CBCS SCHEME

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21EE33

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Electric Circuit Analysis

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Determine 'V_x' in the accompanying circuit in Fig. Q1 (a) using source transformation.

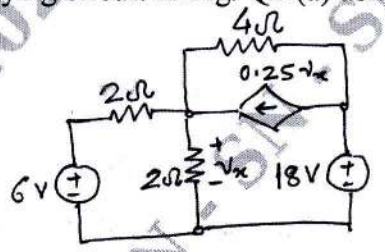

Fig. Q1 (a) **(07 Marks)**

b. Solve the accompanying circuit in Fig. Q1 (b) using mesh analysis and determine 'V_o'.

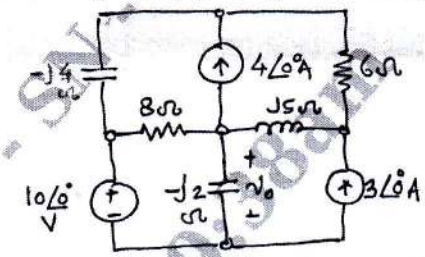

Fig. Q1 (b) **(08 Marks)**

c. Determine the node voltages for the accompanying circuit in Fig. Q1 (c), using nodal analysis.

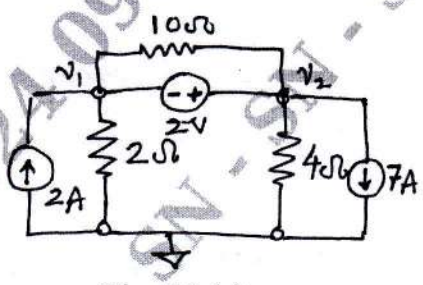

Fig. Q1 (c) **(05 Marks)**

OR

2 a. Determine the voltage 'V_x' in accompanying circuit in Fig. Q2 (a) using source transformation.

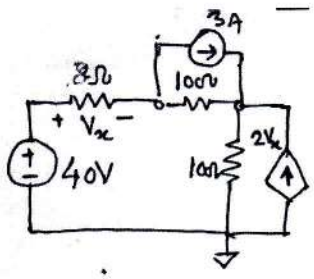

Fig. Q2 (a) **(07 Marks)**

b. Use mesh analysis to determine io in the accompanying circuit in Fig. Q2 (b).

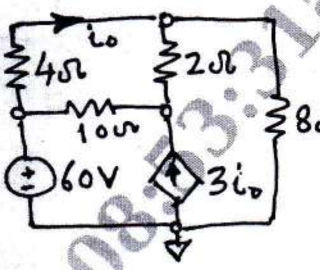

Fig. Q2 (b) **(06 Marks)**

c. Compute V_1 and V_2 using nodal analysis in the accompanying circuit in Fig. Q2 (c).

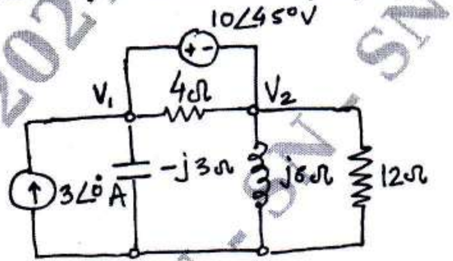

Fig. Q2 (c) **(07 Marks)**

Module-2

3 a. Determine I_O in the accompanying circuit in Fig. Q3 (a), using principle of superposition.

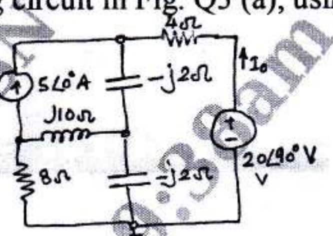

Fig. Q3 (a) **(08 Marks)**

b. Solve the accompanying circuit for 'I', using Thevenin's theorem for the Fig. Q3 (b).

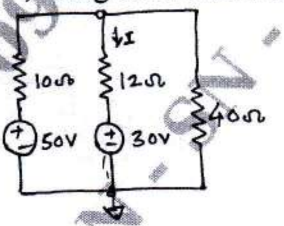

Fig. Q3 (b) **(07 Marks)**

c. State and explain reciprocity theorem, using an appropriate illustration. **(05 Marks)**

OR

4 a. Compute 'v_o' in the accompanying circuit in Fig. Q4 (a), using Thevenin's theorem.

