GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130704
Semester – III
Subject Name: Digital Fundamentals

Type of course: Core

Prerequisite: Basic Electronics and Number Systems

Rationale:

The students need to learn basic concepts of digital circuits and system which leads to design of complex digital system such as microprocessors. The students need to know combinational and sequential circuits using digital logic fundamentals. This is the first course by which students get exposure to digital electronics world.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Module 1 :**Fundamentals of Digital Systems and logic families Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.	**07**	20
2	**Module 2:** Combinational Digital Circuits Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.	**08**	20

3	**Module 3:** Sequential circuits and systems A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters	**08**	20
4	**Module 4:** A/D and D/A Converters Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	**08**	20
5	**Module 5:** Semiconductor memories and Programmable logic devices. Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	**08**	20

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**15**	**15**	**10**	**10**	**05**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. "Digital logic and Computer design", M. M. Mano, Pearson Education India, 2016.
2. "Fundamentals of Digital Circuits", A. Kumar, Prentice Hall India, 2016.
3. "Digital Principles and Applications" Malvino & Leach, McGraw-Hill Education
4. "Modern Digital Electronics", R. P. Jain, McGraw Hill Education, 2009.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Solve the given problem using fundamentals of Number systems and Boolean algebra	10
CO-2	Analyze working of logic families and logic gates and design the simple circuits using various gates for a given problem	10
CO-3	Design and implement Combinational and Sequential logic circuits and verify its working	40
CO-4	Examine the process of Analog to Digital conversion and Digital to Analog conversion	20
CO-5	Implement PLDs for the given logical problem	20

List of Experiments:

1. Getting familiar with various digital integrated circuits of different logic families. Study of data sheet of these circuits and see how to test these circuits using Digital IC Tester.
2. Configure diodes and transistor as logic gates and Digital ICs for verification of truth table of logic gates.
3. Configuring NAND and NOR logic gates as universal gates.
4. Implementation of Boolean Logic Functions using logic gates and combinational circuits. Measure digital logic gate specifications such as propagation delay, noise margin, fan in and fan out.
5. Study and configure of various digital circuits such as adder, subtractor, decoder, encoder, code converters.
6. Study and configurations of multiplexer and demultiplexer circuits.
7. Study and configure of flip-flop, registers and counters using digital ICs. Design digital system using these circuits.
8. Perform an experiment which demonstrates function of 4 bit or 8 bit ALU.
9. Study and configuration of A to D and D to A converter.

Design based Problems (DP)/Open Ended Problem:

1. Design of combinational lock circuits with varying number of bits (For example 4, 8 …..)
2. Design of various types of counters.

3. Design of Arithmetic and Logic Unit using digital integrated circuits.
4. Design project for example digital clock, digital event counter, timers, and various multi-vibrator Circuits, small processor, ports or scrolling display. A student and faculty may choose any other such problem which includes the concept used in the course.

Major Equipment:

1. Digital Storage Oscilloscopes
2. Digital Integrated Circuits Tester.
3. Complete Bread Board Systems, switches and I/O indicators, multimeters, pulse, square wave generators and display facility.
4. Digital Electronics Trainer kit.

List of Open Source Software/learning website:

1. LogiSim software
2. Xcircuit and Scilab
3. NPTEL website and IITs virtual laboratory