Student Name: .....
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Question 1

The ABCD parameters of the two-port $\mathcal{N}$ and the turn ratio of the transformer in Fig. 1 are given.

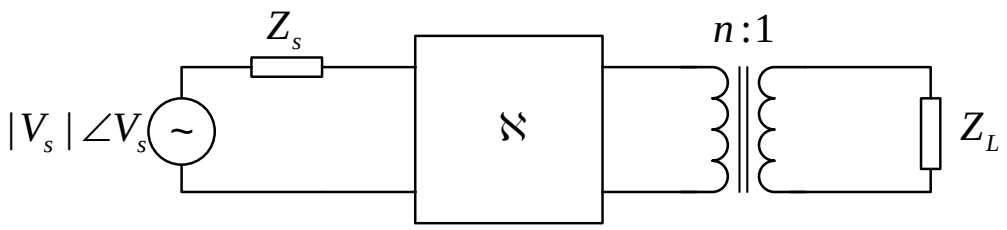

Figure 1: An LTI circuit for which the maximum power delivery condition is required.

(a) Find $Z_L(j\omega)$ that adsorbs the maximum power from the source.

(b) Evaluate the solution for $A(j\omega) = 1 + j, B(j\omega) = -1 + j4, C(j\omega) = \frac{1}{3}, D(j\omega) = 1 + \frac{j}{3}, n = 1, Z_s(j\omega) = 1$.

Question 2

In Fig. 2, $\mathcal{N}_1$ and $\mathcal{N}_2$ are two identical LTI networks with different initial conditions. Here, the network $\mathcal{N}_1$ has nonzero initial conditions while network $\mathcal{N}_2$ is in rest and has zero initial conditions. In the first experimental setup, $\hat{v}(t) = u(t) + \delta(t)$ and $\hat{i}(t) = \delta(t) + \delta'(t)$. Find $v_L(t), t \geq 0$ in the second experiment if $v_C(0^-) = 8$ and $i_L(0^-) = -0.5$.

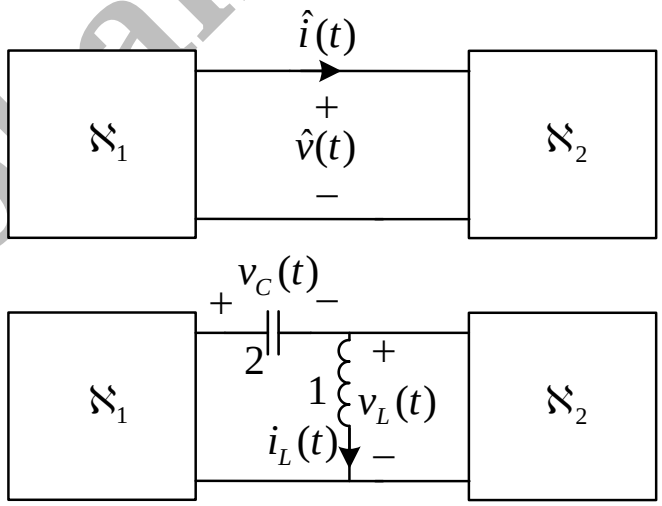

Figure 2: Two LTI networks in two experimental scenarios.

Question 2 continued on next page...

Student Name: .....
Student Number: .....

Question 3

For the circuit of Fig. 3,

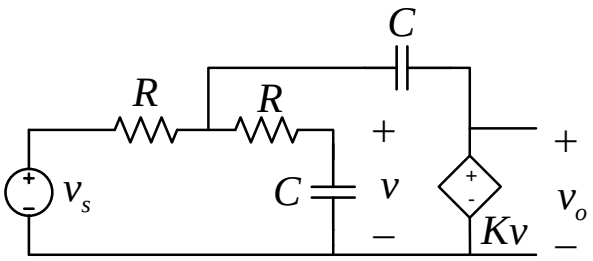

Figure 3: An LTI circuit.

(a) Find the transfer function $H(s) = \frac{V_o(s)}{V_s(s)}$.