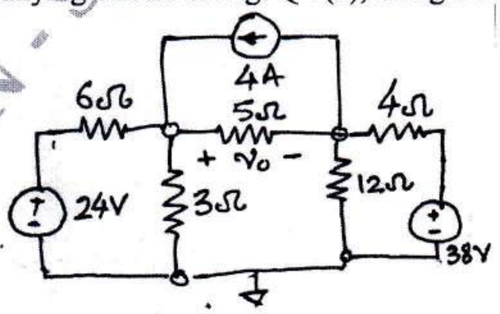

Fig. Q4 (a) **(07 Marks)**

b. Determine 'V_x' using principle of superposition in the accompanying circuit, in Fig. Q4 (b).

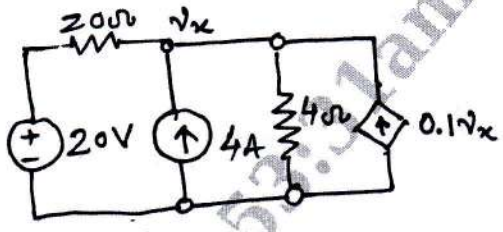

Fig. Q4 (b) **(07 Marks)**

c. Determine the value of 'R_L', that will draw maximum power transport of the circuit, in accompanying circuit Fig. Q4 (c). Also calculate the maximum power.

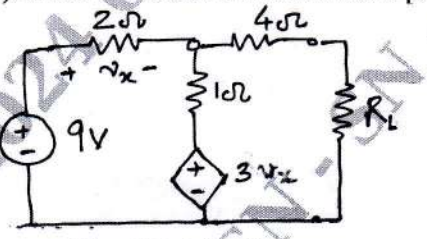

Fig. Q4 (c) **(06 Marks)**

Module-3

5 a. For the accompanying circuit Fig. Q5 (a), determine :

(i) Resonant frequency 'ω_0'.
(ii) Half power frequencies 'ω_1', 'ω_2'.
(iii) Quality factor and bandwidth.
(iv) Amplitude of current at 'ω_0', 'ω_1' and 'ω_2'

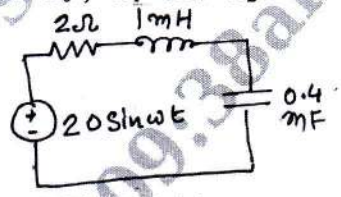

Fig. Q5 (a) **(08 Marks)**

b. The key 'K' in accompanying circuit Fig. Q5 (b) closed at t = 0. Assuming the capacitor in a discharged state for t < 0, obtain an expression for capacitor voltage $V_C(t)$.

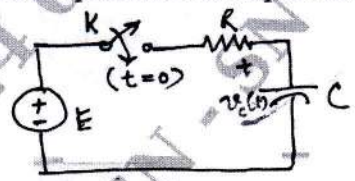

Fig. Q5 (b) **(06 Marks)**

c. Explain the concept of resonance in a series R-L-C circuit with help of appropriate mathematical expression. Draw indicative plots for current V/s frequency and phase V/s frequency for the same and explain. **(06 Marks)**

OR

6 a. The accompanying circuit in 'Fig. Q6 (a) is assumed unexcited for t < 0. The key 'K' is closed at t = 0. Obtain the expression for $V_0(t)$.

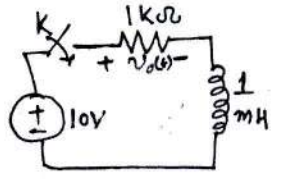

Fig. Q6 (a) **(07 Marks)**

b. For the parallel R-L-C circuit in Fig. Q6 (b) shown in accompanying diagram, Find :

(i) Resonance frequency 'ω_0'.
(ii) Half power frequencies 'ω_1'and 'ω_2'.
(iii) Power dissipated at 'ω_0', 'ω_1' and 'ω_2'

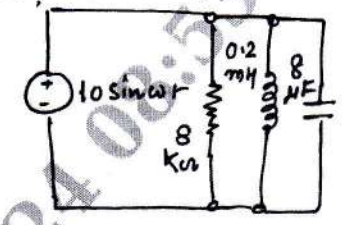

Fig. Q6 (b) **(07 Marks)**

c. Derive the expression for quality factor (Q-factor) for a parallel resonance circuit. Explain its utility in comparing resonant circuits selectivity. **(06 Marks)**

Module-4

7 a. Determine Lapalace's transform of the saw-tooth wave shown in accompanying diagram in Fig. Q7 (a).

