In the Name of God

Multisim Simulation Project

Electrical Circuits 1

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Faculty of Electrical Engineering
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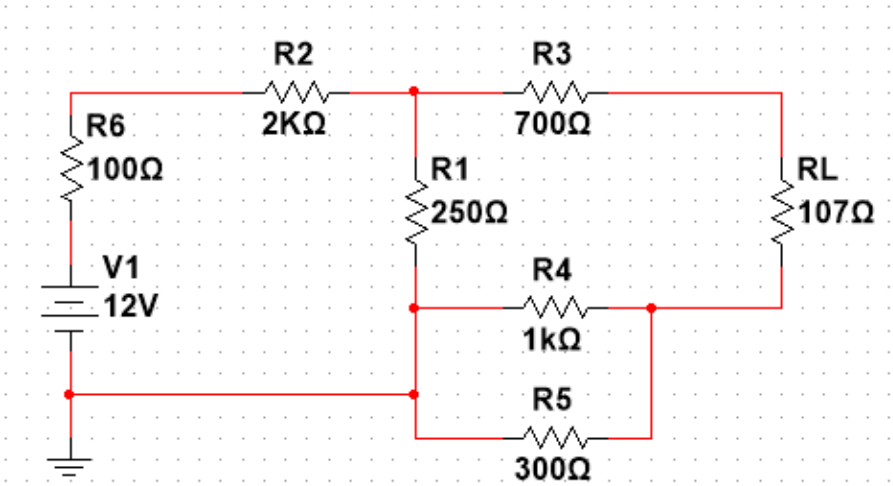
Project Objective

This project aims to reinforce students' understanding of key electrical circuit concepts through simulation and analysis in Multisim. The questions cover Thevenin and Norton equivalent circuits, maximum power transfer, parameter sweep analysis, element voltage/current calculations, effects of capacitors and inductors on waveforms, and voltage waveform analysis, with a focus on RLC circuits. Students are required to design, simulate, and analyze the following circuits.

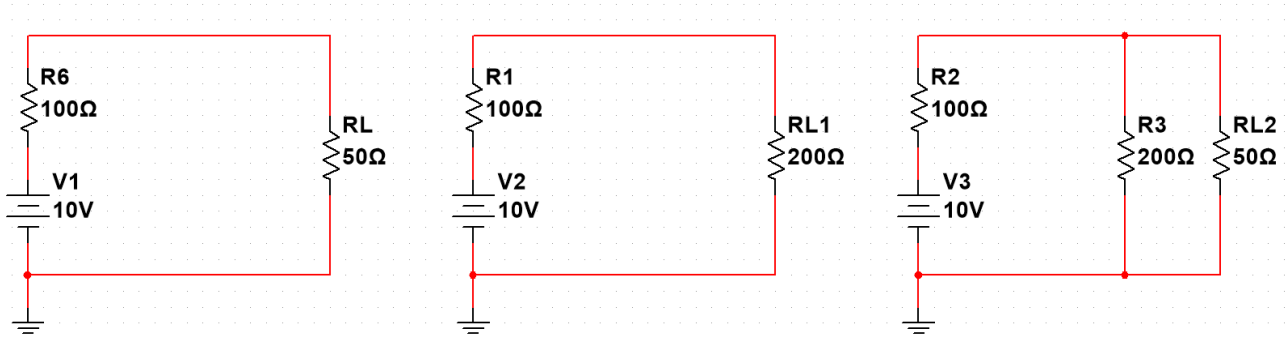
Proposed Questions

Question 1: Thevenin and Norton Equivalent Circuits



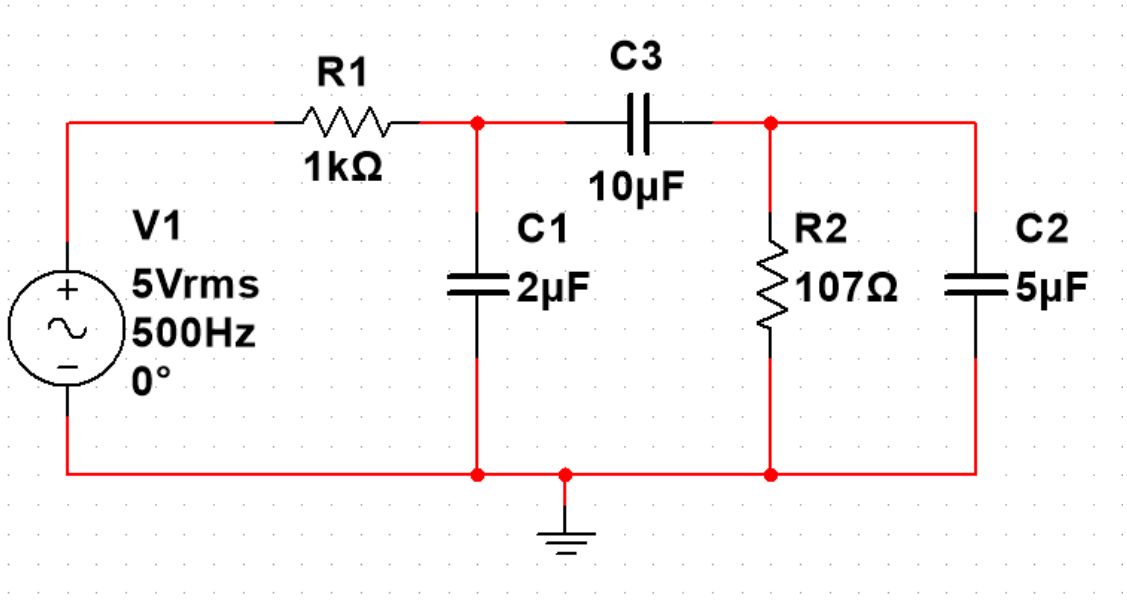
- Calculate the Thevenin and Norton equivalent circuits (Thevenin voltage, Thevenin resistance, Norton current, Norton resistance) manually for the RL(THE RL VALUE IS THE LAST THREE DIGITS OF YOUR STUDENT NUMBER).
- Simulate the circuit in Multisim to verify the Thevenin and Norton equivalents by measuring the open-circuit voltage and short-circuit current.
- Objective: Understand Thevenin and Norton theorems and validate equivalent circuits using Multisim.

