DIGITAL LOGIC
ENEX 152

Lecture : 3 **Year : I**
Tutorial : 1 **Part : II**
Practical : 3

Course Objectives:
This course mainly focuses on study, analyze basic principle, design and applications of digital circuitries in various fields. It also shows an important branch of the electronics that revolutionizes the modern digital world.

1 Introduction (5 hours)

1.1 Digital versus analog signals
1.2 Logic level diagram
1.3 Digital integrated circuits (ICs)
1.4 Clock triggering systems
1.5 Digital system applications
1.6 Digital codes and conversions
  1.6.1 Decimal, binary, octal and hexadecimal codes
  1.6.2 BCD code
  1.6.3 Excess-3 code
  1.6.4 Gray code
  1.6.5 Examples of code conversions
1.7 Alphanumeric codes: ASCII code and EBCDIC code
1.8 1’s complement and 2’s complement
1.9 Signed number representation

2 Logic Gates (3 hours)

2.1 Basic gates and their equivalents
2.2 Universal gates and their equivalents
2.3 Exclusive gates and their equivalents
2.4 Positive and negative logic
2.5 De’Morgan’s laws
2.6 Applications of logic gates

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-adder and full-adder
4.3 Half-subtractor and full-subtractor
4.4 Ripple carry adders and fast adders
4.5 Multiplexers design
4.6 Demultiplexers design
4.7 Basic encoders
4.8 Priority encoders
4.9 Encoder designs
4.10 Decoder designs
4.11 BCD-to-decimal decoder
4.12 Seven-segment decoder
4.13 Magnitude comparators

5 Sequential Logic Circuits (5 hours)

5.1 Latches and flip-flops: SR, D, T and JK
5.2 Excitation tables, characteristic equations
5.3 Master-slave flip-flops
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 (7 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 Designs (8 hours)

7.1 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 One-bit and two-bit input sequence detectors

8 Digital Integrated Circuits (5 hours)

8.1 BJT and MOSFET switching circuits
8.2 TTL parameters
8.3 TTL circuits: NAND, NOT, NOR
8.4 CMOS parameters
8.5 CMOS logic circuits: NAND, NOR, NOT
8.6 Three-state TTL devices
8.7 Digital devices applications
 8.7.1 Multiplexing displays
 8.7.2 Frequency counters
 8.7.3 Time measurements

Tutorial (15 hours)

1. Different code conversion examples
2. Sign numbers addition and subtraction
3. Realization of positive and negative logic gates
4. Application of Boolean algebra and K-map for various logic designs
5. Multiplexer tree concepts
6. Realization of adder/subtractor using multiplexers
7. Demultiplexer tree concepts
8. Realization of adder/subtractor using demultiplexers
9. 16 - to – 4 line encoder design
10. Octal and decimal priority encoder designs
11. 4– to – 16 line decoder design
12. BCD-to-decimal decoder design
13. Any segment of 7-segment decoder design
14. Concept of designing n-bit magnitude comparator
15. Flip-flop conversion from one flip-flop to another type
16. Shift register timing diagram practice
17. Ripple counter design concept
18. Decade synchronous counter design
19. Up and down counter in a single circuit
20. 3-bit and 4-bit binary sequence detector synchronous machine design

Practical (45 hours)

1. Basic gates, universal gates and exclusive gates

2. De' Morgan’s law and its familiarization with NAND and NOR Gates
3. Encoders and decoders
4. Multiplexers and demultiplexers
5. Binary addition and subtraction
6. Latches, RS, and T flip-flops.
7. D and JK flip-flop and master-slave flip-flop
8. Shift registers
9. Circuit realizations on ripple counters
10. Circuit realizations on 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	5	7
2	3	4
3	4	5
4	8	10
5	5	7
6	7	10
7	8	10
8	5	7
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Floyd, T. L. (2015). Digital fundamentals. Pearson Education.
2. Mano, M. M. (1995). Digital design (Latest Edition). Prentice Hall.
3. Leach, D.P., Malvino, A.P., Saha, G. (2012). Digital principles and applications. Tata McGraw-Hill Education.
4. Fletcher, W.I. (1980). An engineering approach to digital design (Latest Edition). Prentice-Hall.
5. Gothmann, W.H. (1982). Digital electronics: An introduction to theory and practice (Latest Edition). Prentice-Hall.