ECE 215: Circuit Theory and Devices (CTD)

Mid-Sem Exam (Set B)

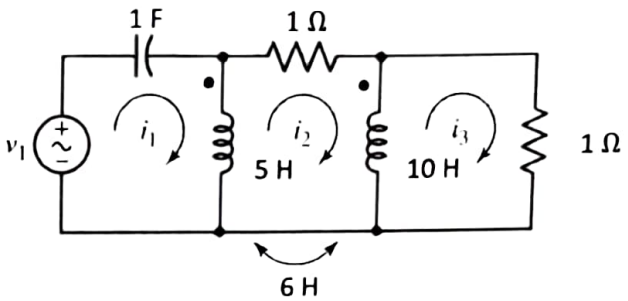
Date: October 7, 2024	Duration: 1 hour	Total points: 40 (+7 bonus)

Instructions

- Write your set in the answer sheet.
- Remember to write units in all your answers.
- Clearly mention the question number you are attempting. Otherwise, zero marks will be given.
- Discussions and calculator sharing are strictly prohibited.

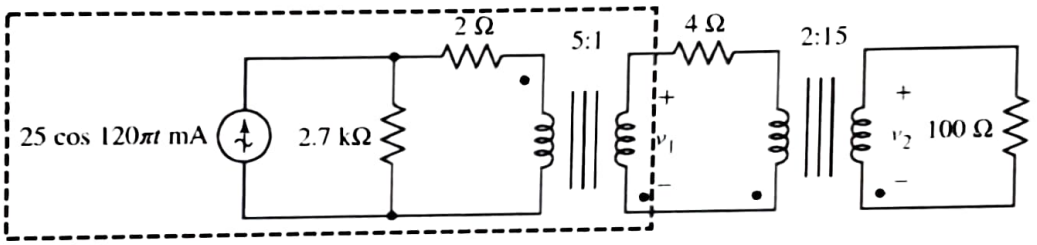
Questions 1 [CO1, CO2] [5 points]

For the following circuit, write and simplify mesh current equations. (There is no need to find current values).



Questions 2 [CO1, CO2] [10 points]

Consider the following circuit.



(a) Find the average power consumed by each resistor. [6 points]
(b) Determine time-domain voltages v1 and v2. [4 points]
(c) Find the Thevenin equivalent for the part of the circuit inside the dotted box. [Bonus 4 points]

Questions 3 [CO1, CO2] [10 points]

A Y-configuration three-phase balanced source is connected to a balanced Y load. The source has positive (also known as "abc") sequence. Z_p is parallel combination of $5 - j3\ \Omega$ and $9 + j2\ \Omega$ and the line voltage is 300 V.

Assuming zero line resistance, calculate

(a) Find Power factor of source [2 points]
(b) Find total power supplied by source [2 points]

$\frac{731}{197}$ $-\frac{187}{197}$

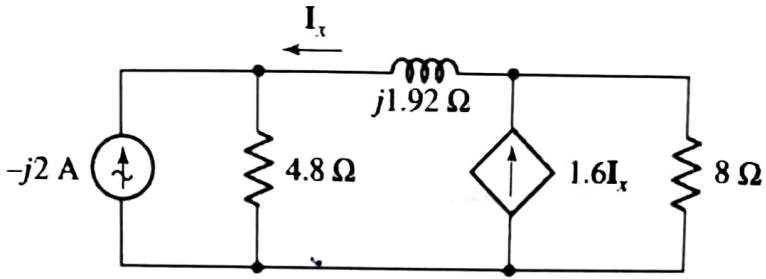
Assuming the line resistance of 1 Ω, calculate

(c) Calculate power factor of source [2 points]

(d) Find total power provided by source [2 points]

(e) Find total power lost in lines and total power supplied to the load [1+1 points]

Questions 4 [CO1, CO2] [10 points]



(a) For each passive element in the circuit, calculate the average power supplied to it. [6 points]

(b) For each source, determine the average power supplied by it. [4 points]

(c) Suppose you want to achieve maximum average power delivered to the load 8 Ω. You can replace resistor 8 Ω with another load. What impedance value will you choose for the new load? [Bonus 3 points]

Questions 5 [CO1, CO3] [5 points]

Use Laplace transform methods to find $i(t)$ passing through inductor (0.2 H), which is connected in series with a resistor (4 Ω) and a voltage source ($\delta(t) + u(t)\ V$). Assume zero initial conditions.

