GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Instrumentation & Control / Automation & Robotics

Course / Subject Code: DI02C00181(Only for C to D Students)

Course/Subject Name: Digital Techniques

w. e. f. Academic Year:	2024-25
Semester:	2nd
Category of the Course:	PCC

Prerequisite:	Digital Techniques
Rationale:	The Digital Techniques syllabus for 2nd-semester Instrumentation & Control diploma engineering students is designed to provide a strong foundation in digital concepts. It helps students develop essential digital skills, enabling them to understand and progress in more advanced engineering subjects. The curriculum aligns with industry needs, ensuring students are well-prepared for successful engineering careers and equipped to adapt to new technologies and challenges.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
CO-1	Understand and Apply the concepts of number systems, binary arithmetic, complements, and code conversions to solve engineering problems and process digital data in various forms.	U,A
CO-2	Understand and Apply the concepts of logic gates, Boolean algebra, and logical operations to simplify Boolean expressions and design logic circuits using basic and universal gates.	U,A
CO-3	Understand and Apply the standard Boolean representations, Karnaugh map (K-map) techniques, and simplification methods to minimize Boolean expressions and realize them using gates.	U,A
CO-4	Understand and Implement various combinational logic circuits for digital system design	R,U,A
CO-5	Understand and Implement various Sequential logic circuits for digital system design.	R,U,A

**Revised Bloom's Taxonomy (RBT)*

GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Instrumentation & Control / Automation & Robotics

Course / Subject Code: DI02000181

Course/Subject Name: Digital Techniques

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 / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Number Systems & Codes**	08	20
	1.1 Number Systems **1.1.1** Types of Number System(Binary, Decimal, Octal & Hexadecimal) **1.1.2** Base or Radix of Number system **1.1.3** Conversion of Number System from one number system to another number system. **1.2** Binary Arithmetic(Addition, Subtraction, Multiplication and Division) **1.3** Complements **1.3.1** 1's & 2's Complements **1.3.2** Subtraction using 1's & 2's Complements **1.4** Codes **1.4.1** BCD, Gray Code, Excess-3.		
2	**Logic Gates & Boolean Algebra**	11	25
	2.1 Two state logical operation **2.1.1** Represent signals in logic 0 and logic 1 in Positive and Negative logic system. **2.2** Tristate logic operation		

	2.3 Logic Gates: **2.3.1** Basic Gates: AND,OR ,NOT Gate Universal Gates: NAND and NOR Gate Special purpose gates: EX-OR and EX-NOR Gate **2.3.2** Symbol, Logical Expression, Truth Table, and Electrical equivalent circuit of each gate **2.3.3** Implementation of AND, OR and NOT gate using Universal gates. **2.4** Boolean Algebra: **2.4.1** Laws, Theorems and Postulates of Boolean Algebra **2.4.2** State and verification of De Morgan's First and Second theorem. **2.4.3** Listing of Boolean expressions for Properties of Boolean Algebra. **2.4.4** Duality Theorems **2.4.5** Simplification of given expression using Boolean Algebra **2.4.6** Development of Logic circuit using the given Boolean Expression		
3	**Digital Logic Simplification**	08	15
	3.1 Standard Boolean representation: **3.1.1** Sum of Product (SOP) and Product of Sum (POS) **3.1.2** Min-Term & Max-Term **3.1.3** Conversion between SOP & POS form. **3.1.4** Realization using NAND/NOR Gates **3.2** K-map reduction technique for the Boolean expression: **3.2.1** Minimization of Boolean expressions (upto 4 variables) using SOP and POS form **3.2.2** Don't care condition in K-map		
4	**Combinational Logic Circuits**	08	20
	4.1 Arithmetic Circuits **4.1.1** Half Adder, Full Adder, Half Subtractor , Full Subtractor, Block diagram of parallel adder using full adder block (up to 4 - bit) **4.2** Decoder: 2 to 4 & 3 to 8		

	4.3 Encoder: 4 to 2 & 8 to 3 **4.4** Multiplexer: 4 to 1 **4.5** Demultiplexer: 1 to 4 **4.6** Code Converter: Gray to Binary and Binary to Gray (up to 4 bits)		
5	**Sequential Logic Circuit**	10	20
	5.1 Sequential Circuit: Introduction **5.1.1** Terms related to sequential Circuit: Digital Clock & Duty cycle **5.1.2** Block Diagram of sequential circuit **5.1.3** Comparison of Combinational & Sequential Logic Circuit **5.1.4** Classification of Sequential Circuits **5.1.5** Flips- Flops and Latch **5.1.6** RS-Latch using NAND and NOR **5.1.7** Triggering methods-Edge trigger and Level Trigger **5.2** Flip-Flops: S-R, J-K, T and D **5.2.1** Truth table and logic circuits of each flip-flop **5.3** Counters **5.3.1** Asynchronous up and down counter (up to 4 bit) **5.3.2** Synchronous up and down counter (up to 4 bit)		
	Total	**45 Hrs.**	**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	**40**	**40**	**-**	**-**	**-**

