# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Master of Engineering**

**Level: PG**

**Branch: Electronics & Communication (Signal Processing Technology)**

**Course / Subject Code :ME01026011**

**Course / Subject Name : Fundamentals of VLSI CAD**

| | |
|---|---|
| w. e. f. Academic Year: | 2024-25 |
| Semester: | 1st Semester |
| Category of the Course: | PEC |

| | |
|---|---|
| **Prerequisite:** | Basic matrices operation. |
| **Rationale:** | This course provides students with the mathematical foundations that are the basis of computer aided-design techniques used in VLSI Design flow. |

**Course Outcome:**

After Completion of the Course, Student will able to:

| No | Course Outcomes | RBT Level |
|---|---|---|
| 01 | Establish comprehensive understanding of the various phases of CAD for VLSI Design. | U |
| 02 | Demonstrate knowledge and understanding of fundamental concepts in CAD. | A |
| 03 | Demonstrate knowledge of computational and optimization algorithms and tools applicable to solving CAD related problems. | A |
| 04 | Establish capability for CAD tool development and enhancement. | A |

**Revised Bloom's Taxonomy (RBT)*

**Teaching and Examination Scheme:**

| Teaching Scheme (in Hours) | | | Total Credits L+T+ (PR/2) | Assessment Pattern and Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | Tutorial / Practical | | |
| L | T | PR | C | ESE (E) | PA / CA (M) | PA/CA (I) | ESE (V) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 20 | 30 | 150 |

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**Course Content:**

| Unit No. | Content | No. of Hours | % of Weightage |
|---|---|---|---|
| 1. | **Introduction**: Introduction to VLSI Design methodologies and abstraction levels, The VLSI Design Problem, The design domains, design actions, design methods and technologies. | 5 | 10 |
| 2. | **Algorithmic Graph Theory**: Terminology of graph. Data Structures for the Representation of Graphs, Computational Complexity, Examples of Graph Algorithms- Depth-first Search, Breadth-first Search etc, Time and space complexity of algorithms | 5 | 12 |
| 3. | **Tractable and Intractable Problems**: Combinatorial Optimization Problems, Decision Problems, Complexity Classes, NP-completeness and NP-hardness, Consequences. | 6 | 12 |
| 4. | General-purpose Methods for Combinatorial Optimization: The Unit-size Placement Problem, Backtracking and Branch-and-bound, Dynamic Programming, Integer Linear Programming, Local Search, Simulated Annealing, Tabu Search, Genetic Algorithms | 6 | 15 |
| 5. | **Logic Synthesis and Verification**: Introduction to Combinational Logic Synthesis, Binary-decision Diagrams, Two-level Logic Synthesis. | 6 | 15 |
| 6. | **High-level Synthesis** : Hardware Models for High-level Synthesis, Internal Representation of the Input Algorithm, Allocation, Assignment and Scheduling, Some Scheduling Algorithms, Some Aspects of the Assignment Problem, High-level Transformations. | 12 | 26 |
| 7. | **Simulation**: General Remarks on VLSI Simulation, Gate-level Modeling and 4 10 Simulation, Switch-level Modeling and Simulation | 5 | 10 |
| | **Total** | **45** | **100** |

**Suggested Specification Table with Marks (Theory):**

| Distribution of Theory Marks (in %) | | | | | |
|---|---|---|---|---|---|
| **R Level** | **U Level** | **A Level** | **N Level** | **E Level** | **C Level** |
| **10** | **20** | **20** | **30** | **10** | **10** |

*Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)*

**References/Suggested Learning Resources:**

**(a) Books:**

1. Algorithms for VLSI Design Automation, Sabih H. Gerez, John Wiley & Son.
2. Evolutionary Algorithms for VLSI CAD, Rolf Drechsler, Springer Science and Business media,1998
3. Spectral Techniques in VLSI CAD, Mitchell Aaron Thornton, Rolf Drechsler, D. Michael Miller, Springer Science and Business media

**(b) Open source software and website:**

1. Xilinx/C++ (software)/Matlab
2. https://nptel.ac.in
3. www.ocw.mit.edu
4. www.berkeley.edu

**Suggested Course Practical List:**

1. Write a program to generate all possible trees for a given graph.
2. Write a program to implement Depth-first Search algorithm.
3. Write a program to implement Breadth-first Search algorithm.
4. Write a program to implement Binary-decision diagrams.
5. Write a program to implement Binary-search algorithm.
6. Write a program to implement Genetic algorithm.
7. Write a program to implement Integer linear programming.
8. Write a program to implement Dijkstra's Shortest-path algorithm
9. Write a program to implement ASAP Scheduling algorithm.
10. Write a program to implement Mobility-based Scheduling algorithm.

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