

A. Course Handout

Institute/School Name	Chitkara University Institute of Engineering and Technology		
Department Name	Department of Interdisciplinary Courses in Engineering (DICE)		
Programme Name	Bachelor of Engineering (B.E.), Computer Science & Engineering		
Course Name	Digital Electronics and Computer Architecture	Session	2023-2024
Course Code	23IC001	Semester/Batch	2 nd /2023
L-T-P (Per Week)	3-0-2	Course Credits	04
Course Coordinator	Dr. Gaurav Sharma		

1. Objectives of the Course

Digital electronics is an area of computer science and a computer facilitates a binary number system for its services. Digital electronics defines the two binary numbers, including 1 and 0, using two voltage levels in a machine known as a logic gate. It contains the data mechanism, the instruction group, and methods for addressing memory. The structural design of a computer system is concerned with the descriptions of the multiple functional modules, including processors and memories, and managing them together into an electronic system. This course provides a wide scope of learning & understanding of basic digital electronics and computer architecture. The main objectives of the course are:

- To familiarize the students with the basic understanding of electronics components and their application in engineering field.
- To apply the concept of basic building blocks of digital electronics.
- To familiarize the students with the basic understanding of computer system architecture and organisation.
- To Interpret the concept of machine instruction, input-output and program interrupt.
- To Illustrate concepts regarding pipelining, parallel processing and Direct Memory Access.

2. Course Learning Outcomes

Student should be able:

	Course Outcome	POs	CL*	KC**	Sessions
CLO01	To understand the basics of electronics elements, their functionality and application to perceive the concept of analog circuits.	PO1,PO3,PO4, PO7	K2	Fundamental Conceptual	12
CLO02	To apply and analyse the concept of boolean algebra in the field of digital electronics for various digital circuits.	PO1,PO4,PO5	K3	Conceptual Procedural	13
CLO03	To conceptualize and understand the fundamental organization of the computer system architecture.	PO7,PO11	K4	Conceptual Fundamental	9
CLO04	To comprehend the register organisation, instruction format and control process in central processing unit of computer.	PO1,PO2,PO12	K2	Factual Fundamental	6
CLO05	To analyse the concept of parallel processing, pipelining and direct memory access to speed-up the computer processing.	PO3, PO5, PO12	K4	Conceptual Procedural	7
Total Contact Hours					71

Revised Bloom's Taxonomy Terminology

*Cognitive Level =CL

**Knowledge Categories = KC

Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CLO01	L		L	M			L					
CLO02	M			L	H							
CLO03							H				L	
CLO04	M	L										L
CLO05			M		H							L

H=High, M=Medium, L=Low

3. ERISE Grid Mapping

Feature Enablement	Level(1-5, 5 being highest)
Entrepreneurship	2
Research	3
Innovation	3
Skills	4
Employability	3

4. Recommended Books (Reference Books/Text Books)

- B1:** Basic Electronics and Linear Circuits by N. N Bhargava, D. C Kulshreshtha, S. C Gupta; McGraw Hill Publications, Second Edition, 2013.
- B2:** Modern Digital Electronics by R. P. Jain; McGraw Hill Publications, Fourth Edition, 2010.
- B3:** Fundamentals of Digital Circuits by A. Anand Kumar; PHI Learning Publications, Second Edition, 2011.
- B4:** Computer System Architecture by M. Morris Mano; Pearson Education, Revised Third Edition, 2018.
- B5:** Computer Architecture and Organization by John P Hayes, McGraw Hill Publications, Third Edition, 1998.
- B6:** Digital Electronics and Computer Architecture by J. V. Suresh Babu and N. Nagendra Reddy, Falcon Publications, First Edition, 2017.
- B7:** Basic Electrical and Electronics Engineering by V. Jegathesan, K. Vinoth Kumar, R. Saravana Kumar, Wiley India, First Edition, 2011.

