



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Mechatronics Engineering

Course / Subject Code : DI03020011

Course / Subject Name : Digital Circuits

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

Rationale:	In the area of Mechatronics, a digital electronic circuit is an inseparable part. Hence every mechatronic diploma engineer needs to have the basic skills of maintaining the digital circuits which are part of the mechatronic equipment. As digital systems continue to replace analog ones, the diploma engineering pass-outs are required to effectively engage with modern digital technology used across various industries, including consumer electronics, automation and control systems etc. Therefore, the fundamental knowledge of Number Systems, logic gates, K-Map, basic combinational and sequential logic circuits as well as digital ICs will enable the students to design, interpret and maintain these digital systems. Knowledge of digital circuits so that students will be able to tackle the increasing digital landscape of modern technology.
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After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Gain knowledge between different types of number systems, and their conversions.	R/U/A
02	Design various logic gates and simplify Boolean equations.	R/U/A
03	Illustrate reduction of logical expressions using Boolean algebra, K-map and implement the functions using logic gates.	R/ A / U
04	Gain Knowledge about various combinational circuits.	U /A
05	Recognize Flip-flops as Sequential circuits	R/U



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3. Teaching and Examination Scheme: (*): CA (Continuous Assessment), PA (Progressive Assessment)

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE (V)	
03	00	02	04	70	30	20	30	150

4. Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to Digital Circuits	03	8
2.	Number System and Binary Codes	07	16
3.	Logic Gates	08	18
4.	Boolean Function Implementation	10	24
5.	Combinational Circuits	08	18
6.	Sequential Circuits	06	16
	Total	42	100

5. Suggested Specification Table with Marks (Theory):

Sr. No	Unit Title	Teaching Hours	Distribution of Theory Marks (in %)						Total Marks
			R	U	A	N	E	C	
1.	Introduction to Digital Circuits	03	3	3	--	--	--	2	08
2.	Number System and Binary Codes	07	2	2	4	--	2	2	12
3.	Logic Gates	08	3	5	4	--	--	--	12



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4.	Boolean Function Implementation	10	4	3	3	2	--	2	14
5.	Combinational Circuits	08	2	4	4	2	--	--	12
6.	Sequential Circuits	06	2	4	4	2	--	--	12
		42	16	21	19	06	02	06	70
			20%	28%	23%	11%	9%	9%	100%

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

6. COURSE DETAILS:-

Unit	Major Learning Outcomes(Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit- I Introduction to Digital Circuits	1a. What is Digital Circuits 1b.Difference between analog signals & digital signals 1c.Positive and negative Logic system	1.1 Definition:- Digital circuits & its Applications 1.2 Difference between analog signals & digital signals 1.3 Positive logic and negative logic levels
Unit-II Number System and Binary Codes	2a.Convert number systems and its complements 2b.Solve problems number systems and binary codes	2.1 Numbers system: Base Conversion of Decimal ,Binary, Octal, Hexadecimal 2.2 Complement Methods: 1's and 2's complement 2.3 Binary Codes: BCDcode,Excess-3 code, Gray code, Binary Addition , Subtraction, Multiplication



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Unit–III Logic Gates	3a.Describe functions of Binary Logic 3b.Differentiate the functions of Basic Logic Gates and Universal Logic Gates 3c.Explain the Truth table of various logic gates	3.1 Basic Logic Gates: AND ,OR,NOT gate 3.2Derived Logic Gates :EX-OR,EX-NOR 3.3 Implementation using Basic Gates 3.4 Universal Logic Gates: NAND,NOR gate 3.5 Implementation using NAND and NOR gate
Unit – IV Boolean Function Implementation	4a.Simplify the Boolean function using Boolean theorems and Boolean Algebra 4b.Differentiate between SOP and POS 4c.Simplify Boolean function using K-map	4.1 Boolean Function: Laws of Boolean Algebra, De Morgan’s Theorems, Sum of Product (SOP) Form, Product of Sum(POS)Form 4.2 Simplification of Boolean Function using Boolean Algebra 4.3 Simplification of Boolean Function using K-map: Up to three Variable
Unit – V Combinational Circuits	5a.Modify Half adder ,Full adder, Half Subtractor and full Subtractor 5b.List Application of multiplexers & De-multiplexer 5c. Differentiate between octal to binary encoders.	5.1 Adder: Half Adder, Full Adder 5.2 Subtractor: Half and Full Subtractor 5.3 Multiplexer and De multiplexer: Multiplexer(4:1),De multiplexer(1:4) Encoder and Decoder: Octal to Binary Encoder(8:3),Decoder(3:8)
Unit – VI Sequential Circuits	6a. Difference Between Combinational Circuit & Sequential Circuit 6b. Design Flip Flops using S-R Latch	6.1.Sequential Circuits & its Applications 6.2. Difference Between Combinational and Sequential Circuits. 6.3. Definition:- Flip-flops , J-K Flip flop , R-S Flip flop, D Flip flop, T-Flip flop, Applications of Flip-flops

7. SUGGESTED PRACTICAL EXERCISES:-

The following practical outcomes (PrOs) are the sub-components of the COs. Some of the PrOs marked ‘*’ are compulsory, as they are crucial for that particular CO at the ‘Precision Level’ of Dave’s Taxonomy related to ‘Psychomotor Domain’.



