ShanghaiTech University Final Examination Cover Sheet

Spring Semester; Academic Year 2021-2022

EE111 Electric Circuits (SIST)

6 Problems
(Open Book, Open Notes, Calculator Allowed)
Answer the Questions in English
Show your work (for partial credits)
08:00-10:00, June 20, 2022

INSTRUCTIONS:

- You have 120 minutes (08:00- 10:00) to complete the exam.
- Write down your answers on blank papers. On each page of your answer, please mark the page number: "Page XX/XX"

STOP! Do not turn this page over until the instructor tells you to do so.

Important: Check that your exam book has 3 pages, including 6 problems in total.

Do NOT write in this section.

For Marker's Use:

Problem	1	2	3	4	5	6	Total
Marks							
Recheck							

Signature of Marker:

Signature of Reviewer:

Date:

1. **(16 points in total)** In Figure P1, use the following two methods to solve the circuit.

(a) **(8 points)** Find the current i using the superposition theorem.

(b) **(8 points)** Find the current i using the source transformation method.

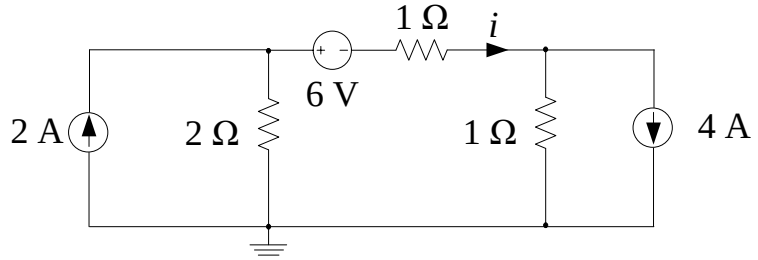

Figure P1

2. **(16 points in total)** In Figure P2, the switch has been opened for a long time and is closed at $t = 0$.

(a) **(2 points)** Find $v_c(0-)$;

(b) **(8 points)** For t > 0, find the Thevenin equivalent circuit at terminals a-b (excluding the capacitor C);

(c) **(6 points)** Find $v_c(t)$ ($t \geq 0$).

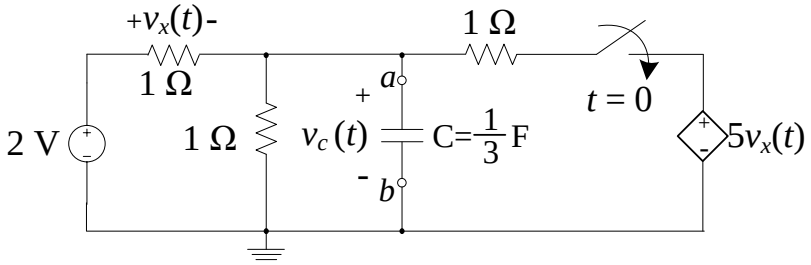

Figure P2

3. **(16 points in total)** In Figure P3, the system operates in steady state.

(a) **(12 points)** Find the output voltage $v_x(t)$;

(b) **(4 points)** With the expression of $v_x(t)$, find the instantaneous power $p(t)$ absorbed by the 5 Ω resistor. Determine the average value and the peak value of $p(t)$.

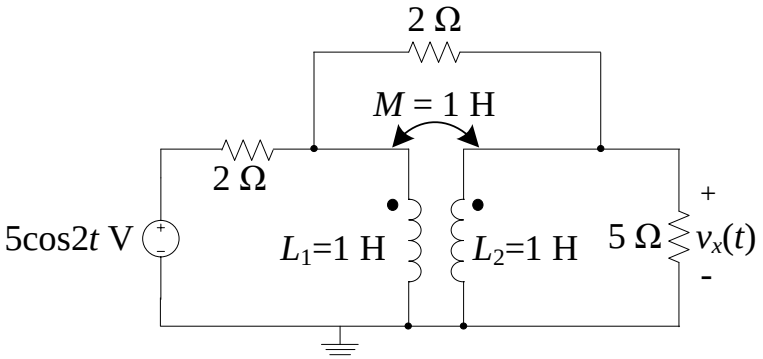

Figure P3

4. **(18 points in total)** A three-phase phasor domain circuit is shown in Figure P4.