5. Other readings and relevant websites

Serial No	Link of Journals, Magazines, websites and Research Papers
1.	https://www.vedantu.com/evs/capacitor-inductor-resistor
2.	https://www.electronics-tutorials.ws/diode/diode_2.html/
3.	https://www.electrical4u.com/pnp-transistor/
4.	https://nptel.ac.in/courses/106104073
5.	https://nptel.ac.in/courses/106106134

6. Recommended Tools and Platforms

Virtual Labs, NPTEL, SWAYAM

7. Course Plan

Session Number	Topic(s)	Book(page no.)
1	Introduction to Course Handout Introduction to Basic Electronics, Digital Electronics and Computer Architecture	B1-B7
	Active and passive components, Ohm's law, Concept and various types of Resistors	B1 (5)
2-3	Capacitors, Inductors and their series and parallel combinations	B1 (12), B7(6, 10, 12)
4	n-type and p-type semiconductor, P-N Junction Diode, V-I Characteristics, Ideal Diode, Diode application as a switch	B1 (69), B1 (79)
5-6	Rectifiers: Half Wave, Full Wave Rectifier: Centre-tap and Bridge Rectifiers, PIV, Efficiency and Ripple Factors	B1 (89)
7-9	Rectification with Filters: Shunt Capacitor, Chock input LC and pi-Filters, Zener Diode, Light Emitting Diode, Bipolar Transistors: NPN and PNP transistor.	B1(105), B1 (137), B7 (436)
9-10	Digital Electronics: Digital and analog systems, logic levels, duty cycle & pulse waveform, Number Systems (Decimal, Binary, Octal and hexadecimal), Conversions in Number System, 1's Complement and 2's complement	B3 (1), B2 (28)
ST-1		
11-12	Representation of Signed Numbers using 1's and 2's Complement Method, Binary Addition, Subtraction and Multiplication, Arithmetic using Complement Method	B3 (31, 36, 39)
13-14	Logic Gates, Basic gates, Universal Gates and special purpose gates with their truth table, symbols, logical expression, Boolean algebra - Laws of Boolean algebra, Realization of simplified Boolean Expressions using Logic Gates	B3 (108), B3 (141)
15-17	K-Map (upto 4 variables) with don't care conditions, Encoders and Decoders, Multiplexers and Demultiplexers, Basic Latches and Flip-Flops with truth tables.	B3 (196), B3 (330, 345, 354, 459)
18	Computer Organisation: Introduction to Computer Organization & Architecture, Basic Computer Organization	B4 (3)
19-20	Instruction Codes, Computer Registers, Computer Instructions, Memory Reference, Register Reference and I/O Instructions, instruction Set Completeness	B4 (144,149)
ST-2		
21-22	Timing and Control, Instruction Cycle, Process to determine the type of instructions, Input-Output and Program Interrupts.	B4 (153, 170)
23-24	Central Processing Unit: Introduction, General Register Organization, Operation of Control Unit	B4 (265)
25-26	Control Word, Stack Organization and Instruction Format, Various Addressing Modes	B4 (268, 270, 283)

27-28	RISC and CISC Characteristics, Introduction to Parallel Processing, Flynn's Classification of Computers	B4 (304, 323)
29-30	Pipelining, Pipeline Hazards, Direct Memory Access (DMA), DMA Transfer, Input-Output Processor (IOP),	B4 (329, 446, 450)
ST-3		
31-32	General Introduction to Computer memory: Memory hierarchy, Main Memory: RAM and ROM, Auxiliary Memory: Magnetic Disks and Tape, Cache Memory	B4(479)
End Term Exam		

