EC E 556, Design Automation of Digital Systems

1. **Credits**: 3  
   **Contact Hours**: 3.8


a. **Other Supplemental Materials**: None

   - **Specific Course Information**:
     a. **Brief description of the content of the course (Course Catalog Description)**: Use of digital computers to simulate, partition, place and interconnect digital electronic systems.
     b. **Pre-requisites or Co-requisites**: ECE/Comp Sci 352; Comp Sci 367; or consent of instructor
     c. **This is a Selected Elective course**.

   - **Specific Goals for the Course**:
     a. **Course Outcomes**:
        1. Students will learn VLSI computer-aided design (CAD) flow, its various components and their interactions for modern chip design.
        2. Students will be able to use dynamic programming to solve an instance of the technology mapping problem for netlist synthesis and minimizing area and delay.
        3. Students will be learn about simulated annealing optimization framework and its effective implementation for chip floor planning using binary tree and sequence pair representations.
        4. Students will be able to write Integer Linear Programming (ILP) formulations for...
variations of global routing problem targeting minimization of routing overflow and wirelength. They will learn practical considerations of using ILP for large industry-sized problems.

5. Students will learn the A* search algorithm for single-net routing and its impact as a core building block in a modern global routing framework.

6. Students will learn practical algorithms for circuit partitioning and detailed routing in modern chip design.

7. Students will learn the significance of various CAD techniques such as clock tree synthesis and power grid planning.

- **ABET Student Learning Outcomes:**

  (a) Ability to apply mathematics, science and engineering principles.
  (b) Ability to design and conduct experiments, analyze and interpret data.
  (c) Ability to design a system, component, or process to meet desired needs.
  (d) Ability to function on multidisciplinary teams.
  (e) Ability to identify, formulate and solve engineering problems.
  (h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
  (j) Knowledge of contemporary issues.
  (k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

- **Brief List of Topics to be Covered:**

  1. Overview of VLSI design flow, styles, and computational complexity
  2. Technology mapping (using dynamic programming)
  3. Introduction to Static Timing Analysis
  4. Circuit partitioning
  5. Floorplanning (using simulated annealing)
  6. Placement
  7. Global routing (using A* shortest path algorithm, and integer linear programming)
  8. Detailed routing (using Dijkstra's algorithm, and left-edge algorithm)
  9. Overview of Clock Tree Synthesis
  10. Overview of power grid planning