Lesson Plan

Lesson: Using Nodal Analysis to Solve a Circuit

Timeframe: 90 minutes

Materials needed: Course handouts, calculator, laptop.

Objectives:

Basic:

1. Identify essential nodes on a circuit diagram.
2. Estimate the number of linear equations necessary to solve a circuit.
3. Select an appropriate reference node.
4. Write KCL equations at each node.

Advanced:

5. Compute nodal voltages by solving a system of linear equations.
6. Use nodal voltages to calculate other circuit parameters.
7. Illustrate that choosing a different reference point does not change the circuit parameters.
8. Distinguish special cases that reduces the number of necessary linear equations.

Background: This lesson is part of an introductory electric circuit analysis course. The course is taken by first-year electrical and computer engineering majors and it help students build a critical foundation that is necessary for many courses in the curriculum. The focus of this lesson is to introduce a practical and systematic approach to compute and solve linear circuits. The topic is typically cover in the second half of the quarter after covering KCL and KVL laws.

Introduction to Lesson:

1. Short Q/A session, based on the data collected from individual space activities. (~5 min)
2. Short quiz covering the basic learning objectives (~5 min)
3. Pair/Share quiz answers (~5 min)
4. In-class (group space) exercises covering the advanced learning objectives (~55 min)
5. Wrap up & 1 minute paper/muddiest point (~5 min)

Procedure [Time needed, include additional steps if needed]:

Pre-Class Individual Space Activities and Resources:

Steps	**Purpose**	**Estimated Time**	**Learning Objective**
Step 1: Watch the following videos: • Identify essential nodes and estimate the number of linear equations • Solving a system of linear equations • Using nodal voltages to find other circuit parameters	Introduce the basic learning objectives and give student an overview of the lesson	25 min	1, 2, 3, 4, 5, 6
Step 2: Solve a short quiz	Formative assessment of the material in the videos.	15 min	1, 2, 3
Step 3: Read the relevant textbook material (Ch 3.2)	Reinforce the material covered in the videos	60 min	4, 5 ,6, 7
Step 4: Watch a walk-through video of me solving a problem from beginning to end.	Holistic illustration of the mechanics of solving a problem and errors common among students.	15 min	1, 2, 3, 4, 5, 6, 7
Step 5:			

In-Class Group Space Activities and Resources:

Steps	**Purpose**	**Estimated Time**	**Learning Objective**
Step 1: Form groups of 2 to 4	Forming groups for a Think/Pair/Share activity		
Step 2: In your group, fill out the gaps in the provided problem set.	Practice the advanced learning objectives	40 min	5, 6, 7, 8
Step 3: Once you reach a solution within your group, write the answer in the appropriate table on the board	Collect solutions to identify problem sets with a lot of discrepancies. i.e. identify the muddiest point in this lesson	5 min	5, 6, 7
Step 4: Go over the identified muddies points (if any)	Cover the concept/s or problem set identified by step 3.s	5 min	5, 6, 7, 8
Step 5: 1 minute paper	Collect student feedback to improve pre-class (individual space) activities if necessary	5 min	

Closure/Evaluation:

Analysis:

The advanced learning objectives sought in this lesson are especially suited for group work. The group space activities were particularly designed to help students develop the required problem-solving skills necessary to achieve the overall course objectives. Moreover, the cooperative learning activities will improve student team work and critical thinking skills. There might be some challenges in organizing the groups and collecting their responses; in addition, some students might show resistance that is typically observed when students are first exposed to active learning activities.

Post-Class Individual Space Activities:

1. Solve textbook problems posted in blackboard and announced in class.
2. Compare your results with the posted numerical solutions.
3. Estimate the location/reason of the errors (if any), try to make the appropriate changes.
4. If you could not reach the correct solution, show me all our tries during office hours.

Connections to Future Lesson Plan(s):

The next lesson will focus on special cases to simplify nodal analysis. The last advanced learning objective in this lesson will be introduced during the group space activities in a problem-based learning approach. This approach will help students identify the special cases and appreciate their usefulness. The basic learning objectives of the next lesson will expand on the usage and the mechanics of these special cases.