

## GUJARAT TECHNOLOGICAL UNIVERSITY

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)  
Semester-IIICourse Title: Digital Circuits  
(Course Code: 4332001)

Diploma Programme in which this course is offered	Semester in which offered
Mechatronics Engineering	Third

**1. 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. Therefore, this course contains contents related to number system, logic gates, Boolean implementation, basic combinational logic and sequential circuits. Hence, by studying this course the student will be able to maintain digital circuits in mechatronic equipment.

**2. COMPETENCY (Programme Outcome according to NBA Terminology)**

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competencies:

- To implement various logic gates in mechatronic systems.
- To learn about different types of combinational circuits to control the mechatronic systems.

**3. COURSE OUTCOMES**

- Gain knowledge between different types of number systems, and their conversions.
- Design various logic gates and simplify Boolean equations.
- Illustrate reduction of logical expressions using Boolean algebra, K-map and implement the functions using logic gates.
- Gain Knowledge about various combinational & sequential circuits.

**4. TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits(L+T +P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CA	ESE	CA	150
4	0	2	6	70	30	20	30	

**Legends:** L-Lecture; T-Tutorial/Teacher Guided Student Activity; P-Practical;  
Semester Examination; PA-Continuous Assessment.

C - Credit; ESE – End

## 5. COURSE DETAILS

Unit	Major Learning Outcomes(Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
<b>Unit- I</b>  <b>Introduction to Digital Circuits</b>	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
<b>Unit-II</b> <b>Number System and Binary Codes</b>	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, Hexa decimal 2.2 Complement Methods: 1's and 2's complement 2.3 Binary Codes: BCDcode,Excess-3code,Graycode, Parity code 2.4 Binary Addition , Subtraction, Multiplication
<b>Unit-III</b> <b>Logic Gates</b>	3a.Describefunctionsof Binary Logic 3b.Differentiate the functions of Basic Logic Gates and Universal Logic Gates 3c.ExplaintheTruthtableof variouslogicgates	3.1 Basic Logic Gates: AND ,OR,NOT gate 3.2 Derived 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
<b>Unit – IV</b> <b>Boolean Function Implementation</b>	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 ,Min terms and Max terms 4.2 Simplification of Boolean Function using Boolean Algebra 4.3 Simplification of Boolean Function using K-map 4.4 K-map: Up to three Variable
<b>Unit – V</b> <b>Combinational Circuits</b>	5a.Modify Half adder ,Full adder, Half Subtractor and full Subtractor 5b.List Application of multiplexers & Demultiplexer 5c.Differentiate between octal to binary encoders. 5d.Explain the working of a BCD to7segment Decoders.	5.1 Adder: Half Adder, Full Adder 5.2 Subtractor: Half and Full Subtractor 5.3 2-bitMagnitudeComparator 5.4 Multiplexer and De multiplexer: Multiplexer(4:1),De multiplexer(1:4) 5.5 Encoder and Decoder: Octal to Binary Encoder(8:3),Decoder(3:8), BCD to 7-segment Decoder

<b>Unit – VI Sequential Circuits</b>	6a.Difference Between Combinational Circuit & Sequential Circuit 6b.Design Flip Flops using S-R Latch 6c.Explain the working of series shift and parallel right register	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, 6.4.Definition :- Shift register ; Series &Parallel Shift
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#### 6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Digital Circuits	04	4	2	2	08
II	Number System and Binary Codes	10	5	5	2	12
III	Logic Gates	08	4	6	2	12
IV	Boolean Function Implementation	12	4	6	4	14
V	Combinational Circuits	12	2	4	6	12
VI	Sequential Circuits	10	4	4	4	12
Total		56	23	27	20	70

#### Notes:-

- This Specification table shall be treated as only general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table.
- It is Preferable to conduct unit tests and mid semester examination. In Mid sem examination Units I, II, III should be considered.
- Ask the questions from each topic as per marks weight age.
- This subject is to be taught by Mechatronics Engineering Faculty.

#### 6. SUGGESTED LIST OF EXERCISES / PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills (**Course Outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

**Note:** Here only course outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

Sr. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA terminology)	Approx Hrs. Required
1	II	Convert decimal number system to binary, octal and hex. Convert binary, octal and hex to decimal.	02
2	II	Convert octal to hex and hex to octal number.	01
3	II	Convert binary to BCD, Excess-3 and gray code Convert BCD, Excess-3 and gray code to binary	01
4	II	Test the functionality of the AND gate, OR gate and NOT gate.	02
5	III	Test the functionality of the EX-OR and EX-NOR gate.	01
6	III	Implement Boolean expression using basic logic gates	01
7	III	Test the functionality of the NAND gate and NOR gate	02
8	III	Test the functionality of NAND gate as a universal building block.	02
9	III	Test the functionality of NOR gate as a universal building block.	02
10	V	Design and implement Half Adder and full adder circuit using IC	02
11	V	Design and implement Half Subtractor and full Subtractor circuit	02
12	V	Design and implement BCD Seven Segment display using basic Logic gates	02
13	VI	Design various types of Flip flops used in Digital Circuits.	01

**Notes:-**

- 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.
- Term work report content of each experience should include following:-
  - Experience description / data and objectives.
  - Drawing of experience / setup with proper circuit diagrams in digital circuits.
- Presentation topic has to be assigned to the student in the beginning of the term by the batch leader. This may be assigned individually or in the group of maximum 2 students.
- For 40 marks ESE , students are to be assessed for competencies achieved. Students should be given following tasks ( any two )
  - Conversions of Binary, Decimal ,Octal , Hexadecimal
  - Draw all the logic gates, derived gates and universal gates with their logic diagram and truth table.'
  - Draw the circuit diagram as per their Boolean equation.
  - Explain the role of combinational and sequential circuits in various digital electronics system.