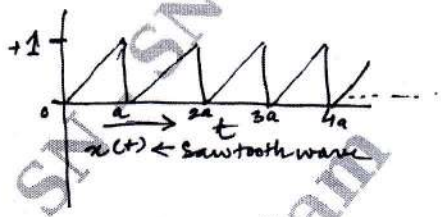

Fig. Q7 (a) **(07 Marks)**

b. The circuit shown in the accompanying diagram in Fig. Q7 (b) excited by $V(t) = 12\sin 5t$ volts, the initial current $i(0^+)$ is 5A, capacitor voltage as $t = 0^+$, $V_C(0^+)$ is 1 V, with polarity indicated. Determine i(t), using Lapalace's transformation method.

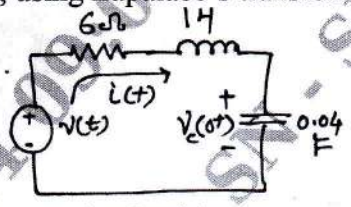

Fig. Q7 (b) **(08 Marks)**

c. Given Laplace's transform of x(t), u(t) is X(s). Prove that, the Laplace's transform of $x(t-a)$, $u(t-a)$ is $\exp(-as)X(s)$. **(05 Marks)**

OR

8 a. Determine the Laplace's transform of square wave shown in accompanying diagram in Fig. Q8 (a).

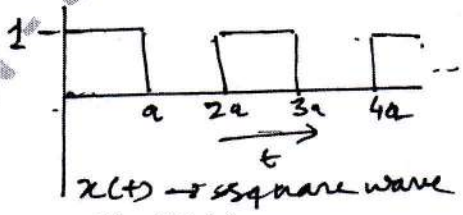

Fig. Q8 (a) **(07 Marks)**

b. The circuit in Fig. Q8 (b) accompanying diagram, is excited by a voltage pulse of height 2V and duration 5 sec. Determine the current flowing in the circuit i(t). Use Laplace's transform method. (Assume zero initial condition).

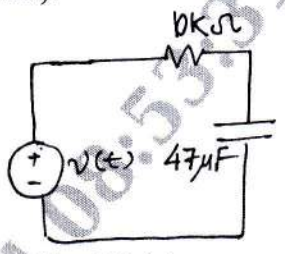

Fig. Q8 (b) **(08 Marks)**

c. State and prove the initial value theorem of Laplace's transform. **(05 Marks)**

Module-5

9 a. A balanced, 3 phase, voltage 400 V, RYB sequence drives a delta connected load of $Z_{RY} = 10\angle 60^\circ\ \Omega$, $Z_{YB} = 20\angle 90^\circ\ \Omega$ and $Z_{BR} = 25\angle 30^\circ\ \Omega$. Determine the line currents and total power supplied to the load. **(07 Marks)**

b. Derive expressions for 'Z' parameters of a 2-port network in terms of its 'Y' parameters. **(06 Marks)**

c. Find Y-parameters of the network shown in Fig. Q9 (c) accompanying diagram.

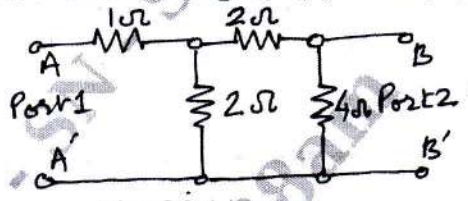

Fig. Q9 (c) **(07 Marks)**

OR

10 a. In a 3 ph, 3 wire $400\angle 0^\circ$ V, R-Y-B system, a 3-phase unbalanced load, $Z_R = 6\angle 0^\circ\ \Omega$, $Z_Y = 6\angle 0^\circ\ \Omega$ and $8\angle -90^\circ\ \Omega$. Compute : line currents and power delivered to the load. **(07 Marks)**

b. What are the conditions for a 2-port network to be termed as reciprocal? Derive the conditions for a network to be reciprocal, in terms of its transmission parameters. **(06 Marks)**

c. Obtain the Y-parameters for the 2-port network shown in accompanying diagram, in Fig. Q10 (c).

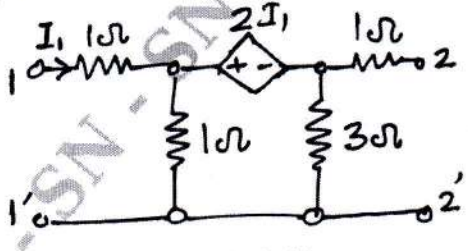

Fig. Q10 (c) **(07 Marks)**

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