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Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1.	Convert decimal number system to binary, octal and hex. Convert binary, octal and hex to decimal. Convert octal to hex and hex to octal number. Convert binary to BCD, Excess-3 and gray code Convert BCD, Excess-3 and gray code to binary	02	04
2.	Simplify given Boolean expression using K-map and design Logic Circuit using basic logic gates.	01	02
3.	Verify the truth tables of the different Logic Gates.	03	02
4.	Test the functionality of the AND gate, OR gate and NOT gate.	03	02
5.	Test the functionality of the EX-OR and EX-NOR gate.	03	02
6.	Implement Boolean expression using basic logic gates	03	02
7.	Test the functionality of the NAND gate and NOR gate	03	02
8.	Test the functionality of NAND gate as a universal building block.	03	02
9.	Test the functionality of NOR gate as a universal building block.	03	02
10.	Design and implement Half Adder and full adder circuit using IC	04	02
11.	Design and implement Half Subtractor and full Subtractor circuit	04	02
12.	Design various types of Flip flops used in Digital Circuits.	05	04
13.	Prepare a PPT on Various topics given by Subject Teacher	All Units	----
	Total (Hours)	----	28



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NOTES:-

- I.** More Practical Exercises can be designed and offered by the concerned course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a representative list.
- II.** It is compulsory to prepare log book/continuous records of exercises. It is also required to get each exercise recorded in log book/continuous records, checked and duly dated signed by teacher. CA component of practical marks is dependent on continuous and timely evaluation of exercises.
- III.** Term work report must not include any photocopy/ies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.

- a. Brief details of industry visited.
- b. Type, location, products, rough layout, human resource, etc., of industry.
- c. Details, description and broad specifications of machineries/processes observed.
- d. Safety norms and precautions observed.
- e. Student's own observation on industrial environment, productivity concepts, quality consciousness and quality standards, cost effectiveness, culture and attitude.
- f. Any other details/ observations asked by accompanying faculty.
- g. For 40 marks ESE , students are to be assessed for competencies achieved. Students should be given following tasks (any two)
 - i. Conversions of Binary, Decimal ,Octal , Hexadecimal
 - ii. Draw all the logic gates, derived gates and universal gates with their logic diagram and truth table.'
 - iii. Draw the circuit diagram as per their Boolean equation.
 - iv. Explain the role of combinational and sequential circuits in various digital electronics system.

8. References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication
1.	Fundamentals of Digital Circuits	A.Anand Kumar	PHI Learning, Latest Edition ISBN:81-203-1745-9
2.	Digital Logic and Computer Design	Mano M. Morris	Pearson publication, Latest Edition ISBN:81-203-0417-9
3.	Digital Electronics Principles	Malvino and Leech	Tata McGraw- Hill, New Delhi, Latest Edition



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(b) Open source software and website:

- i. Practical Semiconductor Data Manuals: BPB Publications; New Delhi
- ii. Magazines like Electronics for you.
- iii. Electronic Work Bench, Multi SIM
- iv. www.alldatasheet.com
- v. <http://www.asic-world.com/digital/tutorial.html>
- a. <https://www.youtube.com/watch?v=mzxWLjEU1xU&list=PLgwJf8NK-2e4sAMptCE4kYRqoWhIvk2cm&index=8>
- b. https://www.youtube.com/watch?v=eKVD_ec4U6M&list=PLgwJf8NK-2e4sAMptCE4kYRqoWhIvk2cm&index=9
- c. <https://www.youtube.com/watch?v=GIItLxgrzIPs&list=PLgwJf8NK-2e4zRyPzO6HI9sUOR8v-80RT&index=4>
- d. https://www.youtube.com/watch?v=kt8d3CYWGH4&list=PLuYnCh-Sh1XdvuSGjQRi2jgUH9_CiVR8J&index=2
- e. https://www.youtube.com/watch?v=J_2B0addyk

9. List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1.	Breadboard & Digital Logic trainer Kit	
2.	Function Generator	
3.	Digital Multi Meter (DMM)	
4.	Cathode Ray Oscilloscope(CRO)	
5.	DC Power supplies	
6.	Experimental Boards	
7.	Various ICs like: • Logic Gate ICs like AND (7408), OR (7432), NOT (7404), NAND (7400), NOR (7402), EX-OR (7486), and EX-NOR (74266)	



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10. Suggested Project List & Student Activities:

Sr. No.	Activity.
1.	Term work report must not include any photocopy/i.e , printed manual/pages, litho ,etc. It must be hand written / hand drawn by student only.
2.	Term work report content of each experience should include following:- i. Experience description / data and objectives. ii. Drawing of experience / setup with proper circuit diagrams in digital circuits. iii. Draw all the logic gates, derived gates and universal gates with their logic diagram and truth table. iv. Draw the circuit diagram as per their Boolean equation.
3.	• Chart and Project Model Presentations: Demonstrate project models or deliver seminars on various topics covered in the course content. • Numerical Problem Solving: Solve the numerical problems provided by the subject faculty in tutorial and prepare their solutions Book. d) Solve real life problems using logic theory and implement them using digital logic circuits.