**7. SUGGESTED LIST OF STUDENT ACTIVITIES**

Following is the list of proposed student activities like:

- i. Course/Topic based seminars,
- ii. Internet based assignments,
- iii. Teacher guided self-learning activities,
- iv. Course/library/internet/lab based mini-projects etc. These could be individual or group-based.

**8. SPECIAL INSTRUCTIONAL STRATEGIES (if any)**

- i. Learning Digital Circuits in the classroom takes place through activities like Seminar, group's discussion, Assignments and project.
- ii. Preparing notes for laboratory work, design circuit and truth tables in the classroom before the practical work in the laboratory.

**Guidelines for Progressive Assessment (PA) of Theory**

The Progressive Assessment of theory may include the few activities like: Class Test, Assignment, Seminar/Symposium on application of digital circuits, Project, Collection/Records of IC datasheet, Group discussion/Debate

**Guidelines for Progressive Assessment (PA) of Practical**

Distribution of Marks for different Components in Progressive Assessment(PA)		
Sr. No	Content	% of Marks
1	Lab Record.	25%
2	Performing of the practical/exercise	25%
3	Viva voice.	20%
4	Planning, team working, communication etc.	15%
5	Timely Submission, Punctuality and Attendance.	15%
Total		100%

**9. SUGGESTED LEARNING RESOURCES****A) List of Books**

S. No.	Title of Books	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

**B) List of Major Equipment/Materials with Broad Specifications**

- i. Breadboard
- ii. Function Generator
- iii. Digital Multi Meter (DMM)
- iv. Cathode Ray Oscilloscope(CRO)

- v. +
- vi. DC Power supplies
- vii. Experimental Boards

**C) List of Software/Learning Websites**

- 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](http://www.alldatasheet.com)
- v. <http://www.asic-world.com/digital/tutorial.html>
- vi. [www.nptel.com](http://www.nptel.com)

**10. COURSE CURRICULUM DEVELOPMENT COMMITTEE Faculty**

**Members from Polytechnics**

Prof. H.G. Tailor, Lecturer in Department of Mechatronics, B&B Institute of Technology

**11. SUGGESTED MICRO-PROJECTS**

**Only one micro-project** is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more Cos. The duration of the micro-project should be about **14-16 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

**14. SOFTWARE/LEARNING WEBSITES**

- A) <https://www.youtube.com/watch?v=2joeDD5-v3s>
- B) <https://www.youtube.com/watch?v=47u7b2yh7s8>
- C) <https://www.youtube.com/watch?v=1zYRnZ6Pe2A&list=PLgwJf8NK-2e4sAMptCE4kYRqoWhlvk2cm&index=2>
- D) <https://www.youtube.com/watch?v=mzxWLjEU1xU&list=PLgwJf8NK-2e4sAMptCE4kYRqoWhlvk2cm&index=8>
- E) [https://www.youtube.com/watch?v=eKVD\\_ec4U6M&list=PLgwJf8NK-2e4sAMptCE4kYRqoWhlvk2cm&index=9](https://www.youtube.com/watch?v=eKVD_ec4U6M&list=PLgwJf8NK-2e4sAMptCE4kYRqoWhlvk2cm&index=9)
- F) <https://www.youtube.com/watch?v=GlLxgrzIPs&list=PLgwJf8NK-2e4zRyPzO6HI9sUOR8v-80RT&index=4>

G) [https://www.youtube.com/watch?v=kt8d3CYWGH4&list=PLuYnCh-Sh1XdvuSGjQRi2jgUH9\\_CiVR8J&index=2](https://www.youtube.com/watch?v=kt8d3CYWGH4&list=PLuYnCh-Sh1XdvuSGjQRi2jgUH9_CiVR8J&index=2)

H) [https://www.youtube.com/watch?v=J\\_2B0addyk](https://www.youtube.com/watch?v=J_2B0addyk)

I) <https://www.youtube.com/watch?v=Ut2SjYuVBM0>

### 13. PO-COMPETENCY- CO MAPPING

Semester III	Digital Circuits (Course Code:)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
<u>Competency</u>	Use the Concepts of Digital Circuits to solve broad-based engineering related problems.						
Course Outcomes CO-1 Gain knowledge between different types of number systems, and their conversions	3	3	-	2	-	3	1
CO-2 Design various logic gates and simplify Boolean equations.	2	2	3	2	-	2	2
CO-3 Illustrate reduction of logical expressions using Boolean algebra, K-map and implement the functions using logic gates.	3	2	3	1	2	2	3

CO-4 Gain Knowledge about various combinational & sequential circuits.	3	2	3	2	2	1	3
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### **BOS RESOURCE PERSONS:-**

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Dr.S.H.Sundarani BOS Chairman HOD Mechanical Engg.	Government Polytechnic Ahmedabad	9227200147	<a href="mailto:gpasiraj@gmail.com">gpasiraj@gmail.com</a>
2	Dr. Rakesh D. Patel BOS Member HOD Mechanical Engg.	B & B Institute of Technology VV Nagar	9825523982	<a href="mailto:rakeshgtu@gmail.com">rakeshgtu@gmail.com</a>
3	Dr.Atul.S. Shah BOS Member Principal	B.V.Patel Institute of Technology Bardoli	7567421337	<a href="mailto:Asshah97@yahoo.in">Asshah97@yahoo.in</a>