ECE 215: Circuit Theory and Devices (CTD)

End-Sem Exam (Set A)

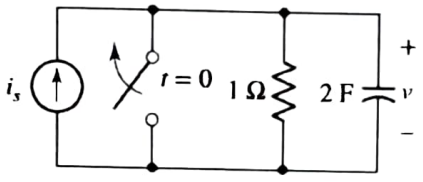
Date: December 8, 2024	Duration: 2 hours	Total points: 50 (+10 bonus)

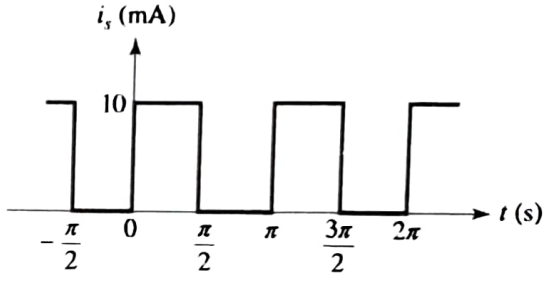
Instructions

- Write your set in the answer sheet.
- Remember to write units in all your answers.
- Clearly mention the question number you are attempting. Otherwise, zero marks will be given.
- Discussions and calculator sharing are strictly prohibited.

Questions 1 [CO, CO] [10 points]

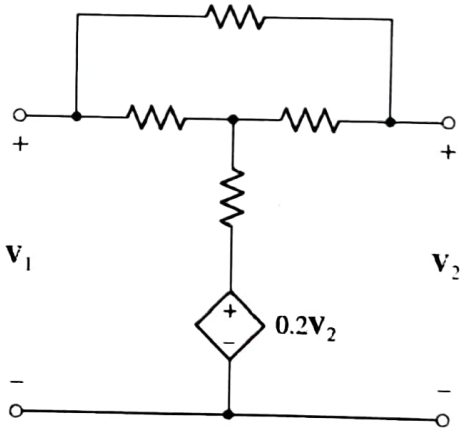
Calculate $v(t)$ in a Fourier series representation, if $i_s(t)$ is given by the below waveform and $v(0) = 0$.





Questions 2 [CO, CO] [10 points]

Obtain the impedance parameters of the network shown in the figure. All resistances are 3Ω.



Questions 3 [CO, CO] [10 points]

Draw the Bode magnitude and phase plot for the following transfer function.

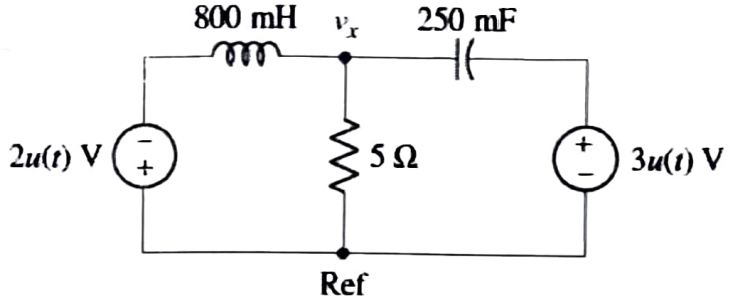
$$\mathbf{H(s)} = 1000\mathbf{s}/[(\mathbf{s}+1)(10000+20\mathbf{s}+\mathbf{s}^2)]$$

Questions 4 [CO, CO] [10 points]

For the circuit shown in the figure,

(a) Write s-domain nodal equation for $V_x(s)$. [5 points]

(b) Solve for $v_x(t)$. [5 points]

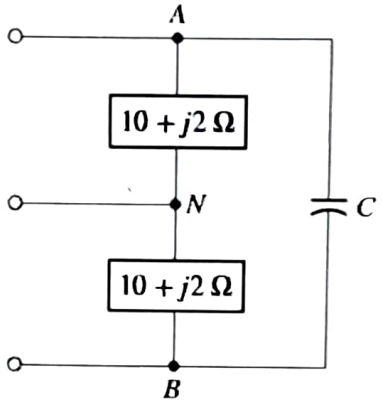


Questions 5 [CO, CO] [10 points]

A single-phase three-wire balanced source operates at 50 Hz such that V_{AN} = 115 V. It is connected to a balanced load shown in the figure below.

(a) Determine the power factor of the load if the capacitor is omitted [5 points]

(b) determine the value of capacitance C that will achieve a unity power factor for the total load. [5 points]



Question 6 [**Bonus** 5 points]

For a parallel RLC circuit, show that the half-power bandwidth is inversely proportional to the quality factor.

Question 7 [**Bonus** 5 points]

Find the Thevenin equivalent of the network as seen by looking into terminals a and b.