hill.
3. Hamacher, Vranesic, Zaky, "Computer Organization", McGraw Hill.
4. Andrew S. Tanenbaum and Todd Austin, "Structured Computer Organization", Pearson Education
5. N. D. Jotwani, "Computer system organization", McGraw Hill
6. R.S.Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085A", Penram International
7. Douglas Hall, Microprocessors and Interfacing, TMH.
8. Computer Organisation and Architecture, Smruti R. Sarangi, McGrawHill (2015)

(b) Open source software and website:

NPTEL Course:

1. Computer Architecture By Prof. Smruti Ranjan Sarangi | IIT DelhA
2. Computer Architecture and Organization By Prof. Indranil Sengupta, Prof. Kamalika Datta | IIT Kharagpur
3. Computer Architecture By Prof. Anshul Kumar | IIT Delhi

Suggested Course Practical List:(List can be change according to Latest Development)

1. Implement Booth's Algorithm
2. Write the working of 8085 simulator GNUsim8085 and basic architecture of 8085 along with small introduction.
3. Write an assembly language code in GNUsim8085 to add two 8 bit numbers
4. Write an assembly language code in GNUsim8085 to store numbers in reverse order in memory location.
5. Write an assembly language code in GNUsim8085 to implement arithmetic instruction
6. Write an assembly language code in GNUsim8085 to find the factorial of a number.
7. Write an assembly language code in GNUsim8085 to implement logical instructions.
8. Write an assembly language code in GNUsim8085 with user defined function which accepts two 8 bit numbers and return their sum.
9. Design ALU using Logisim.
10. Implement 16-bit single-cycle MIPS processor in Verilog HDL

- **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1	Assignment writing. Numerical based assignment is preferable.	5 assignments of 3h each. Total = 15h	Based on the assignment submitted.
2	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding-based problems of 3h each. Total = 15h	Based on the coding solution submitted.
3	Technical Video based learning related to the subject	Duration of video = 5h Report preparation & Presentation = 10h Total = 15h	Report /presentation based on the video learning outcomes.
4	Discussion on research paper based on relevant subject	3 research paper = 15h	Summarize research paper and evaluation critical parameters
5	Poster/chart/power point preparation on technical topics	Duration = 10 h	Based on poster/chart preparation and presentation skills
6	Application/Software development	Duration = 15 h	Depending on the complexity of the Application/Software
7	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
8	Seminar / Presentation	Duration for study and preparation=5h Report writing=3h Presentation=2h Total=10h	Topic can be selected technical content beyond syllabus
9	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 10h Total = 15h	Based on in-depth study, technical depth, data collected, fact finding, etc.
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Self-learning on-line course	Minimum duration of the course should be 15h.	Examination based assessment at the end of course. Based on the certificate produced.
12	Complex problem solving	Maximum 3 problem. Study of the problem and solution finding, Total = 15h	Based on the depth of the solution submitted.
13	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on

			industry/ lab data.
14	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
15	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment /health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions

Note:

- All the suggested activity should be related to the subject.
- Min 3 activities must be carried out as per the availability of faculties and students.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.

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