Digital Logic Design Lab Outline

Lab#01: Introduction to Lab Equipment

1. Discussion about Digital Circuits, ICs (in general) + Gate and their ICs
2. Demonstration of DLD Trainer Board, its different modules/ breadboard
3. Purpose of using a breadboard and how it is used?
4. Connectivity/Continuity test using a Digital Multi-Meter to understand the connections of a breadboard.
5. Introduction to **Logicly** Software.
6. Simulation and implementation of basic logic gates on software and trainer board respectively.

Lab#02: Universal Logic Gates

1. What are Universal Gates? Purpose of using Universal gates.
2. How rules of Boolean Algebra are applied to implement different logic gates using only NAND & NOR gate.
3. Understanding the role of De-Morgan's Law
4. Simulation & Implementation of all the basic gates using only NAND & only NOR gate.

Lab#03: Writing Boolean Expressions (SOP & POS) & Constructing Logic Circuits

1. What is a Boolean Expression? What does it represent?
2. How to write an expression with the help of a logic diagram and truth table?
3. How to draw/construct a logic circuit with the help of Boolean expression.
4. Different tasks given for practice & simulation, covering both SOP/POS forms to write Boolean expressions from logic circuits and vice versa.

Lab#04: K-Map Reduction i.e. 2, 3 & 4 variable K-maps

1. Introduction to K-Map. How it is drawn for 2, 3 & 4 Varaibles.
2. Reduction of Boolean expressions using K-Map.
3. Tasks given as practice to reduce expressions, devise its truth table and construct the logic circuit.
4. Simulation on software to verify the functionality of reduced expressions.

Lab#05: Binary Adders (Half/Full Adder)

1. Functionality of a binary adder.
2. What are the types and their applications in digital circuits?
3. Half Adder; Introduction/Truth table/logic Circuit
4. Full Adder; Introduction/Truth table/logic Circuit
5. How a full adder can be designed using 2 half adders?
6. How Full Adder is used in a Ripple Carry Adder?
7. Tasks given for simulation to understand the working of adders.

Lab#06: Binary Subtractors (Half/Full Subtractor)

1. Working of Binary Subtractor. What are the types and their applications in digital circuits?
2. Half Subtractor; Introduction/Truth table? logic Circuit
3. Full Subtractor; Introduction/Truth table? logic Circuit
4. How a full subtractor can be designed using 2 half subtractors?
5. Tasks given for simulation to understand the working of binary subtractors.

Lab#07: Working of a Binary Comparator

1. What is a Comparator? Its applications
2. 1- bit comparator; Truth table/ Boolean expression/logic circuit
3. 4-bit comparator; truth table/Boolean expression/logic circuit
4. Task given to design and simulate 2-bit comparator.
5. Task given to design and simulate 4-bit comparator.

Lab#08: Code Converters (Binary to Gray & Vice Versa/ BCD to Excess-3)

1. What is Gray Code and its significance?

2. What is Excess-3 Code and its significance?
3. Design and simulate the circuitry for a Binary to Gray and BCD-to-Excess 3 Code Converter.

Lab#09: Binary Encoders & Decoders

1. Introduction to Encoders & Decoders. Their practical applications.
2. Discussion on different types of encoders & decoders(Priority Encoder/BCD to Seven Segment Decoder) with Enable.
3. Difference between Common Anode and Common Cathode Display
4. Design and simulation of a 8 to 3 Priority Encoder.
5. Design and simulation of a 2 to 4 decoder.
6. Design and simulation of BCD to Seven Segment Decoder.
7. **Self Study Task;** To understand how higher order decoders can be made from lower order decoders?

Lab#10: Multiplexers and Demultiplexers

1. Introduction to Multiplexers and De-multiplexers. Their practical applications.
2. Design and simulation of 8 to 1 Multiplexer.
3. Design and simulation of 1 to 4 line de-multiplexer
4. Design and simulation of 4 to 1 Multiplexer using 2 to 1 Multiplexers.

Lab#11: Latches (SR Latch, D Latch)

1. Introduction to Sequential Circuits
2. Difference between Latches & Flip Flops
3. Construction & Working of SR and D Latch (Using NAND/NOR)
4. Timing Diagrams of Latches
5. Implementation and Simulation of SR Latch

Lab#12: Flip Flops

1. Introduction to Flip Flops
2. Construction & Working of D and JK Flip Flop
3. Timing Diagrams of Flip Flops
4. Implementation and Simulation of JK Flip Flop

Lab#13: Counter

1. Introduction to Counters, their uses and applications.
2. Types of Counters (Asynchronous/Synchronous)
3. Implementation of Counter using IC
4. Simulation of Counter using JK Flip FLop

Lab#14: Registers

1. Introduction to Registers
2. Modes of Operation (SISO,SIPO,PIPO,PISO)
3. Implementation of Register using IC
4. Simulation of Register using D Flip FLop