



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

## COURSE CONTENT

DIGITAL LOGIC DESIGN LABORATORY								
<b>III Semester: ECE   EEE</b>								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECE06	Core	0	0	2	1	40	60	100
<b>Contact Classes: Nil</b>	<b>Tutorial Classes: Nil</b>	<b>Practical Classes: 36</b>			<b>Total Classes: 36</b>			
<b>Prerequisites:</b>								

### I. COURSE OVERVIEW:

The digital system design laboratory introduces the hardware description language for the design and development of digital integrated circuits and field programmable devices. It provides VHDL language elements, synthesizable register transfer logic models in structural, dataflow, behavioral modeling of combinational and sequential circuits. Includes applications in the area of VLSI system design.

### II. COURSE OBJECTIVES:

**The students will try to learn:**

- I The fundamental principles of the VHDL and its constructs used in design implementation of digital logic systems.
- II The concepts of behavioral, dataflow and structural modeling of fundamental digital logic circuits using VHDL.
- III The exposure to various stages of a typical state of the art CAD VLSI tool for simulation, synthesis, place and route, layout and power and clock routing module.

### III. COURSE OUTCOMES:

**At the end of the course students should be able to:**

- CO 1 : Utilize the concept of Boolean algebra to verify the truth table of Boolean expressions using logic gates in Hardware Description Language.
- CO 2: Make use of dataflow, structural and behavioral modelling styles of HDL for simulating the combinational logic circuits.
- CO 3: Analyze the truth tables and characteristic equations of flip flops for the functional simulation and timing analysis of sequential circuits.
- CO 4 : Construct the synchronous and asynchronous sequential circuits using the flip flops.
- CO 5 : Model a finite state machine with mealy and moore machines a finite state machine with mealy and moore machines for detecting a given sequence.
- CO 6: Examine the functionality of real time traffic light controller, chess clock controller FSM, elevator operations using HDL code.

## IV. COURSE CONTENT:

### EXERCISES 1: GETTING STARTED EXERCISES

To be proficient in VHDL programming, you need to be able to operate on basic gates:

1. Basic gates realization.
2. Realization of Product of Sum (POS) Boolean expression
3. Realization of Sum of Product (SOP) Boolean expression
4. Implementation of code conversions

### EXERCISES -2: EXERCISES ON GATE REALIZATION

To be skillful in VHDL programming, you need to be able to realize Boolean expressions using gates

- 1 Basic gates realization using NAND gate
- 2 Basic gates realization using NOR gate
- 3 XOR, XNOR gates realization using minimum number of NAND gates
- 4 Three input NAND gate using min no of 2 input NAND Gate

### EXERCISE3: EXERCISES ON ADDERS AND SUBTRACTORS

To be proficient in programming, you need implement the following digital circuits

- 1 Implementation of half adder
- 2 Implementation of full adder
- 3 Realization of full adder using half adder
- 4 Implementation of half subtractor
- 5 Implementation of full subtractor

### EXERCISE -4: EXERCISES ON MULTIPLEXERS AND DEMULTIPLEXERS

To be proficient in programming, you need implement the following data selector circuits:

- 1 Implementation 8\*1 multiplexers
- 2 Implementation of 1\*8 demultiplexers
- 3 Realization of higher order multiplexers using lower order multiplexers

### EXERCISE -5: EXERCISES ON DECODERS

To be proficient in programming, you need implement the following digital circuits

- 1 Implementation of 2 to 4 and 3 to 8 decoders
- 2 Realization of higher order decoders using lower order decoders
- 3 Develop a functional model of a BCD-to-seven-segment decoder for a light emitting diode (LED) display.

### EXERCISE -6: EXERCISES ON ENCODERS AND PRIORITY ENCODERS

To be proficient in programming, you need implement the following digital circuits

- 1 Implementation of 4 to 2 encoders
- 2 Implementation of 8 to 3 encoders
- 3 Build 8 to 3 priority encoder

### EXERCISE -7: EXERCISES ON BARREL SHIFTER AND ALU

To be proficient in programming, you need implement the following digital circuits

- 1 Design a 4-bit barrel shifter using multiplexer.
- 2 Implementation 8-bit ALU to perform the arithmetic, logical operations

### EXERCISE -8: EXERCISES ON LATCHES AND FLIP-FLOPS.

To be proficient in programming, you need implement the following sequential logic circuits

- 1 Implementation of SR latch, JK latch, D latch and T latch
- 2 Implementation of JK flip-flop, D flip-flop and T flip-flop
- 3 Realization of D flip-flop using JK flip-flop
- 4 Realization of T flip-flop using JK flip-flop
- 5 Realization of T flip-flop using D flip-flop

### EXERCISE 9: EXERCISES ON COUNTERS

To be proficient in programming, you need implement the following sequential logic circuits

- 1 Implementation of a 4-bit Ripple Counter
- 2 Implementation of a 4-bit Synchronous Counter
- 3 Design of Up/Down Counter with Mode Control

- 4 Realization of a Ring Counter
- 5 Implementation of a Decade Counter (BCD Counter)

#### **EXERCISE -10. EXERCISES ON REGISTERS**

To be proficient in programming, you need to implement the following register circuits

- 1 Implementation of a 4-bit Serial-In Serial-Out (SISO) Register
- 2 Design of a Universal Shift Register
- 3 Pseudo random number generator using LFSR

#### **EXERCISE -11: EXERCISES ON CARRY-LOOK AHEAD ADDER**

To be proficient in programming and design, you need to implement and analyze the following:

- 1 Implementation of a 4-bit Carry Look-Ahead Adder
- 2 Analysis of CLA vs. Ripple Carry Adder

#### **EXERCISE -12: EXERCISES ON SEQUENCE DETECTOR**

To be proficient in FSM design and programming, you need to implement the following:

- 1 Implementation of a Sequence Detector for “1101” (non-overlapping case)
- 2 Implementation of a Sequence Detector for “1101” (overlapping case)

#### **EXERCISE 13. EXERCISES ON CASE STUDY: GRAY-ENCODED COUNTER AND JOHNSON-ENCODED COUNTER**

#### **EXERCISE 14: EXERCISES ON CASE STUDY: ELEVATOR CONTROLLER**

#### **V. TEXTBOOKS:**

1. Digital Design Using VHDL, M. Morris Mano & Michael D. Ciletti (Pearson)
2. Fundamentals of Digital Logic with VHDL Design ,Stephen Brown & Zvonko Vranesic (McGraw Hill)
3. VHDL: Programming by Example,Douglas L. Perry

#### **VI. WEB REFERENCES:**

1. <https://nptel.ac.in/courses/117108040/>

#### **VII MATERIALS ONLINE**

1. Course Outline Description
2. Lab Manual