8. Delivery/Instructional Resources

Session No.	Topics	Web References	Audio-Video
1-3	Basics of Electronics: Introduction to Basic Electronics, Active and passive components, Ohm's law, Concept and various types of Resistors, Capacitors, Inductors and their series and parallel combinations, n-type and p-type semiconductor	https://www.electronics-notes.com/articles/basic_concepts/ http://web.mit.edu/6.012/www/SP07-L2.pdf	https://nptel.ac.in/courses/122106025 https://nptel.ac.in/courses/108101091
4-7	P-N Junction Diode, V-I Characteristics, Ideal Diode, Diode application as a switch, Rectifiers: Half Wave, Full Wave Rectifier: Centre-tap and Bridge Rectifiers, PIV, Efficiency and Ripple Factors, Rectification with Filters: Shunt Capacitor, Chock input LC and pi-Filters, Zener Diode, Light Emitting Diode	https://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/semiconductor-diodes/pnjunctionsemiconductor-diode.html https://ecenotesgeu.files.wordpress.com/2016/09/rectifiers.pdf	https://nptel.ac.in/courses/122106025 https://nptel.ac.in/courses/108101091
8-9	Bipolar Transistors : NPN and PNP transistor.	https://www.elprocus.com/difference-between-npn-and-pnp-transistor/	https://nptel.ac.in/courses/122106025
10-13	Digital Electronics: Digital and analog systems, logic levels, duty cycle & pulse waveform Number Systems (Decimal, Binary, Octal and hexadecimal), Conversions in Number System, 1's Complement and 2's complement, Representation of Signed Numbers using 1's and 2's	https://www.studocu.com/in/document/kannur-university/computer-science/digital-electronics-number-system/32305209	https://nptel.ac.in/courses/108105132

	Complement Method, Binary Addition, Subtraction and Multiplication, Arithmetic using Complement Method		
14-15	Logic Gates, Basic gates, Universal Gates and special purpose gates with their truth table, symbols, logical expression, Boolean algebra - Laws of Boolean algebra, Realization of simplified Boolean Expressions using Logic Gates.	https://www.madeeasy.in/uploads/examsolution/09.DigitalElectronics_UPPSCTheory.pdf	https://nptel.ac.in/courses/108105132
16-17	K-Map (upto 4 variables) with don't care conditions, Encoders and Decoders, Multiplexers and Demultiplexers, Basic Latches and Flip- Flops with truth tables.	https://www.electronicshub.org/flip-flops/ https://web.ece.ucsb.edu/Faculty/Johnson/ECE152A/L3%20-%20Karnaugh%20Maps%20%20Combinational%20Logic%20Design.pdf https://www.electronicsforu.com/technology-trends/learn-electronics/flip-flop-rs-jk-t-d?utm_source=google&utm_medium=cpc&utm_campaign=Ele.com+-+traffic+Dynamic+Search+-22-12-2021&gclid=CjwKCAjwqZSIBhBwEiwAfoZUIGkXdVDy-xW_OHQoDy--4J412LbqZrlzattmewS9IF7eOCOS4yPaxRoCdHsQAvD_BwE	https://nptel.ac.in/courses/108105132
18	Computer Organisation: Introduction to Computer Organization & Architecture, Basic Computer Organization, Instruction Codes	https://nitsri.ac.in/Department/Electronics%20&%20Communication%20Engineering/Chapter1-Introduction.pdf https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/ https://www.codingninjas.com/studio/library/instruction-codes-and-addresses	https://archive.nptel.ac.in/courses/106/105/106105163/

