CHUKA **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EENG 455: ELECTRICAL NETWORK ANALYSIS

STREAMS: BSc. EENG **TIME: 2 HOURS**

DAY/DATE: TUESDAY 09/04/2024 **8.30 A.M. – 10.30 A.M.**

INSTRUCTIONS

- This examination paper contains **FOUR** questions.
- Attempt **compulsory QUESTION ONE** and **any other TWO** questions.

a. Define a PORT as used in electrical circuits and give examples of elements that makes a one port network (3 Marks)

b. Briefly explain what you understand by driving point impedance function (2 Marks)

c. Proof that the equivalent inductance for two parallel aiding inductors can be given by

$L_{eq} = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M}$ (6 Marks)

d. Figure Q1 (d) below is a parallel connected source-free RLC network. find v(t) if the initial conditions are $v_c(0) = 0$, $i_L(0) = -10A$. Sketch its corresponding v(t) characteristic and comment on the type of damping in this case (7 Marks)

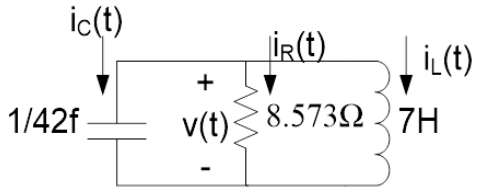

Figure Q1 (d)

e. Find the transmission parameters for the circuit shown in figure Q1 (e) below

(6 Marks)

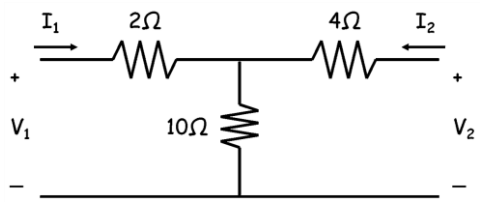

Figure Q1(e)

f. The total inductance of two coils connected in series cumulatively is 1.6 H and connected differentially is 0.0.4 H. The self-inductance of one coil is 0.6 H. Calculate (6 Marks)

(i) the mutual inductance and

(ii) the coupling coefficient.

QUESTION TWO (20 MARKS)

a. (i) Define the term "Resonance" as used in electrical networks (1 Mark)

(ii) Give three applications of resonance (3 Marks)

b. Starting from basic principles, determine the y-parameters in terms of z-parameters. (7 Marks)

c. Two inductors whose self-inductances are 75 mH and 55 mH respectively are connected in parallel aiding. Their mutual inductance is 22.5 mH. Calculate the effective inductance of the parallel combination. (3 Marks)

d. Find the hybrid parameters for the two-port network shown in figure Q2 (d) below. (6 Marks)

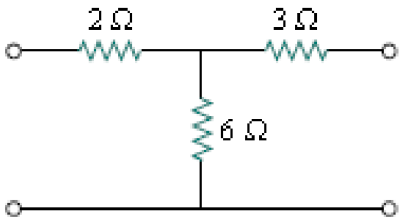

Figure Q2 (d)

QUESTION THREE (20 MARKS)

a. Define the term "Bandwidth" (1 Mark)

b. Explain what you understand by coefficient of coupling and give two of its properties (3 Marks)

c. Show that the condition for symmetry for z-parameters can be given as $Z_{11}=Z_{22}$ (5 Marks)

d. A circuit having a resistance of 4.0Ω with an inductance of 0.5 H and variable capacitance in series is connected across a 100 V, 50 Hz supply. Calculate: (6 Marks)

(i) The capacitance required to attain resonance

(ii) Voltage across the inductance and the capacitance at resonance

(iii) The Q factor of the circuit

e. Two inductive coupled coils have self-inductance of L1=50 mH and L2=200 mH. The coupling coefficient is 0.5. (5 Marks)

(i) Find the mutual inductance

(ii) The maximum possible value of M

QUESTION FOUR (20 MARKS)

a. Explain the term Dynamic impedance (1 Mark)

b. What is the dynamic impedance for an ideal tank circuit with Rs=0 shown the figure Q4 (b) below (2 Marks)

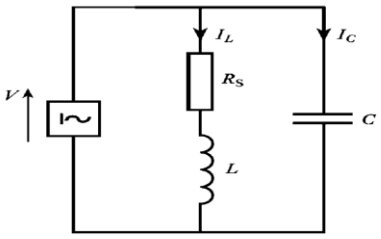

Figure Q4 (b)

c. Starting from basic principles, show that the condition for transmission lines is A=D (6 Marks)

d. In the parallel RLC circuit shown in figure Q4 (d) below, R=8 kΩ, L=0.2 mH and C=8 μF. (6 Marks)

(i) Calculate ω_r, Q and BW

(ii) Find $\omega_1$and ω_2

(iii) Determine the power dissipated at ω_r, $\omega_1$and ω_2

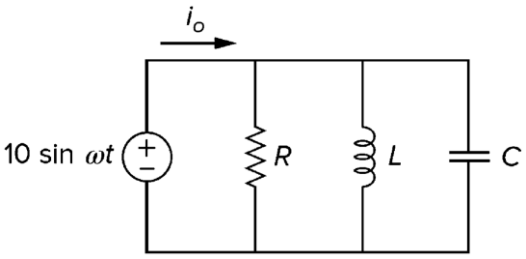

Figure Q4 (d)

e. Find the Y-parameters of the circuit shown in figure Q4 (e) below. (5 Marks)

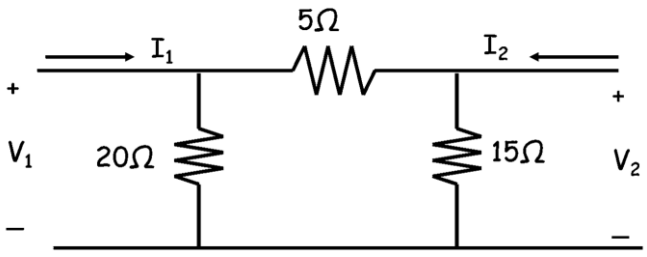

Figure Q4 (e)

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