

# LOGIC CIRCUIT

## ENEX 203

**Lecture** : 3  
**Tutorial** : 1  
**Practical** : 1.5

**Year : II**  
**Part : I**

### Course Objectives:

The objective of this course is to provide basic understanding of the digital world and design of the basic digital circuits using various logic gates ICs. This course focuses on study of basic principle, design and applications of digital circuitries in various fields.

### 1 Introduction (4 hours)

- 1.1 Digital versus analog signals
- 1.2 Digital integrated circuits (ICs)
- 1.3 Logic level diagram
- 1.4 Basic gates and their equivalents
- 1.5 Universal gates and their equivalents
- 1.6 Exclusive gates and their equivalents
- 1.7 Positive and negative logic
- 1.8 De' Morgan's laws
- 1.9 Applications of logic gates

### 2 Logic Gates (3 hours)

- 2.1 Digital codes and conversions
  - 2.1.1 Decimal, binary, octal and hexadecimal code
  - 2.1.2 BCD code
  - 2.1.3 Excess-3 code
  - 2.1.4 Gray code
  - 2.1.5 Examples of code conversions
- 2.2 Alphanumeric codes: ASCII code and EBCDIC code
- 2.3 1's complement and 2's complement
- 2.4 Signed number representation

### 3 Boolean Algebra and K-Maps (4 hours)

- 3.1 Boolean algebra and its laws
- 3.2 Simplifications of Boolean expressions
- 3.3 Minterms and maxterms
- 3.4 Sum-of- product and product-of-sum methods
- 3.5 Truth tables and Karnaugh map
- 3.6 Four variables K-maps

- 3.7 Cell, pairs, quads and octets
- 3.8 Rolling, envelop effects and redundant groups
- 3.9 Don't care conditions

**4 Combinational Logic Circuits (8 hours)**

- 4.1 Design procedures
- 4.2 Half/Full adders and subtractors
- 4.3 Ripple carry adders
- 4.4 Multiplexer and demultiplexer design
- 4.5 Encoder and decoder design
- 4.6 BCD-to-decimal decoder
- 4.7 Seven-segment decoder
- 4.8 Digital comparators

**5 Sequential Logic Circuits (6 hours)**

- 5.1 Latches and flip-flops: SR, D, T and JK
- 5.2 Types of flip-flop triggering systems
- 5.3 Excitation tables, characteristic equations
- 5.4 Flip-flop timing diagrams
- 5.5 Flip-flops as the state machines
- 5.6 Flip-flop conversions
- 5.7 Flip-flop applications

**6 Registers and Counters (8 hours)**

- 6.1 Register fundamentals, register types
- 6.2 SISO, SIPO, PISO and PIPO registers
- 6.3 Data transfer timing diagrams
- 6.4 Asynchronous counters
- 6.5 Up, down and mod-n asynchronous counters
- 6.6 Synchronous counters
- 6.7 Up, down and mod-n synchronous counters
- 6.8 Register and counter applications

**7 Sequential Machine Design (8 hours)**

- 7.1 Synchronous machine design procedures
- 7.2 Primitive state diagrams
- 7.3 Transition/flow tables
- 7.4 Redundant states
- 7.5 Pure binary assignment tables
- 7.6 Excitation maps
- 7.7 Realization of the models

- 7.8 Circuit diagram of synchronous machine
- 7.9 Input sequence detectors synchronous machine

## 8 Digital Devices Applications

(4 hours)

- 8.1 Frequency counters
- 8.2 Time measurements
- 8.3 Multiplexing displays

### Tutorial

(15 hours)

1. Application of De' Morgan's laws
2. Sign numbers addition and subtraction
3. Application of Boolean algebra and K-Maps
4. Realization of adder/subtractor using MUXs/DEMUXs
5. Octal and decimal priority encoder designs
6. Flip-flop conversion: One flip-flop to another type
7. Shift register timing diagram practice
8. Up/down counter in a single circuit
9. Synchronous machine design

### Practical

(22.5 hours)

1. Logic gates, truth tables verifications and De' Morgan's laws
2. Encoder and decoder design
3. Multiplexer and demultiplexer design
4. Latches, RS, D, JK and T flip-flops realizations
5. Shift registers design and realizations
6. Circuit realizations of ripple counters
7. Circuit realizations of synchronous counters

### Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	4	6
2	3	5
3	4	6
4	8	10
5	6	8
6	8	10
7	8	10
8	4	5
<b>Total</b>	<b>45</b>	<b>60</b>

\* There may be minor deviation in marks distribution.

## References

1. Leach Donald P., Malvino A. P., Saha G. (2012). Digital Principles and Applications. Tata McGraw-Hill.
2. Floyd T. (2020). Digital Fundamentals. John Willy & Sons Pvt. Ltd.
3. Mano M. M. (2010). Digital Design. Delhi: McGraw-Hill Publication.
4. Gothmann W. H. (2009). Digital Electronics: An Introduction to Theory and Practice. PHI Edition.