COURSE TITLE	**DIGITAL ELECTRONICS**
COURSE CODE	**01EC1102**
COURSE CREDITS	**4**

Objective:

1 The primary goal of this course is to provide a comprehensive understanding of fundamental digital electronics concepts essential for the analysis and design of modern digital systems. Students will gain proficiency in foundational topics such as number systems, logic gates, and Boolean algebra, while exploring the construction and functional operation of key digital circuits, including adders, subtractors, multiplexers, decoders, flip-flops, counters, and memory devices. Ultimately, the course aims to develop the practical capability to simplify, analyze, and design various digital electronic circuits, equipping students with the necessary skills to tackle complex logic-based engineering challenges.

Course Outcomes: After completion of this course, student will be able to:

1 Apply knowledge of various number systems and binary codes to solve computational problems

2 Analyze logic gates, related devices, and logic families along with their characteristics

3 Apply Boolean algebra and minimization techniques to simplify and optimize digital logic circuits

4 Design and implement combinational circuits based on given specifications

5 Design and implement sequential logic circuits and model digital systems

Pre-requisite of course: Elementary Knowledge of science and mathematics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Number Systems Arithmetic and Codes** Analogue versus Digital, Various Number Systems and Conversion between them, Number. System arithmetic, Binary Codes, Error detection and correction codes. Floating point numbers	6
2	**Boolean Algebra and digital circuit design** Introduction of gates, timing diagram, circuit design, Postulates and Theorems, types of Boolean expressions, Simplification and minimisation techniques Karnaugh Map Method and Tabulation Method	7

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Contents : Unit	Topics	Contact Hours
3	**Combinational Logic Circuits** Combinational Circuits and their implementations, Arithmetic Circuits including Adders and Subtractors, BCD Adder, Look-Ahead Carry Generator, ALU, Multiplier, Magnitude comparator. Multiplexer, Encoders, Demultiplexers and Decoders, Parity Generation and Checking, Switching Algebra, PLA	10
4	**Sequential Logic Circuits** IC-555 Multivibrator, IC555 based circuits, Latch, R-S and D Flip-flop, Level Triggered and Edge-Triggered Flip-flops, J-K and T Flip-flop, Synchronous and Asynchronous Input, Flip-flop Timing Parameters, Asynchronous Counter, Synchronous Counter, Designing Counter with Arbitrary Sequences, Registers, Moore/ Melay Machines, FSM	12
5	**Logic Families** Significance of Families, Characteristic Parameters, Types of Logic Families: TTL, ECL, CMOS, Bi-CMOS, NMOS and PMOS, Comparison between various logic families	3
6	**Hardware Description Language (Verilog)** Fundamentals of Verilog, Overview of Digital Design with Verilog HDL, Gate-Level Modelling, Dataflow Modelling, Behavioural Modelling	4
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment 1** To design and implement cockpit warning light control and an electronic lock system using basic logic gates.	2
2	**Experiment 2** To implement applications of universal gates (NAND/NOR) in liquid level monitoring and automobile alarm systems.	2
3	**Experiment 3** To design industrial machine control logic using Boolean expressions for real-time automation applications.	2
4	**Experiment 4** To apply Boolean algebra techniques for designing and simplifying programmable logic circuits.	2
5	**Experiment 5** To design and implement a digital arithmetic unit capable of performing addition and subtraction operations	2
6	**Experiment 6** To design a data routing and channel selection system using multiplexers and demultiplexers	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
7	**Experiment 7** To design and implement a priority encoder for an emergency alarm system and a 7- segment display decoder for digital output.	2
8	**Experiment 8** To perform and verify the operation of SR, D, JK, and T flip-flops.	2
9	**Experiment 9** To design and implement a serial-to-parallel data converter using shift registers.	2
10	**Experiment 10** To implement a frequency divider and multiplier using a bidirectional shift register.	2
11	**Experiment 11** To design and implement a digital clock using counters.	2
12	**Experiment 12** To design and implement an event counting system such as a visitor counter.	2
13	**Experiment 13** To implement and verify basic logic gates using Verilog.	2
14	**Experiment 14** To design and simulate a multiplexer and Demultiplexer using Verilog.	2
15	**Experiment 15** To implement and analyze flip-flops using Verilog.	2
16	**Experiment 16** To design and implement a decoder/encoder using Verilog.	2
17	**Experiment 17** To design and implement an Arithmetic Logic Unit (ALU) using Verilog HDL.	2
18	**Experiment 18** To design and implement different types of counters using Verilog HDL.	2
Total Hours		**36**

Textbook :

1 Digital Electronics: Principles, Devices and Applications, Anil K. Maini, Wiley-India Pvt. Ltd, 2008

References:

1 Digital Principles and Application, Digital Principles and Application, Malvino & Leach, McGraw-Hill Education, 2010

2 Fundamentals of Digital Logic with Verilog Design, Fundamentals of Digital Logic with Verilog Design, Stephen Brown and Zvonko Vranesic, McGraw-Hill, 3rd edition, 2014

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
15.00	20.00	30.00	20.00	10.00	5.00

Instructional Method:

1. The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc. for effective teaching.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Practical examination will be conducted at the end of the semester for evaluation of performance of students in laboratory.
4. Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.
5. The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, Flipped class, Project based learning, Collaborative learning, MOOCs etc. for effective teaching.

Supplementary Resources:

1. https://www.javatpoint.com/digital-electronics
2. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

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