# FACULTY OF ENGINEERING & TECHNOLOGY

## Effective from Academic Batch: 2022-23

**Programme:** **BACHELOR OF TECHNOLOGY (Electronics and Communication Engineering)**

**Semester:** **III**

**Course Code:** **202060302**

**Course Title:** **Digital Circuit Design**

**Course Group:** Professional Core Course

**Course Objectives:** The Students will learn basic concepts of digital circuits and systems which leads to design of complex digital systems such as microprocessors. The students will learn about combinational and sequential circuits using digital logic fundamentals. The students will analyze logic process and implement logical operations. This is the first course by which students will get exposure to digital electronics world.

**Teaching & Examination Scheme:**

| Contact hours per week | | | Course Credits | Examination Marks (Maximum / Passing) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | J/V/P* | | Total |
| Lecture | Tutorial | Practical | | Internal | External | Internal | External | |
| 3 | 0 | 2 | 4 | 50/18 | 50/17 | 25/9 | 25/9 | 150/53 |

* **J**: Jury; **V**: Viva; **P**: Practical

**Detailed Syllabus:**

| Sr. | Contents | Hours |
|---|---|---|
| 1 | **Fundamentals of Digital Electronics:** Logic gates and their Integrated Circuits (ICs), Number Systems - binary, signed binary, octal, hexadecimal number; binary arithmetic, one's and two's complements. Introduction to digital logic family such as RTL, DTL, TTL, ECL, CMOS, IIR, HTL etc. their comparative study, Basic circuit, performance characteristics, Wired logic, open collector output etc. Characteristics of digital ICs. | 8 |
| 2 | **Boolean Algebra & Mapping Methods:** Boolean algebra – postulates & theorems, Standard representation for logic functions, Karnaugh Map representation and simplification of logic functions, minimization of logical functions, don't care conditions, Quine McCluskey method of function realization, Realizing Logic functions using logic gates. | 8 |



Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120
(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in

| | | |
|---|---|---|
| **3** | **Combinational Logic Circuits:**<br>Fundamentals of Combinational Logic, Adders – Half adder, Full adder, BCD adder, Serial adder, Look Ahead Carry Adder, Subtractors, Multiplexers, De-Multiplexers, Encoders, Decoders, Code Converters, popular MSI chips, digital comparator, parity checker/generator, priority encoders, decoders/drivers for display devices, ALU, elementary ALU design. | **10** |
| **4** | **Sequential Logic Circuits:**<br>A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-KT and D types of flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(asynchronous)counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters. | **10** |
| **5** | **Programmable Logic Devices:** Introduction to Programmable Logic Devices, ReadOnly Memory, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL), Combinational PLD-Based State Machines, State Machines on a Chip. | **4** |
| **6** | **VLSI Design flow:** Design entry: Schematic, FSM & HDL, different modeling styles in Verilog: Behavioral and Structural Modeling, Data types and objects, Synthesis and Simulation Verilog constructs and codes for combinational and sequential circuits. | **5** |
| | | **45** |

**List of Practicals / Tutorials:**

| | |
|---|---|
| **1** | Getting familiar with various digital integrated circuits of different logic families. Study of data sheet of digital circuits and see how to test these circuits using Digital IC Tester. |
| **2** | Configure diodes and transistor as logic gates and Digital ICs for verification of truth table of logic gates. Measure digital logic gate specifications such as propagation delay, noise margin, fan in and fan out. |
| **3** | Configuring NAND and NOR logic gates as universal gates. |
| **4** | Implementation of Boolean Logic Functions using logic gates and combinational circuits. |
| **5** | Study and configure of various basic digital circuits such as adder and subtractor. |
| **6** | Study and configure combinational digital circuits such as decoder, encoder, multiplexer, demultiplexers. |
| **7** | Design various Code Converters circuits. |
| **8** | Study and configure flip-flops using digital ICs. |
| **9** | Study and configure Sequential Circuits such as shift registers and counters using digital ICs. |
| **10** | Study and configuration of A to D Converter. |
| **11** | Study and configuration of D to A Converter. |
| **12** | Implementation of NAND gate using Diode, Resistor & Transistor in Multisim software.<br>Implementation of Full adder circuit in Multisim software.<br>Implementation of Johnson counters in Multisim software. |



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**Reference Books:**

| | |
|---|---|
| **1** | A. Anand Kumar, **Fundamentals of Digital Circuits,** 4th Edition, PHI. |
| **2** | M. Morris Mano, **Digital logic and Computer Design**, Pearson Education India. |
| **3** | Donald P. Leach, Albert Paul Malvino, Goutam Saha, **Digital Principles and Applications**, 8th Edition, McGraw- Hill. |
| **4** | R. P. Jain, **Modern Digital Electronics**, 4th Edition, McGraw- Hill. |

| **Supplementary learning Material:** | |
|---|---|
| **1** | **Logisim / Digital Works Software**<br>The software is used most often by students to design and experiment with digital circuits in simulation. Circuits are designed in Logisim using a graphical user interface like traditional drawing programs, an interface also found in many other simulators. Unlike most other simulators of Logisim's sophistication, Logisim allows the user to edit the circuit during simulation |
| **2** | **Multisim**<br>Multisim is industry standard SPICE simulation and circuit design software for analog, digital, and power electronics in education and research. Multisim integrates industry standard SPICE simulation with an interactive schematic environment to instantly visualize and analyze electronic circuit behavior. |
| **3** | Video lecture series by Neso Academy with detailed explanation on Digital Design.<br>https://www.youtube.com/watch?v=M0mx8S05v60&list=PLBlnK6fEyqRjMH3mWf6kwqiTbT7 98eAOm |
| **4** | Video lecture series from IITs with unit wise explanation<br>https://nptel.ac.in/courses/117/106/117106086/ |

**Pedagogy:**

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

**Internal Evaluation:**

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.



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**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

| Distribution of Theory Marks in % | | | | | | **R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating |
|---|---|---|---|---|---|---|
| **R** | **U** | **A** | **N** | **E** | **C** | |
| 15 | 15 | 10 | 10 | 5 | 5 | |

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes (CO):**

| Sr. | Course Outcome Statements | %weightage |
|---|---|---|
| **CO-1** | Learn the fundamentals of number systems and digital logics. | **20** |
| **CO-2** | To understand working of logic gates & digital circuits with logic families. | **30** |
| **CO-3** | Analyze, design and implement combinational and sequential logic circuits. | **35** |
| **CO-4** | Develop a digital logic circuit and apply it to solve real life problems. | **15** |

| **Curriculum Revision:** | |
|---|---|
| Version: | **2.0** |
| Drafted on (Month-Year): | June -2022 |
| Last Reviewed on (Month-Year): | - |
| Next Review on (Month-Year): | June-2025 |



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