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:

Sr.	Title of Book	Author Name	Publication/ISBN
1	Fundamentals of Digital Circuits	Anand Kumar	PHI learning Private limited ISBN:978-81- 203-5268-1
2	Modern Digital Electronics	Jain R.P	McGraw-Hill Publishing, ISBN:9780070669116
3	Digital Principles	Malvino A. P. Donald .P. Leach	McGraw-Hill Education ISBN:9789339203405
4	Digital Electronics: Principles, Devices and Applications	Anil.K.Maini	Wiley India ISBN:9780470032145
5	Digital Electronics	G.K.Kharate	Oxford University Press ISBN: 9780198061830
6	Digital Logic and Computer Design	M. Morris Mano	Pearson Education India ISBN: 9789332542525

(b) Open-source software and website:

No.	Resource Name	Web Address
1	Open source AICTE EBooks platform	https://ekumbh.aicte-india.org/
2	Virtual Labs for Digital Systems	https://de-iitr.vlabs.ac.in/
3	Swayam Portal	https://swayam.gov.in/
4	Basics of Digital Electronics	https://studytronics.weebly.com/digital-electronics.html
5	Introduction To Digital Number System & Logic Gates	https://www.udemy.com/course/basics-of-digital-techniques/
6	Digital Circuits	https://onlinecourses.nptel.ac.in/noc19_ee51/preview
7	Online Simulator	https://circuitlab.com
8	Virtual Trainer kit	https://www.deldsim.com

Suggested Course Practical List: If any

Sr. No.	Practical Outcomes (PrOs)	Unit No.	CO	Approx. hours required.
1	To understand and perform conversions between various number systems: Decimal, Binary, Octal, and Hexadecimal.	1	1	2
2	Test the functionality of AND, OR, NOT, EX-OR and EX-NOR logic Gates using equivalent 74 series.	2	2	4
3	Test the functionality of the Universal Gates using equivalent 74 series.	2	2	2
4	Construct Basic Gates using NAND as Universal Gate.	2	2	2
5	Construct Basic Gates using NOR as Universal Gate.	2	2	2
6	Verify De-Morgan's Theorem (1 and 2).	2	2	2
7	Test simplified circuit using minimum logic gates employing Karnaugh map method for given Boolean expression.	3	3	4
8	Implement 2 input and 3 input Adder Circuit.	4	4	2
9	Implement 2 input and 3 input Subtractor Circuit.	4	4	2
10	Build and test the functionality of 3 to 8 decoder circuit.	4	4	2
11	Build and test the functionality of 8 to 3 Encoder circuit.	4	4	2
12	Build and test the functionality of 4:1 Multiplexer	4	4	2
13	Build and test the functionality of 1:4 De-Multiplexer.	4	4	2
14	Implement and verify the truth table of RS and D Flip flop.	5	5	2
15	Implement and verify the truth table of JK and T Flip flop.	5	5	2
16	Build and test the functionality of 4 bit Asynchronous up & down Counter.	5	5	4
17	Build and test the functionality of 4 bit Synchronous up & down Counter.	5	5	4
	Minimum 10 to 12 Practical Exercises			**30 Hrs.**

List of Laboratory/Learning Resources Required:

1. Digital IC Tester
2. Breadboard Development System
3. Trainer Kits for digital ICs
4. Regulated Power Supply

5. Digital Multimeter
6. Pulse Generator.

Suggested Project List:

The projects serve as practical learning experiences for students in the field of Instrumentation and Control Engineering. These projects integrate theoretical knowledge with hands-on application, fostering competency development across various Course Outcomes (COs). Below are guidelines for designing and executing micro-projects:

1. Build a Digital TC tester Circuit
2. Build a 4 bit parity generator and parity checker circuit.
3. Build a circuit to implement 4 bit adder
4. Build a circuit to test 7 segment displays.
5. Build a Circuit for LED flasher.
6. Implement 1:8 DEMUX using 1:4 /1:2 DE-MUX.
7. Implement 16:1 MUX using 8:1/4:1 MUX.

Suggested Activities for Students: If any

In addition to classroom and laboratory learning, students are encouraged to engage in co-curricular activities that enhance their understanding and practical skills. These activities can be conducted in groups and should be documented in 5-page reports. Collecting physical evidence of their work will also contribute to their portfolio, which can be valuable during placement interviews.

1. Prepare the survey report on the applications of different types of number system and code converters used in the design of Digital System.
2. Test digital IC's using various testing equipment like digital IC tester, Digital multi-meter etc.
3. Give seminar on any course relevant topic.
4. Conduct library/internet survey regarding different data sheet and manuals
5. Prepare power point presentation on digital circuits and their application.
6. Undertake a market survey of different digital IC's required for different application.
7. Search for video/animations/ power point presentation on internet for complex topic related to the course and makes a presentation.

* * * * * * *