19-20	Computer Registers, Computer Instructions, Memory Reference, Register Reference and I/O Instructions, instruction Set Completeness, Timing and Control	https://www.pvpsiddhartha.ac.in/dep_it/lecture%20notes/COA/CSA%20UNIT%202.pdf https://www.studocu.com/in/document/babu-banarasi-das-university/computer-organization-architecture/computer-architecture-21-40/48437969	https://archive.nptel.ac.in/courses/106/105/106105163/
21-22	Instruction Cycle, Process to determine the type of instructions, Input-Output and Program Interrupts	https://vardhaman.org/wp-content/uploads/2021/03/COA-Unit-II-part-1.pdf https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004171006162950anshu_singh_engg_input_output.pdf	https://archive.nptel.ac.in/courses/106/105/106105163/
23-25	Central Processing Unit: Introduction, General Register Organization, Operation of Control Unit, Control Word, Stack Organization and Instruction Format, Various Addressing Modes	http://gacbe.ac.in/pdf/ematerial/18BIT44A-U3.pdf https://gppanchkula.ac.in/wp-content/uploads/2021/06/e_content_of_co-1.pdf	https://nptel.ac.in/courses/106103068 https://archive.nptel.ac.in/courses/106/105/106105163/
26-28	RISC and CISC Characteristics, Introduction to Parallel Processing, Flynn's Classification of Computers, Pipelining, Pipeline Hazards	https://www.geeksforgeeks.org/computer-organization-risc-and-cisc/ https://byjus.com/gate/flynns-classification-notes/ https://www.studytonight.com/computer-architecture/pipelining	https://nptel.ac.in/courses/106103068 https://archive.nptel.ac.in/courses/106/105/106105163/
29-32	Direct Memory Access (DMA), DMA Transfer, Input-Output Processor (IOP), General Introduction to Computer memory: Memory hierarchy, Main Memory: RAM and ROM, Auxiliary Memory: Magnetic Disks and Tape, Cache Memory	https://www.elprocus.com/direct-memory-access-dma-in-computer-architecture/ https://www.studytonight.com/computer-architecture/input-output-processor https://www.studytonight.com/computer-architecture/memory-organization	https://archive.nptel.ac.in/courses/106/105/106105163/ https://nptel.ac.in/courses/106103068

9. Action plan for different types of learners

Slow Learners	Average Learners	Fast Learners
Remedial Classes, Doubt Sessions, Guided Tutorials	Workshop, Doubt Session	More Practical Assignments/ Quiz/Competitions, Project

10. Evaluation Scheme & Components

Evaluation Component	Type of Component	No. of Assessments	Weightage of Component	Mode of Assessment
Component 1	Continuous Evaluations	02*	25%	Computer Based Test
Component 2	Sessional Tests (STs)	03**	25%	Computer Based Test
Component 3	End Term Examination (ETE)	01***	50%	Computer Based Test
Total		100%		

* There will be two Continuous Evaluations (CE) for a lab in a semester as CE-1 and CE-2, one will be considered as mid term/day to day evaluation and another one will be based on developed project. Average marks of CE-1 and CE-2 will be taken as final marks. Lab file record, lab performance in whole semester and internal viva with experiment performance will be taken in consideration of CE-1.

** All STs are compulsory. ST1 and ST2 have weightage of 25% each and ST3 has 50% out of total weightage of component 2.

***It is mandatory to complete Components 1 and 2. Further, as per Academic Guidelines minimum 75% attendance is required to become eligible for appearing in the End Semester Examination.

11. Syllabus of the Course

Subject: Digital Electronics and Computer Architecture			
S. No.	Topic (s)	No. of Sessions	Weightage %
1	Basics of Electronics: Introduction to basic electronics, Active and passive components, Ohm's law, Concept and various types of Resistors, Capacitors, Inductors and their series and parallel combinations, n-type and p-type semiconductor, P-N Junction Diode, V-I Characteristics, Ideal Diode, Diode application as a switch, Rectifiers: Half Wave, Full Wave Rectifier: Centre-tap and Bridge Rectifiers, PIV, Efficiency and Ripple Factors, Rectification with Filters: Shunt Capacitor, Chock input LC and pi-Filters, Zener Diode, Light Emitting Diode, Bipolar Transistors: NPN and PNP transistor.	12	20%
2	Digital Electronics: Digital and analog systems, logic levels, duty cycle & pulse waveform, Number Systems (Decimal, Binary, Octal and hexadecimal), Conversions in Number System, 1's Complement and 2's complement, Representation of Signed Numbers using 1's and 2's	13	30%

