GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Power Electronics

Course / Subject Code: DI03024031

Course / Subject Name: Digital Electronics

w. e. f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	PCC

Prerequisite:	Fundamental Knowledge of Electronics
Rationale:	The aim of introducing this course on digital electronics to impart knowledge of basic building blocks of digital logic circuits. This will enable the student to become aware of various number systems, logic gates and logic families, combinational and sequential logic circuits, which is the foundation for understanding the digital controls, microprocessors and computer systems. Through this course the student will be able to apply the same in almost all areas of electronic control and develop the testing skills.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Use number systems for requirements in digital circuits.	R,U,A
02	Implement simplified Boolean equations using logic gates.	R,U,A
03	Test different types of combinational logic circuits.	R,U,A
04	Test different types of sequential logic circuits.	R,U,A
05	Classify logic families.	R,U,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Number System and Binary Codes** 1.1 Introduction to Number Systems: Binary, Octal, Decimal, Hexadecimal 1.2 Number Conversion: Decimal Number system: Decimal to Binary/Hexadecimal/Octal number conversation. Binary number system: Binary to Decimal/Hexadecimal/Octal number conversation. Complements: 1's Complement, 2's Complement Binary Addition, Subtraction, Multiplication Binary Codes: Gray Code, BCD Code. Code conversation. Hexadecimal Number system: Hexadecimal to Decimal/Binary/Octal number conversation. Octal Number system: Octal to Decimal/Binary/Hexadecimal number conversation.	10	22%
2.	**Boolean Algebra and Functions** 2.1 Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR. 7400 series IC. 2.2 Boolean Algebra: Laws, Duality Theorem, De-Morgan's Theorems, Boolean Expression and functions. 2.3 The Map method. Representation of Logic Expression: SOP, POS. K-Map Representation: Two, Three and Four Variable K-map, SOP, POS; simplification, K-Map using Don't care condition.	10	22%
3.	**Combinational Logic Circuits** 3.1 Combinational Circuits: Arithmetic Circuits: Half Adder, Full Adder, Half Subtractor, Full Subtractor Magnitude comparator: 1-bit, 2-bit and 4-bit Decoders: 2-to 4-line, 3-to-8-line decoder Demultiplexers: 1-to 4-line, 1-to-8-line demultiplexer. Encoders: 4-to-2-line, 8-to-3-line encoder. Multiplexers: 4-to 1-line, 8-to 1-line multiplexer.	10	22%

4.	**Sequential Logic circuits** 4.1 Sequential Circuit: Definition, Block Diagram. Latches: S - R (NOR, NAND) Edge triggered Flip Flops: S – R, D, J – K and T.	8	18%
5.	**Basics of Logic Families** 5.1 Logic Families: Significance, related parameters and Types. 5.2 Logic gates using different logics Logic gates using Diode logic, Logic gates using Resistor Transistor Logic, Logic gates using Diode Transistor logic, Logic gates using Transistor-Transistor logic.	7	16%
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
20	60	20	--	--	--

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Digital Logic and Computer Design	M. Morris Mano	Pearson Education India, ISBN-10: 933254252X
2	Fundamentals of Digital Circuits	A. Anand Kumar	PHI Learning, ISBN-10: 8120352688
3	Digital Electronics Principles, Devices and Applications	Anil K. Maini	John Wiley & Sons Ltd, ISBN 978-0-470-03214-5
4	Digital Electronics and Logic Design	Dr. Sharma Sanjay	S. K. Kataria & Sons, ISBN 978-93-5014-199-1

(b) Open-source software and website:

1. www.youtube.com
2. https://nptel.ac.in/courses/108105132
3. www.vlab.co.in

Suggested Course Practical List:

