

---

*Suggested Teaching Guidelines for*

**Advanced Digital Design PG-DVLSI March-2024**

**Duration:** 50 class room hours

**Objective:** To introduce Digital Design and Advance Digital Design Issues

**Prerequisites:** Knowledge of Digital Fundamentals

**Evaluation method:** CCEE Theory exam – 80% weightage

Internal exam – 20% weightage

**List of Books / Other training material**

**Text Book:**

1. Digital Design - Principles and Practices by John F Wakerly

**Reference:**

1. An Engineering Approach to Digital Design by Fletcher

**Session 1**

**Lecture: Basic Digital Circuits**

- Basic Digital Circuits: Introduction, Principles, Working.
- Usage / Applications.

**Session 2**

**Lecture: Combination Circuits**

- Logic Arrays
- NAND-NAND / NOR-NOR circuits
- Encoders and Decoders

**Session 3**

**Lecture: Arithmetic Circuits**

- 2's Complement
- Half and Full adders
- RCA,CLA,CSA

**Session 4 & 5**

**Lecture: Logic Minimization**

- Introduction to Various Logic Minimization techniques
- Quine McCluskey technique
- Shannon's reduction using relay switches

**Session 6**

**Lecture: Logical Hazards**

- Hazards and glitches
- Hazard elimination

**Session 7**

**Lecture: Logic Families**

- Introduction to different Logic families with their sub-families/types.
- TTL – NAND using TTL with working, different types of TTL families with features, usage.
- ECL – NAND using ECL with working, different types of ECL families with features, usage.
- CMOS – NAND using CMOS with working, Different types of CMOS families with features, usage.
- Comparison of speed and power of different families and sub-families/types.

## **Session 8**

### **Lecture: Tristate and other circuits**

- Tristate
- Muller-C
- AOI (And-Or-Inverter)
- Design of Logic Gates with CMOS technology: NOT, NAND, NOR, XOR.

## **Session 9**

### **Lecture: Sequential Circuits**

- Sequential Circuit Principles
- Types of Sequential Circuits
- Clock jitter, clock skew, timing parameters, propagation delays
- Latches
- Flip-flops

## **Session 10 & 11**

### **Lecture: Counter Design and Frequency Division**

- Counters: Introduction and types
- Designing of Counters using FSM approach: MOD-N, Binary, Decade
- Binary Counter as a Frequency divider
- Frequency division hazards

## **Session 12**

### **Lecture: Registers**

- Registers
- Shift Registers
- LIFO
- FIFO
- LFSR

## **Session 13 & 14**

### **Lecture: Finite State Machines (FSM)**

- Types of FSM
- Problem solving
- State reduction techniques

## **Session 15 & 16**

### **Lecture: Static Timing Analysis**

- Need of Static Timing Analysis of Digital Circuits
- Metastability
- Setup and Hold Violations
- Time Borrowing and Time Stealing

### **Session 17 & 18**

#### **Lecture: Asynchronous Circuits**

- Introduction to multiple clock domain circuits
- Working across multiple clock domains
- Handshaking

### **Session 19 & 20**

#### **Lecture: Asynchronous to Synchronous Circuit Interaction**

### **Session 21-24**

#### **Lecture: Case studies of Advanced Digital Design Circuits**

- Several case studies like complex FSMs, Real life problems and their solutions, Pipelined Approaches for Communication Protocols or Recursive Operations, Design Optimization, Latency reduction, Development of Microprocessor / Microcontroller Design, Circuit Development for Data Encryption / Decryption Algorithms etc.