Question 2: Maximum Power Transfer



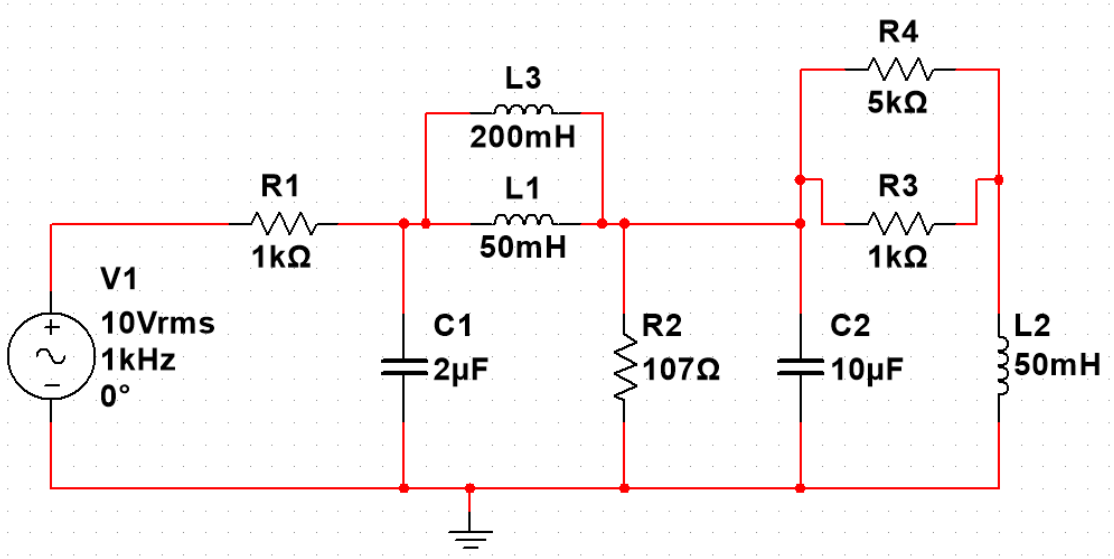
- Use Multisim's Parameter Sweep tool to vary R_L from 50Ω to 200Ω in steps of 10Ω and measure the power delivered to R_L.
- Plot the power versus R_L and identify the load resistance that achieves maximum power transfer. Compare with the theoretical value ($R_L = R_s$).
- Add a parallel resistor to load (R3). Do the previous parts again and compare.
- Objective: Learn the maximum power transfer theorem and apply Parameter Sweep in Multisim.

Question 3: Voltage/Current Analysis and Parameter Sweep in RC Circuit



- R2 must be valued according to the last three digits of your student number.
- Calculate the voltage across and current through each element manually using impedance analysis.
- Simulate the circuit in Multisim and use Parameter Sweep to vary the frequency from 100Hz to 1kHz in steps of 100Hz. Measure and plot the voltage across the capacitor.
- Compare the simulated voltages and currents with manual calculations and analyze the frequency-dependent behavior.
- Objective: Practice voltage/current calculations and explore frequency effects using Parameter Sweep.

Question 4: RLC Circuit Resonance and Parameter Sweep



- R2 must be valued according to the last three digits of your student number.
- Calculate the resonant frequency of the circuit manually. Simulate the circuit in Multisim and use Parameter Sweep to vary the source frequency from 500Hz to 5kHz in steps of 100Hz.
- Plot the current through the circuit and the voltage across the resistor using the virtual oscilloscope. Identify the resonant frequency from the simulation and compare it with the theoretical value.
- Analyze the effect of resonance on the circuit's behavior (e.g., maximum current at resonance) and discuss the role of the inductor and capacitor.
- Objective: Understand RLC resonance, apply Parameter Sweep, and analyze waveform changes at resonance.

Instructions

- All simulations must be performed in Multisim.
- Use tools like the virtual oscilloscope, multimeter, and Parameter Sweep for analysis.
- Compare simulation results (plots, measured values) with manual calculations.
- The project report should include circuit schematics, simulation results (e.g., waveforms, power plots), and comparative analysis.

Submission Guidelines

Please submit your assignment by uploading a zip file containing your Multisim simulation files and a comprehensive PDF report (including simulation screenshots, manual calculations, and explanations) to the designated platform. The zip file should be named in the format `PRJ1-NAME-LASTNAME-STUDENTNUMBER`. Comprehensive reports will receive extra credit. Any similarity between submitted assignments will result in a zero grade for the involved students.

Good Luck,
Sina Farhangdoost