Faculty of Computer Science & Engineering

CLO03-PLO05

Instructor: Engr. M. Shakaib Khan **CE211L-FALL2025**

Problem Context

In today's technology-driven world, every modern engineering system — from home automation to industrial control — relies on circuits that sense, process, and respond intelligently to real-world signals. Understanding and applying circuit analysis techniques is fundamental to the design of such systems.

This PBL activity bridges theoretical knowledge with hands-on practice. Students will use the foundational principles of resistive, capacitive, inductive, and op-amp circuits to design, analyze, simulate, and implement a practical electronic system that performs a meaningful function.

Problem Statement

Your task is to design, simulate, and implement a functional electronic circuit that demonstrates the real-world application of the principles studied in this course. The system should address a practical need and highlight how circuit analysis concepts can be effectively applied to real engineering challenges.

You are encouraged to select or innovate upon a topic that aligns with modern societal or industrial needs. Examples include, but are not limited to:

1. **Fire or smoke alarm system**
2. **Temperature-based fan controller**
3. **Water-level or overflow indicator**
4. **Automatic lighting system**
5. **Battery charge monitoring circuit**
6. **Motion-activated security alert**
7. **Smart irrigation moisture detector**

Project Deliverables and Methodology

Each group will complete the following steps to ensure a comprehensive learning and design experience:

1. **Circuit Design & Simulation**
    i. Develop a schematic using standard circuit components.
    ii. Apply circuit analysis techniques (KCL, KVL, Nodal, Mesh, Thevenin, etc.).
    iii. Validate the design through simulation using tools such as Multisim, Proteus, or LTSpice.
2. **Hardware Implementation**
    i. Construct and test your circuit on a breadboard or protoboard.
    ii. Ensure component ratings and connections are technically feasible and safe.
3. **Technical Report (2 Pages)**
    a. **Include:**
        i. Problem statement and objective
        ii. Circuit schematic and design rationale
        iii. Simulation results and analysis
        iv. Implementation details and key findings
    b. Submit as a PDF file via Teams (one submission per group).
4. **Demonstration**
    a. Present your working prototype during the second-last week of the semester.
    b. Explain circuit operation, challenges faced, and improvements made.
2. **Teamwork Reflection**
    a. Document each member's contribution, collaborative process, and lessons learned.
    b. Groups must consist of 2 to 3 members.

PBL Attributes:

PBL Attribute	Justification in this Project
1. Real-World Problem	Students identify a practical societal or industrial issue that can be solved using fundamental circuit laws and components.
2. Self-Directed Learning	Students research circuit configurations, tools, and analysis approaches independently.
3. Problem-Solving	Encourages analytical reasoning, application of circuit analysis concepts, and debugging for correct operation.
4. Hands-on Application	Involves practical hardware construction, testing, and measurements.
5. Technology Integration	Simulation tools are used to validate theoretical predictions and analyze circuit behavior.
6. Iterative Testing	Promotes design refinement and debugging across simulation and hardware stages.
7. Innovation & Creativity	Students are encouraged to propose unique design ideas and efficient solutions.
8. Collaboration	Develops communication, teamwork, and project management skills within a group.

Evaluation Rubric

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (1–2)	Unsatisfactory (0)
1. Problem Definition & Relevance	Clearly identifies and justifies a real-world problem; strong societal/industrial context	Relevant and realistic	Moderately defined problem	Poorly justified or unclear	No clear problem defined
2. Circuit Design, Analysis & Simulation	Accurate design using correct laws/theorems; simulation fully matches analysis	Mostly accurate analysis; minor errors	Basic simulation and partial validation	Weak or inconsistent design	No valid design or simulation
3. Hardware Implementation & Testing	Functional, neat, and verified circuit; consistent with theory	Functional with minor errors	Partial implementation	Poor construction or faulty testing	Not implemented
4. Innovation, Creativity & Technical Understanding	Original design idea or effective optimization; strong understanding of components	Some creative elements and good understanding	Average design and justification	Minimal creativity	No evidence of innovation or understanding
5. Teamwork, Communication & Reporting	Excellent collaboration; clear, complete, and well-organized report and demo	Good teamwork and reporting	Basic presentation and documentation	Poor coordination	No teamwork or report

Expected Learning Outcomes

After completing this PBL, students will be able to:

1. **Apply** fundamental circuit laws and theorems to real-world systems.
2. **Analyze and verify** circuit operation through simulation and testing.
3. **Integrate** theoretical knowledge with practical implementation.
4. **Demonstrate** teamwork and professional communication.
5. **Engage** in creative, iterative problem-solving reflective of real engineering practice.