

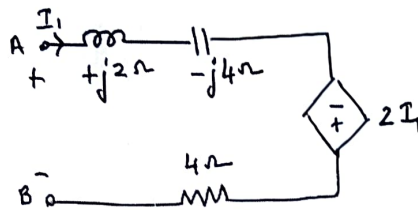
ECE 215: Circuit Theory and Devices:
Mid-Term Exam (90 marks)

Instructions

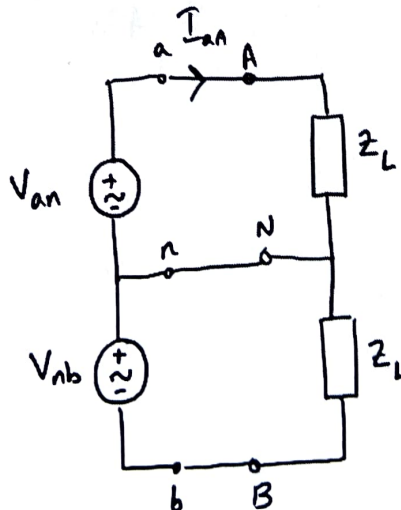
1. All questions are compulsory.
2. Duration of the exam is 2.5 hours

Short questions (5 marks each)

1. A load draws 10000 VA with a leading power factor of 0.83. The wire impedance to the load dissipates 100 W. What is the complex power supplied by the source? What is the power factor of the source?
2. Find the Thevenin's voltage and impedance of the following circuit seen from input terminals A-B.

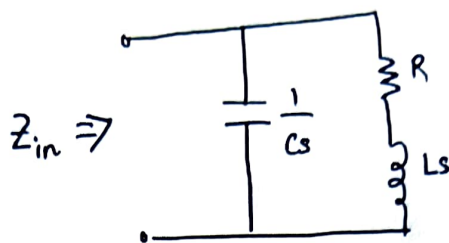


3. In a single-phase differential power supply to a balanced load, the RMS phase voltage, $V_{an} = 230\angle 60^\circ$ V at 50 Hz. The RMS line current $I_{aA} = 1\angle 30^\circ$ mA. Find the DC component and the sinusoidal component of the instantaneous power supplied by the power supply. (Hint: Consider both phases of the power supply.)



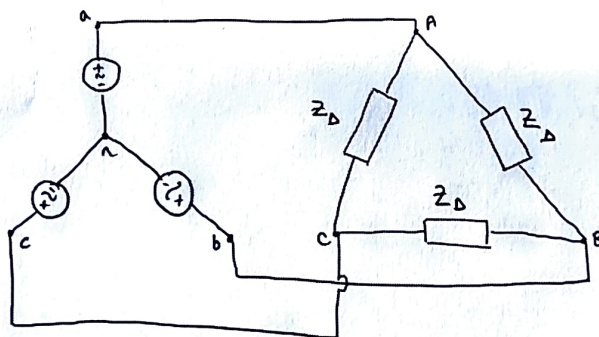
4. There are two low pass filters: one of order 2 and the second of order 4. Both filters have an identical cut-off frequency. What is the slope (decay rate per decade) of each filter in the stop band? How many memory elements are present in each of the filters? How many poles are there in the transfer function of each of the low pass filters?

5. Identify the frequency at which the input impedance of the circuit shown below reaches resonance.

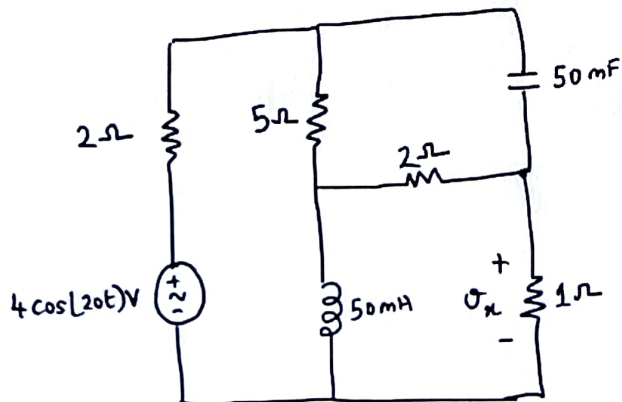


Long Questions

1. (20 marks) Consider a balanced three-phase power supply that is connected to a balanced Delta-load. The phase voltage of the source, is $V_{an} = 110\angle 0^\circ$ at 60 Hz. Each wire is lossless and each phase of the load, Z_Δ , draws 5 kW at a lagging power factor of 0.75.
- Determine the source's phase and line voltages in phasor and in time-domain.
 - Determine the load's phase and line currents in phasor and in time-domain.
 - What is the complex power, time-averaged power and reactive power supplied by the source?
 - What is the impedance of each phase of the load, Z_Δ ?



2. (20 marks) Determine the voltage $v_x(t)$ in the following circuit.



3. (25 marks) Consider a series circuit with $R = 10k\Omega$, $L = 1\mu H$, $C = 10mF$. They are connected to a source AC voltage $V_{in}(\omega)$. The output voltage, $V_{out}(\omega)$, is taken across the inductor and capacitor as shown.
- What is the transfer function of the circuit: $H(\omega) = \left| \frac{V_{out}(\omega)}{V_{in}(\omega)} \right|$
 - Plot the magnitude and phase response of the transfer function in the semilog sheets that are provided.
 - Determine the nature of the filter (lpf/hpf/bpf/bsf), the order of the filter and whether it is active or passive.
 - Determine the pass band, stop band and cut off frequencies of the filter.

