GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE03000181

Subject Name: Digital System Design

WEF Academic Year :	2024-25
Semester :	3
Category of the Course :	PCC

Prerequisite :	Basic Electronics
Rationale :	The students need to learn the fundamentals of digital circuits and systems to develop complicated digital systems like microprocessors. Using the principles of digital logic, the students must understand the combinational and sequential circuits. The students will learn the design of combinational and sequential circuit. Students are introduced to the domain of digital electronics for the first time in this course.

Course Outcomes:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level*
01	Apply the knowledge of digital number systems, Boolean algebra and logic gates for forming logic functions.	AP
02	Analysis and Design of Combinational Circuits, MSI and PLD circuits	AN, CR
03	Analysis and Design of Sequential Circuits and State Machines	AN, CR
04	Comprehend the digital logic families	UN
05	Understand and Analyze the digital to analog converters and analog to digital converters.	AN, EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	TW/SL	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
60	0	30	30	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1.	Binary Number Systems, Boolean Algebra and Logic Gates : Binary, Octal and Hexadecimal numbers, number base conversions, basic theorems and properties of Boolean algebra, Boolean functions, Canonical and Standard forms, POS and SOP forms, digital logic gates.	6	15
2.	Simplification of Boolean Functions and Combinational Logic Circuit Design : Logic minimization using the Map and the Tabulation methods up to six variables, NAND and NOR implementation of logical circuits, determination of prime implicants, Design of : Adders, Subtractors, Code Converters.	8	15
3.	MSI and PLD Circuit Design: Parallel Adder and Subtractor, BCD adder, magnitude comparator, multiplexers and decoders, Read Only Memory (ROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL), MSI and PLD circuit design problems,	8	20
4.	Sequential Logic Circuits : Introduction, Flip Flops, Triggering Flip-Flops, Analysis of clocked sequential circuit, flip flop excitation tables, flip flop conversions.	8	15
5.	State Machine Design : Introduction to state machines, need, classification and analysis of state machine, design of ripple counters, design of synchronous counters, state changes reference to clock, number of state flip flop, input forming logic, output forming logic, redundant states, general state machine architecture, concept of asynchronous state machines, registers, shift registers.	10	15
6.	Logic families : Classification, characteristics and specifications of logic families, Transistor-Transistor Logic (TTL), CMOS, NAND and NOR gate constructions.	6	10
7.	Analog to Digital and Digital to Analog Converters : Introduction, D to A converters : Weighted Register and R-2R Converter, specifications, D to A converter IC , A to D Converters : Flash, Counter, SAR and Dual slope converters, specifications, D to A converter IC.	6	10
Total			100

Reference Books:

1. Digital Logic and Computer Design by M Morris Mano Fourth Edition, Prentice Hall Publication
2. Digital Design by M Morris Mano and Michael D. Ciletti, Pearson Education

3. Digital Logic & State Machine Design by David J. Comer, Third Indian Edition, Oxford University Press
4. Modern Digital Electronics by R. P. Jain Fourth Edition, Tata McGraw-Hill Education
5. Digital Principles and Applications by Malvino & Leach, Seventh Edition, McGraw Hill Education
6. Fundamentals of Digital Circuits by A. Anand Kumar, Fourth Edition, PHI Learning Pvt. Ltd.

Suggested Course Practical List :

1. Getting familiar with various digital Integrated Circuits, understand and analyze data sheets of these ICs.
2. Configure different logic gates using electronic components like diodes, transistors, resistors.
3. Configure and implement NAND and NOR gates as universal gates.
4. Implement boolean logic function using logic gates analyze the circuit considering propagation delay, noise margin, fan in, fanout.
5. Design and implement various combinational circuits like adders, subtractors, comparators, code convertors.
6. Understand and configure multiplexer, demultiplexer, encoder and decoder circuits.
7. Design and implement various combinational circuits using MSI (multiplexers and decoders)
8. Understand and configure different flip flop circuits
9. Design and implement various sequential circuits like registers and counters using digital ICs.
10. Perform an experiment which demonstrates function of 4 bit or 8 bit ALU.
11. Understand and configure various logic families and implement NAND and NOR gates using TTL and DTL.
12. Understand and analyze various digital to analog converters and analog to digital converters.

List of Laboratory/Learning Resources Required:

1. 1. DC Power Supply/ Batteries
2. Function Generator
3. CRO/DSO
4. Multimeter
5. Discrete components like bread board, switches, LEDs, Buzzers, single lead wires(connectors), various digital ICs.
6. Open source softwares : Pspice and NGspice, Scilab, IIT Virtual Laboratory
7. Learning resources : NPTEL website.

- **Activities suggested under Self-learning/Team Work:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding-based assignment of 2h each. Total = 10h	Based on the coding solution submitted.
5.	Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
8	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h	Based on evaluation of critical problems and solutions

		Total = 20 h	
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 h	Depending on the complexity of the Application/Software

Note:

- All the suggested activity should be related to the subject.
- The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

* * * * * * *