(b) Find the values of K *for which the zero-state response is stable.*

(c) Find the value of K *for which the circuit acts like an oscillator.*

(d) Find the impulse response if $K = 1$ *and* $RC = 0.5$.

Question 4

For the circuit of Fig. 4,

Question 4 continued on next page...

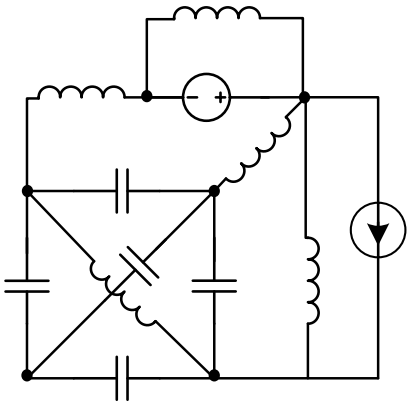

Figure 4: An LTI LC circuit.

(a) Find the number of natural frequencies of the network.

(b) Find the number of zero natural frequencies of the network.

(c) Find the number of state variables.

(d) Find the circuit order.

Question 5

A delta-connected positive-sequence balanced three-phase source drives the loads in Fig. 5. The source line voltage is $V_{ab} = 10\sqrt{3}\underline{/30^\circ}$ Vrms and $Z_1 = 18 + j12$, $Z_2 = 6 + j4$, and $Z_3 = 1 + j$.

Question 5 continued on next page...

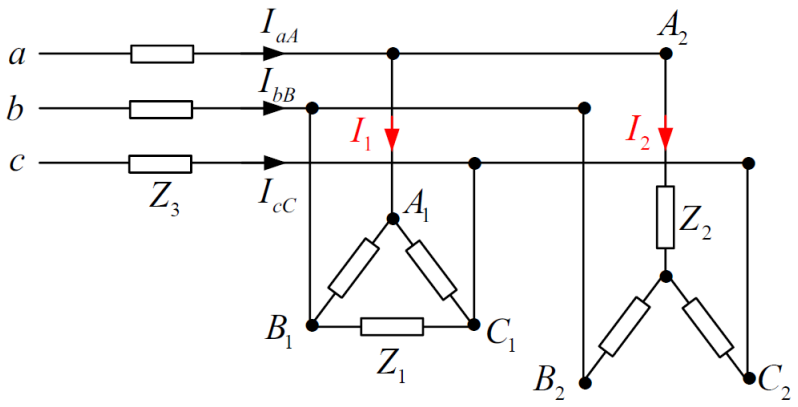

Figure 5: Two balanced interconnected three-phase loads.

(a) Calculate I_1 and I_2.

(b) Calculate I_{cC}.

(c) Calculate the complex, reactive, and active powers delivered by the source.

(d) Compute the load power factor seen by the source.

Question 6

For the circuit of Fig. 6, the initial conditions are $i_1(0^-) = I_{01}$, $i_2(0^-) = I_{02}$, $v_1(0^-) = V_{01}$, and $v_2(0^-) = V_{02}$.

Question 6 continued on next page...

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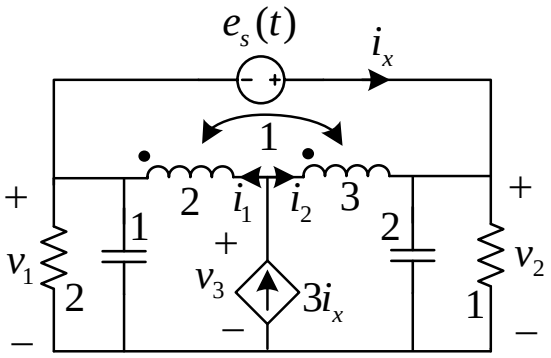

Figure 6: An LTI circuit for which different circuit equations are required.

(a) Find the Laplace-domain modified node equations.

(b) Find the time-domain modified node equations.

(c) Find the phasor-domain modified node equations.

(d) Find the state equations.

(e) Find the network natural frequencies.

(f) Find the natural frequencies of i_1.