S. No.	Practical List
1.	Study various number system.
2.	Build/Test the basic logic gates (AND, OR and NOT).
3.	Build/Test the EX-OR, EX-NOR logic gates.
4.	Build/Test NAND and NOR as universal gate.
5.	Test the De- Morgan's theorem.
6.	Build/Test half adder circuit
7.	Build/Test full adder circuit
8.	Build/Test half subtractor circuit
9.	Build/Test full subtractor circuit
10.	Build/Test decoder circuit.
11.	Build/Test the encoder circuit.
12.	Build/Test the comparator circuit.
13.	Build/Test multiplexer circuit.
14.	Build/Test Demultiplexer circuit.
15.	Build/Test SR flip-flop.
16.	Build/Test D flip-flop.
17.	Build/Test JK flip-flop.
18.	Build/Test T flip-flop.
19.	Built/Test various logic gates using diode logic/RTL logic/DTL logic/TTL logic.

List of Laboratory/Learning Resources Required:

S. No.	Equipment Name with Broad Specifications
1	**Digital Electronics Trainer** Trainer should have Features of Logic symbol/ Schematic Diagram indicated on board mimic, On Board DC Power Supplies, Onboard Pulse Generator (TTL), Pulser Switches, 8-bit Data Switches (TTL), 8-bit bicolor LED display, Logic Probe, BCD to seven segment display Scope of Learning: Test the performance of Logic AND, OR, NOT, NAND, NOR, RS Flip-flop, JK Flip-flop, D Flip-flop and verify its Truth table, Study of Logic algebra.

S. No.	Equipment Name with Broad Specifications
	Study the application of logic gate circuit, Study the implementation of simple logic design., Test the performance of digital combinational logic circuits, Study the application of D Flip-flops as Shift Register, Study the application of JK Flip-flops Technical Specifications: DC Power Supplies: + 5V, 1A; +3V to +15V, 500 mA (variable)- 3V to -15V, 500 mA (variable), Pulse Generator: 1Hz to 1MHz Amplitude: 5V (TTL)Duty Cycle:50 %, TTL output Mains:230V AC ±10%
2	**Digital Work Station** The Trainer should have Feature of Graphical LCD to show the menu of experiment and gate level diagram for selected experiment, Solderless breadboard, On Board DC Power Supply, On board Pulse Generator. Scope of Learning: Test the performance of Not gate, OR gate & AND gate, Universal gate, NAND Gate, XOR and XNOR gate, NOT Gate Using NAND Gate, OR Gate Using NAND Gate, AND Gate Using NAND Gate, AND-OR Gate, AND-NOR Gate, NAND-OR Gate, NAND-NOR Gate, NAND-NAND Gate, NOR-NOR Gate, Half Adder, Full Adder, Half Subtractor, Full Subtractor, 4-1 MUX, 1-4 DMUX, 4-2 Encoder. Technical Specification: DC Supply: +5 V, 500 mA, Clock Frequency: 1 Hz, 100 Hz, 1 KHz, 100 KHz, Amplitude: 3.3V, Duty cycle: 50 %, TTL output, Main Supply: 100V - 240V AC, 50/60Hz
3	**Flip Flop Trainer** Trainer Should have Features of Adaptable illustration of Flip-Flops, +5V SMPS Adaptor provided with the trainer for power supply. Scope of Learning: Study of S-R, J-K, D and T Flip-Flop and to verify their Transition table. Input: +5V DC, Main Supply: 100V - 240V AC, 50/60Hz
4	**4½ Digit Multimeter** Function Range and Resolution Basic Accuracy: DC volts, AC volts, Accuracy: 0.025 %, 0.4 % (true-rms) DC current, AC current, Accuracy: 0.15 %, 0.7 % (true-rms) Temperature: -200.0 °C to 1350.0 °C Accuracy:1.0 % Resistance, capacitance and frequency measurement. Accuracy: .005%

Suggested Project List:

1. Design universal test board for Digital Circuits to verify different Gates.
2. Design various Combinational and sequential logic Circuit board.

Suggested Activities for Students:

1. Chart and Project Model Presentations: Demonstrate project models or deliver seminars on various topics covered in the course content.
2. Numerical Problem Solving: Solve the numerical problems provided by the subject faculty in tutorial and Prepare their solutions Book.

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