(a) **(2 points)** For the source part, is the connection delta or Y? For the load part, is the connection delta or Y?

(b) **(2 points)** Is the system a balanced three phase system?

(c) **(8 points)** Find the load voltages $\tilde{V}_{an}$, $\tilde{V}_{bn}$ and $\tilde{V}_{cn}$ and load currents $\tilde{I}_{an}$, $\tilde{I}_{bn}$ and $\tilde{I}_{cn}$.

(d) **(6 points)** For each phase, find the average power (or real power), reactive power, complex power absorbed by the load of each phase. Find the power factor of each phase and determine whether it is a leading or lagging power factor.

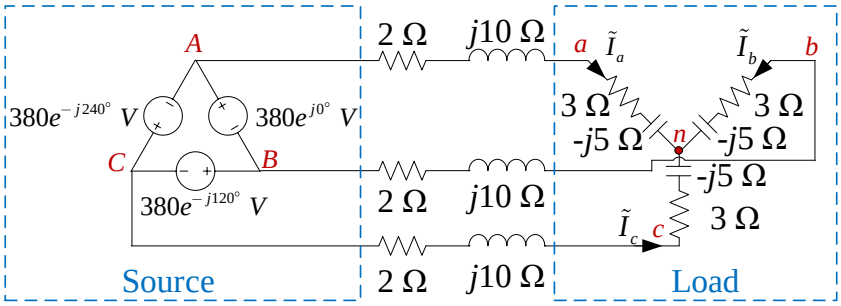

Figure P4

5. **(16 points in total)** A phasor domain circuit is shown in Figure P5. The operational amplifiers are idea and operate in their linear regions. The system angular frequency is ω. R_1 = 10 kΩ, R_2 = 20 kΩ, R_3 = 10 kΩ, R_4 = 5 kΩ, C_1 = 10 μF, C_2 = 0.1 μF.

(a) **(8 points)** Find the transfer function $H(\omega) = \tilde{V}_{out}/\tilde{V}_{in}$.

(b) **(2 points)** For the type of this filter, is it passive or active filter (select 1 out of 2 options)? Is it low-pass, high-pass, band-pass and band-reject filter (select 1 out of 4 options)?

(c) **(6 points)** Show the Bode plots of $H(\omega)$, including the magnitude plot and the phase plot.

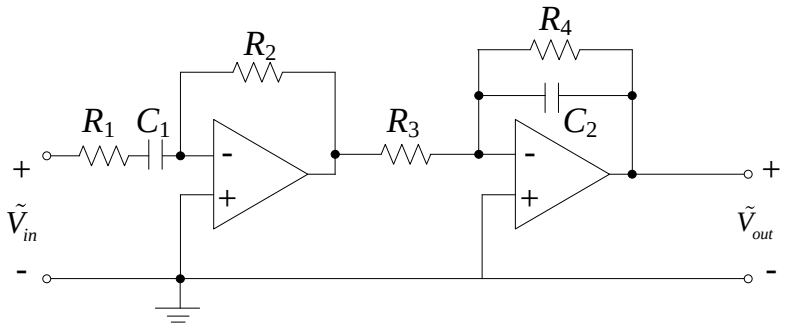

Figure P5

6. **(18 points in total)** In Figure P6, $v_s(t) = (t+2)u(t)$ V, and $u(t)$ is a unit step function. $i_1(0\text{-}) = i_2(0\text{-}) = 1$A.

(a) **(2 points)** What is the order of the circuit (1st order, 2nd order or 3rd order, select 1 out of 3 options)?

(b) **(6 points)** Use time domain method to solve $i_1(t)$.

(c) **(8 points)** Build the Laplace domain circuit and use Laplace domain method to solve $i_1(t)$.

(d) **(2 points)** What is the relationship of the results in (b) and (c)?

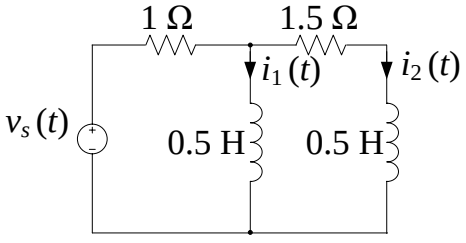

Figure P6