**CS6105 DIGITAL FUNDAMENTALS AND COMPUTER ORGANIZATION**

Prerequisites for the course: None

**OBJECTIVES:**

- To learn Boolean algebra and simplification of Boolean functions
- To learn to design and analyze different combinational circuits
- To study the basics of synchronous sequential logic and analyze and design sequential circuits
- To understand the important components of a computer system and the basic organization
- To learn to write code in hardware definition languages for designing larger digital systems

| CS6105 DIGITAL FUNDAMENTALS AND COMPUTER ORGANIZATION | L | T | P | EL | CREDITS |
|---|---|---|---|---|---|
| | 3 | 1 | 4 | 3 | 7 |

| MODULE I : | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 1 | 4 | 3 |

Number Systems – Binary, Octal, Hexadecimal – Representation of negative numbers - 1's and 2's Complements - Arithmetic Operations – Binary Codes.

**SUGGESTED ACTIVITIES :**

- In Class activity for place - value systems
- Practical – Abacus – Counting – Activity

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| MODULE II : | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 1 | 4 | 3 |

Boolean Algebra – Theorems and Postulates - Functions – Truth Table - Logic Gates – Universal gates

**SUGGESTED ACTIVITIES :**

- Flipped classroom and activity
- Proofs and Simplification in class
- EL – Practical Problems - Introduction to propositional problems using conjunction, disjunction and negation
- Practical - Implementation of simple functions using gates

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| MODULE III : | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 1 | 4 | 3 |

Canonical and Standard Forms – Minterms and Maxterms - Sum of Products and Product of Sums - Simplification of Boolean Functions - Karnaugh Map – 2,3,4 variables - NAND / NOR Implementations.

**SUGGESTED ACTIVITIES :**

- EL - Exclusive OR function
- Practical - Simplification and implementation of Boolean functions

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| MODULE IV : | L | T | P | EL |
|---|---|---|---|---|
| | 6 | 1 | 8 | 3 |

Combinational Circuits – Arithmetic Circuits - Half and Full Adders - Subtractors - Binary Parallel adder – Carry Look-ahead Adder - BCD Adder - Magnitude Comparator - Binary multiplier - Code Converters. Introduction to HDL.

**SUGGESTED ACTIVITIES :**

- Flipped Class room
- Introduction to HDL – in class and EL based on that
- Practical - Implementation of the arithmetic circuits and getting started with HDL

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| MODULE V : | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 1 | 8 | 3 |

Decoder, Encoder, Priority Encoder, Mux/Demux - Applications. HDL for these circuits.

**SUGGESTED ACTIVITIES :**

- Applications in class
- EL – HDL for these combinational circuits
- Practical - Implementation of these circuits and HDL implementations

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| MODULE VI: | L | T | P | EL |
|---|---|---|---|---|
| | 5 | 1 | 4 | 3 |

R –S Latch - D Latch - Flip flops – SR, JK, T, D, Master /Slave FF, HDL for latches and flip flops - Analysis of clocked sequential circuits – Moore /Mealy models - Flip flop excitation tables - Design of clocked sequential circuits.

**SUGGESTED ACTIVITIES :**

- Introduction in class
- Analysis in Class
- Flipped Classroom for further study
- Practical - Implementation of Flip flops

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| **MODULE VII:** | **L** | **T** | **P** | **EL** |
|---|---|---|---|---|
| | **3** | **1** | **4** | **3** |

Registers – Shift Registers, Universal Shift Register Counters – Ripple Counters, Synchronous Counters, Ring Counter, Johnson Counter - HDL for counters and shift registers

**SUGGESTED ACTIVITIES :**

- Combinations of in Class & Flipped class rooms
- Practical - Implementations of counters and shift registers
- EL - HDL descriptions
- EL - Mini project for designing and implementing a digital system using both hardware and software (HDL)

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| **MODULE VIII:** | **L** | **T** | **P** | **EL** |
|---|---|---|---|---|
| | **3** | **1** | **4** | **3** |

Practical Problems in Sequential design – Timing diagrams - Problems combining Combinational & Sequential Components – State reduction – State Assignment

**SUGGESTED ACTIVITIES :**

- Timing diagrams in class
- Flipped classroom
- Practical - HDL descriptions to be continued

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| **MODULE IX:** | **L** | **T** | **P** | **EL** |
|---|---|---|---|---|
| | **3** | **1** | **4** | **3** |

Memory Systems – RAM, ROM, PLD, PLA and PAL - Design of digital systems

**SUGGESTED ACTIVITIES :**

- Combination of in class & Flipped
- Practical - Project demonstration and presentation

**SUGGESTED EVALUATION METHODS:**

- Tutorial problems
- Assignment problems
- Quizzes

| MODULE X: | L | T | P | EL |
|---|---|---|---|---|
| | 3 | 1 | 4 | 3 |
| Basic Components of a digital computer - Functions - Organization - Instruction Execution - Data path and control path | | | | |
| **SUGGESTED ACTIVITIES :**<br>• Mostly in Class<br>• Practical - Project demonstration and presentation | | | | |
| **SUGGESTED EVALUATION METHODS:**<br>• Tutorial problems<br>• Assignment problems<br>• Quizzes | | | | |

**TEXT BOOKS:**

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, V Edition, Pearson Education, 2013.
2. Charles H. Roth Jr, “Fundamentals of Logic Design”, Fifth Edition, Jaico Publishing House, Mumbai, 2003.

**REFERENCES:**

1. John F. Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Pearson Education, 2007.
2. Donald D. Givone, “Digital Principles and Design”, Tata McGraw Hill, 2003.
3. G. K. Kharate, “Digital Electronics”, Oxford University Press, 2010.

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Simplify complex Boolean functions
- Design and analyze digital circuits with combinational and sequential components
- Implement digital circuits using MSI chips and PLDs
- Use HDL to build digital systems
- Point out the basic functionalities of the components of a digital computer and their organization

**EVALUATION PATTERN:**

| Category of Course | Continuous Assessment | Mid – Semester Assessment | End Semester |
|---|---|---|---|
| **Theory Integrated with Practical** | **15(T) + 25 (P)** | **20** | **40** |

**CO - PO Mapping:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | | | |
| **CO2** | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | | |
| **CO3** | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | | |
| **CO4** | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | | |
| **CO5** | ✓ | ✓ | | ✓ | | | ✓ | | | | | |