| Program : | **Diploma in Electronics/ Electronics and Communication Engineering/ Biomedical Engineering** |
|---|---|
| Course Code : **3044** | Course Title: **Digital Electronics** |
| Semester :**3** | Credits: **4** |
| Course Category: **Program Core** | |
| Periods per week: **4 (L:3, T:1, P:0)** | Periods per semester:**60** |

**Course Objectives:**

- To introduces the concept of realizing digital logic using Boolean algebra.
- To familiarize the implementation of combinational and sequential circuits.
- To assimilate the idea of application of flip flops to realize synchronous and asynchronous counters.
- To familiarize different types of memories, which are prominent members of logical families.

**Course Prerequisites:**

| Topic | Course code | Course Title | Semester |
|---|---|---|---|
| Basic Engineering Mathematics Principles | | Mathematics I & II | 1 & 2 |
| Fundamentals of Electric Circuits, Passive components | | Fundamentals of Electrical &Electronics Engineering | 2 |
| Semiconductor theory, diodes, transistors | | Basic Electronics | 2 |

**Course Outcomes:**

On completion of the course, the student will be able to:

| COn | Description | Duration (Hours) | Cognitive level |
|---|---|---|---|
| CO1 | Minimize logic functions using Boolean algebra. | 18 | Applying |
| CO2 | Develop combinational logic circuits | 15 | Applying |
| CO3 | Illustrate the working of Flip Flops and Shift Registers. | 14 | Understanding |
| CO4 | Design synchronous and asynchronous counters | 11 | Applying |
| | Series Test | 2 | |

**CO-PO Mapping:**

| Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | |
| **CO2** | 3 | | | | | | |
| **CO3** | 2 | | | | | | |
| **CO4** | 3 | | | | | | |

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

**Course Outline:**

| Module Outcomes | Description | Duration (Hours) | Cognitive Level |
|---|---|---|---|
| **CO1** | **Minimize logic functions using Boolean algebra.** | | |
| M1.01 | Identify various number systems and perform conversion from one number system to another. | 5 | Understanding |
| M1.02 | Outline various Binary Codes.Use binary arithmetic for addition and subtraction | 4 | Understanding |
| M1.03 | Illustrate the universal property of NAND and NOR gates. | 3 | Understanding |
| M1.04 | Apply K Map for simplification of Boolean expression. | 6 | Applying |
| **Contents:**<br>**Number Systems & Boolean Algebra**<br>Introduction to different Number Systems - Binary, Decimal, Hexadecimal - Conversion from one Number System to another, Binary codes - Binary Coded Decimal, Gray Code, ASCII code, Excess - 3 code, Binary addition, unsigned and signed numbers, 1's complement and 2's complement arithmetic.<br>Introduction to Logic gates, Universal property of NAND and NOR gates.<br>Boolean Algebra - Rules and laws of Boolean Algebra, De-Morgan's Theorem,SOP expression and POS expression,Karnaugh Map and its use for simplification of Boolean expressions up to 4 variables, pairs, quads, octets, don't care conditions | | | |
| **CO2** | **Develop combinational logic circuits** | | |
| M2.01 | Explain the evolution of IC technology. | 2 | Understanding |
| M2.02 | Define the features of logic families. | 3 | Understanding |
| M2.03 | Compare and contrast different logic families. | 2 | Understanding |
| M2.04 | Design various combinational logic circuits. | 8 | Applying |
| | Series Test - I | 1 | |

**Contents:**

**Logic families and combinational logiccircuits**

IC technologies-SSI, MSI, LSI, VLSI and ULSI

Logic families - features- threshold voltage, propagation delay,power dissipation, fan-in and fan-out, voltage and current parameters, noise margin, speed power product. Comparison of TTL, ECL and CMOS logic families.

Combinational logic circuits -Half Adder, Half subtractor, Full Adder andFull subtractor(using any gates), Concept of Parallel adder – Ripple carry adder, Encoders- Decimal to BCD Encoder, Decoders- 3 line to 8 line decoder, Code converters – Binary to Gray and Gray to Binary, multiplexers - 2 x1 and 4x1and de-multiplexers- 1 to 4.

| **CO3** | **Illustrate the working of Flip Flops and Shift Registers**. | | |
|---|---|---|---|
| M3.01 | Compare and contrast combinational and sequential logic circuits | 2 | Understanding |
| M3.02 | Explain Flip flops using gates. | 7 | Understanding |
| M3.03 | Illustrate Shift Registers using Flip Flops. | 3 | Understanding |
| M3.04 | Illustrate Counters using Shift register. | 2 | Understanding |

**Contents:**

**Sequential logic circuits**: Distinguish Combinational and Sequential circuits.

**Flip Flops** – SR latch and flop flop using NAND gate- symbol and truth table, Edge triggering and Level triggering, JK flip flop – logic symbol and truth table, Asynchronous inputs- Preset and Clear, JK-Master slave flip flop –logic symbol and truth table, D and T flip flops from JKFF- logic symbol and truth table

**Shift registers** - Serial in Serial out, Parallel in Parallel out, Serial in Parallel out, Parallel in Serial out. Applications of Shift Registers - Ring counter, Johnson counter.

| **CO4** | **Design synchronous and asynchronous counters and memory devices** | | |
|---|---|---|---|
| M4.01 | Compare and contrast Synchronous and Asynchronous Counters. | 1 | Understanding |
| M4.02 | Design Asynchronous Counters using Flip Flops. | 4 | Applying |
| M4.03 | Design Synchronous counters using flip flops. | 4 | Applying |
| M4.04 | Classify Semiconductor Memories. | 2 | Understanding |
| | Series Test - II | 1 | |

**Contents:**

**Counters and Memory devices**

Counters, modulus of a counter, Asynchronous Counters – 3 bit ripple counter (up counter and down counter), Mod 6 and mode 10 asynchronous counter using T flip flops,

| |
|---|
| Synchronous counter -design of 3 bit up counter and down counter.<br>Classification of Memories - RAM, DRAM, SRAM, SDRAM, DDRAM. ROM - PROM, EPROM, EEPROM, Flash memory and Cache memory. |

**Text /Reference:**

| T/R | BookTitle/Author |
|---|---|
| T1 | Digital principles &Applications, Albert Paul Malvino& Donald P. Leach, McGraw Hill Education; Eighth edition, ISBN: 978-9339203405 |
| R2 | Digital Electronics, Roger L. TokheimMacmillian, McGraw-Hill Education (ISE Editions);International 2 Revised edition, ISBN: 978-0071167963 Macmillian |
| R3 | Digital Electronics- An introduction to theory and practice, William H. Gothmann, Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485 |
| R4 | Fundamentals of LogicDesign, Charles H. Roth Jr. Jaico Publishing House; First edition, ISBN: 978-8172247744 |
| R5 | Digital Electronics, R. Anand, Khanna Publications, New Delhi (Edition 2018) ISBN: 978-93-82609445 |

**Online resources:**

| Sl.No | Website Link |
|---|---|
| 1 | https://en.wikibooks.org/wiki/Digital_Electronics |
| 2 | https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/ |
| 3 | https://www.allaboutcircuits.com/textbook/digital/ |
| 4 | https://www.researchgate.net/publication/264005171_Digital_Electronics |