	Complement Method, Binary Addition, Subtraction and Multiplication, Arithmetic using Complement Method, Logic Gates, Basic gates, Universal Gates and special purpose gates with their truth table, symbols, logical expression, Boolean algebra - Laws of Boolean algebra, Realization of simplified Boolean Expressions using Logic Gates, K-Map (upto 4 variables) with don't care conditions, Encoders and Decoders, Multiplexers and Demultiplexers, Basic Latches and Flip-Flops with truth tables.		
3	Computer Organisation: Introduction to Computer Organization & Architecture, Basic Computer Organization, Instruction Codes, Computer Registers, Computer Instructions, Memory Reference, Register Reference and I/O Instructions, instruction Set Completeness, Timing and Control, Instruction Cycle, Process to determine the type of instructions, Input-Output and Program Interrupts.	9	20%
4	Central Processing Unit: Introduction, General Register Organization, Operation of Control Unit, Control Word, Stack Organization and Instruction Format, Various Addressing Modes, RISC and CISC Characteristics, Introduction to Parallel Processing, Flynn's Classification of Computers, Pipelining, Pipeline Hazards, Direct Memory Access (DMA), DMA Transfer, Input-Output Processor (IOP), General Introduction to Computer memory: Memory hierarchy, Main Memory: RAM and ROM, Auxiliary Memory: Magnetic Disks and Tape, Cache Memory	13	30%

12. Complete Lab Course Coverage Plan:

Session No.	Lab Session	Resource Link
1	To familiarize with basic electronic equipments (CRO, DSO, Function Generator, Multimeter, DC Power Supply, Breadboard etc.) and electronics components (resistor, capacitor, inductor, diode, LED, transistor, etc.).	CRO and Function Generator:- http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAE/exp1/index.html# Basic Electronic Components:- http://vlabs.iitkgp.ernet.in/be/index.html#

2	To plot and analyse the forward and reverse characteristics of PN junction Si / Ge diode and determine the knee voltage.	http://vlabs.iitkgp.ernet.in/be/exp5/index.html
3	To analyze and plot Zener diode as voltage regulator and observe the output voltage with variable input voltage.	http://vlabs.iitkgp.ernet.in/be/exp10/index.html#
4	To study the operation of half wave and full wave rectifiers (with and without filters).	Half Wave Rectifier:- http://vlabs.iitkgp.ernet.in/be/exp6/index.html Full Wave Rectifier:- http://vlabs.iitkgp.ernet.in/be/exp7/index.html
5	To study and verify the truth tables of various logic gates on digital trainer kit using TTL ICs.	https://de-iitr.vlabs.ac.in/exp/truth-table-gates/theory.html
6	To study and verify D and J-K Flip-Flop using their respective ICs.	https://de-iitr.vlabs.ac.in/exp/truth-tables-flip-flops/simulation.html
7	To study and verify the function of BCD (Binary Coded Decimal) to seven segment decoder (IC 7447) and operation of 7-segment LED display on digital trainer kit.	http://vlabs.iitkgp.ernet.in/dec/exp1/index.html#
8	To implement and study 4:1 multiplexer and 1:4 demultiplexer using logic gates using virtual labs.	https://de-iitr.vlabs.ac.in/exp/multiplexer-demultiplexer/index.html
9	To study various internal and external hardware components of computer architecture and its organization.	https://gptcthirurangadi.in/download/pdf/academic-files/4137--AKNMGptc.pdf
10	To design and simulation of Arithmetic Logic Unit (ALU) using virtual labs.	http://vlabs.iitkgp.ac.in/coa/exp8/index.html
11	Continuous Evaluation-1 (Experiment Performance)	
12-14	Project Work	
15	Continuous Evaluation-2 (Based on Project Work)	

This Document is approved by:

Designation	Name	Signature
Course Coordinator	Dr. Gaurav Sharma	
Dean-DICE	Dr. Rajneesh Talwar	
Date (DD-MM-YYYY)	03-01-2024	