



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Power Electronics Engineering

Level: UG

Subject Code: BE04024041

Subject Name: Digital Electronics

WEF Academic Year :	2024-25
Semester :	4
Category of the Course :	PCC

Prerequisite:	Basic Electronics
Rationale:	Day by day, world is becoming digital. Hence, the students of electronics engineering need to learn the fundamentals of digital circuits and systems to build a solid foundation in digital thinking, enabling students to analyze, design, simulate, and implement real-world digital systems from simple combinational blocks to relatively less complex state machines and programmable logic devices. In these subject students are introduced to the domain of digital electronics for the first time as base for future courses related to advance technology in digital processing field.

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	Analyze Combinational Circuits, MSI and PLD circuits, Sequential Circuits and State Machines.	AN
03	Design of Combinational Circuits, MSI and PLD circuits, Sequential Circuits and State Machines.	CR
04	Comprehend the digital logic families	UN
05	Select ADC and DAC for given applications.	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
L	T	P	TW / SL	TH		Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
45	0	30	45	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



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* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

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, tristate logic	5	15
2.	Simplification of Boolean Functions and Combinational Logic Circuit Design: Logic minimization using the K-Map and the Tabulation methods up to six variables, Universal gates, implementation of logical circuits, determination of prime implicants, Design of simple combinational circuits like 1 bit half and full Adders, Subtractors, Code Converters etc.	6	15
3.	MSI and PLD Circuit Design: Parallel Adder and Subtractor, BCD adder, magnitude comparator, multiplexers and decoders, Read Only Memory (ROM), PLD (Programmable Logic Devices) like PLA (Programmable Logic Array), PAL (Programmable Array Logic), MSI and PLD circuit design problems	6	20
4.	Sequential Logic Circuits: Introduction, construction and working of latch, types and working of different Flip Flops, interconversion of various Flip-Flop, Triggering Flip-Flops, Master slave flip flop, Analysis of clocked sequential circuit, Flip-Flop excitation tables, flip-flop conversions.	8	15
5.	State Machine Design: State machines, introduction, requirement, classification and analysis of state machine, design of ripple counters, design of synchronous counters, state changes reference to clock, number of state flip flops, input forming logic, output forming logic, redundant states, general state machine architecture, concept of asynchronous state machines, registers, shift registers.	8	15
6.	Logic families: Classification, characteristics and specifications of logic families, Transistor-Transistor Logic (TTL), ECL, CMOS etc., Construction of various logic gates using different logic family, input and output stage of loc gates, pull-up and pull-down resistors, open collector, open drain output stage, fan in and fan out etc.	6	10



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7.	Analog to Digital and Digital to Analog Converters: D to A converters: Construction and working of various DAC like Weighted Register, R-2R Converter, PWM based, specifications, D to A converter IC etc., Selection of DAC A to D Converters: Construction and working of various ADC types like Flash, Counter, SAR, Sigma-Delta and Integration type converters, specifications, V-F Converter, A to D converter IC etc., Selection of ADC	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. Build and test different logic gates using electronic components like diodes, transistors, resistors.
3. Build and test different logic gates using universal (only NAND or only NOR) gates.
4. Implement Boolean logic functions using logic gates analyze the circuit considering propagation delay, noise margin, fan in, fan out.
5. Design, implement and test various combinational circuits like adders, subtractors, comparators, code converters.
6. Implement and test multiplexers, demultiplexer, encoder, decoder circuits.
7. Design and implement various combinational circuits using MSI (multiplexers and decoders)
8. Implement and test different flip flop circuits
9. Design, implement and test various sequential circuits like registers and counters using digital ICs.
10. Demonstrates function of 4-bit or 8-bit ALU using simulation software.
11. Configure various logic gates using logic families and implement NAND and NOR gates using TTL and DTL.
12. Study of various DAC and ADC.

List of Laboratory/Learning Resources Required:



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1. DC Power Source, Function Generator, DSO / Logic analyzer, Multimeter
2. Discrete components like bread board, switches, LEDs, Buzzers, single lead wires(connectors), various digital ICs or Trainer board
3. Open-source software: Pspice and NGspice based simulation software like KiCAD, Scilab, IIT Virtual Laboratory
4. Learning resources: NPTEL website.

• **Activities suggested under Problem Based Learning:**

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 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 assignments 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 problems. 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 papers = 20 h	Summarize research paper and evaluation critical parameters



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Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
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 = 10 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
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 activities 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.

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