Module IV: Digital Electronics Fundamentals

Basic Electronics Engineering – *3rd Semester UG Engineering (AICTE Curriculum)*

Section 1: Analog vs Digital Signals

- **Analog signals**: Continuous in time and amplitude (e.g., audio, temperature).

- **Digital signals**: Discrete time and amplitude; represented by binary (0 and 1).

Section 2: Boolean Algebra

- Deals with binary variables and logical operations.

- Common laws: Identity, Null, Domination, Idempotent, Involution, Demorgan's Theorem

2.1 Basic Gates

- **AND, OR, NOT**

2.2 Universal Gates

- **NAND and NOR** can be used to construct any logic circuit.

Section 3: Logic Gates and K-Map Simplification

3.1 Symbols, Truth Tables, Logic Expressions

- Each gate has a standard logic symbol, corresponding Boolean expression, and truth table.

3.2 Karnaugh Map (K-Map)

- Graphical tool for simplifying Boolean expressions.

- Minimizes logic complexity and gate count.

Section 4: Combinational Circuits

4.1 Half Adder

- Adds two 1-bit numbers.

- Outputs: Sum and Carry

4.2 Full Adder

- Adds three 1-bit numbers (A, B, Cin).

- Outputs: Sum and Carry

4.3 Half and Full Subtractor

- Performs binary subtraction with borrow output.

4.4 Multiplexers (MUX)

- Selects one input from many using control lines.

4.5 Demultiplexers (DEMUX)

- Routes one input to one of many outputs using control signals.

Section 5: Sequential Circuits

5.1 Flip-Flops

- Bistable devices that store binary data (1-bit memory)

- Types: SR, JK, D, T Flip-Flops

5.2 Shift Registers

- Move bits left/right across clock cycles.

- Used in data conversion, communication protocols.

5.3 Counters

- Sequence of flip-flops used to count pulses.

- Types: Synchronous and Asynchronous

Section 6: Microprocessors and Microcontrollers

6.1 Block Diagram Overview

- CPU, memory, I/O ports, clock, and control unit

6.2 Applications

- Microprocessors: General-purpose processing (PCs, servers)

- Microcontrollers: Embedded systems (home appliances, robotics, IoT)