DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

SUPPLEMENTARY/SPECIAL UNIVERSITY EXAMINATIONS – 2020/2021

FIRST YEAR SUPPLEMENTARY/SPECIAL EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING, BACHELOR OF EDUCATION IN TECHNOLOGY (ELECTRICAL AND ELECTRONIC) ENGINEERING, AND BACHELOR OF SCIENCE IN TELECOMMUNICATION AND INFORMATION ENGINEERING

EEE & TIE 1202: CIRCUIT NETWORK THEORY

DATE: OCTOBER 2021 TIME: 2 Hours

INSTRUCTIONS

This paper consists of **FIVE** questions. Answer questions **ONE** and **ANY OTHER TWO**.

QUESTION ONE — 30 marks

a) Explain the two general approaches to network analysis giving examples

6 marks

b) Given the circuit (Fig 1b) and J=5 A; E_0=20 V; R_1=4 Ω; R_2=2.4 Ω; R_3=1.6 Ω; R_4=6 Ω., Find the values of all currents

6 marks

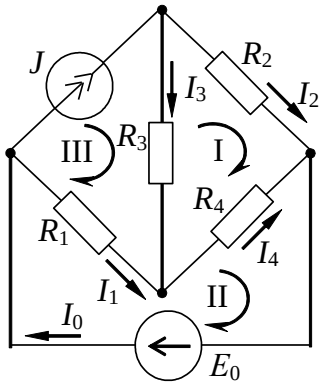

Fig. 1b

c) Explain the Kirchhoff's first and second law

6 marks

d) The equation of an alternating current is given by $i = 42.42 \sin 628t$. Calculate its i) Maximum value ii) Frequency iii) RMS value iv) Average Value v) Form Factor.

5 marks

e) Write the polar form of voltage given by, $V = 100 \sin\left(100\pi + \frac{\pi}{6}\right) V$

2 marks

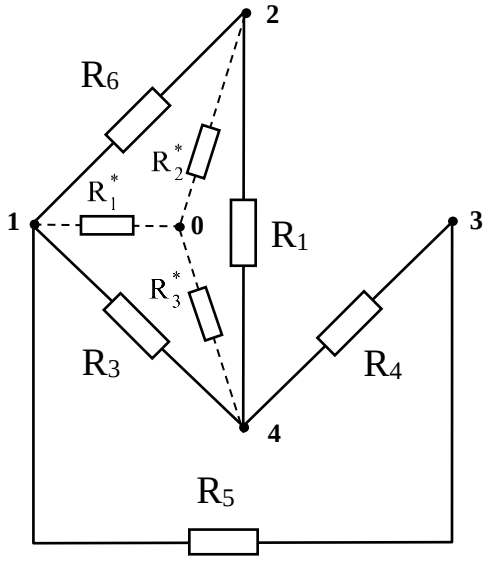

Fig. 1f

f) Transform delta resistances R_1, R_3, R_6 to star resistances R_1^*, R_2^*, R_3^*:(see fig 1f) and then solve for equivalent resistance given that $R_1 = R_4 = 5\ \Omega$, $R_3 = R_6 = 4\ \Omega$, $R_5 = 3\ \Omega$,

5 marks

QUESTION TWO — 20 marks

a) Given the circuit parameters of circuit Fig 2a as: $R_1 = R_4 = 5\ \Omega$, $R_2 = R_3 = R_6 = 4\ \Omega$, $R_5 = 3\ \Omega$, $R_7 = 6\Omega$, $E_1 = 42$ V, $E_2 = 50$V, $E_3 = 40$V, $E_4 = 60$V, $E_5 = E_7 = 20$V, I = 4 A

i. Write the system equation according to Kirchhoff's Current law for node 1,2, and 3.

2 marks

ii. Write the system equation according to Kirchhoff's Voltage Law for loop 1, loop 2, and loop 3.

3 marks

iii. Find the value of all currents using the current loop method.

10 marks

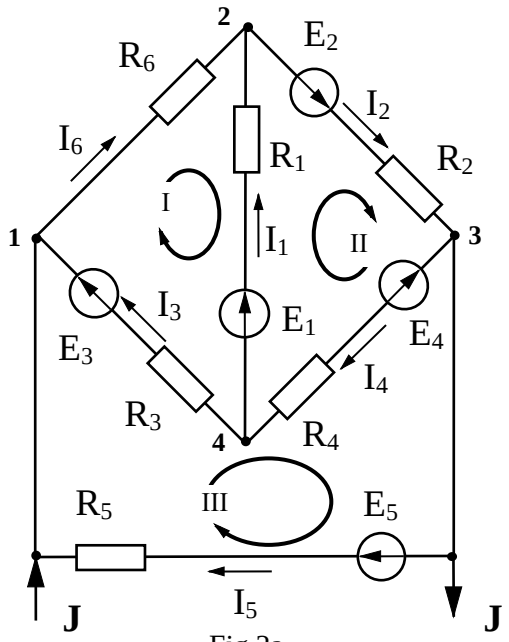

Fig 2a.

b) Two a.c. Voltages are represented by: $v_1(t) = 30\sin*(314t + 45°)$, $v_1(t) = 60\sin*(314t + 60°)$, Calculate the resultant voltage v(t) and express in the form $v(t) = V_m \sin*(314t + \varphi)$,

5 marks

QUESTION THREE **20 marks**

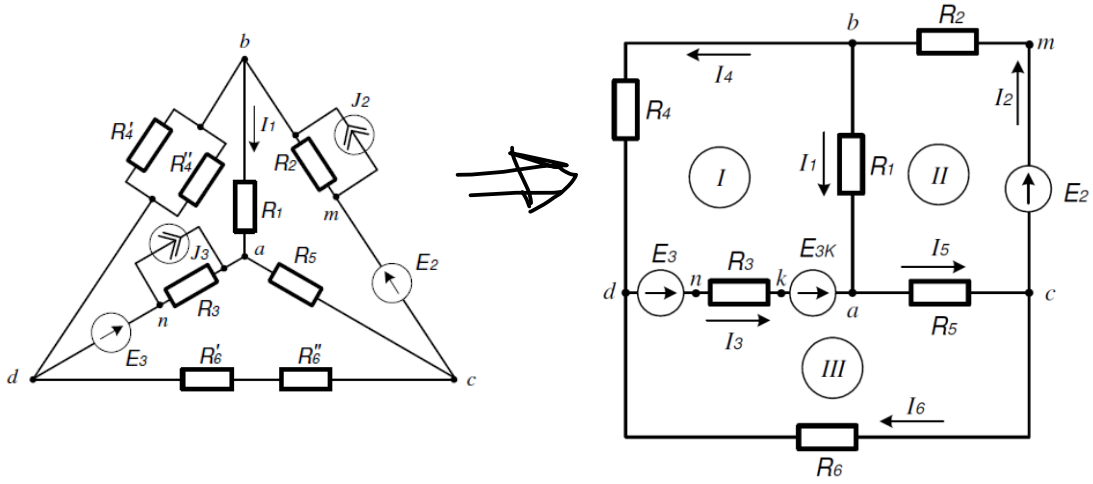

Fig 3a.

a) Given that, the circuit parameters: $R_1 = 20\ \Omega$, $R_2 = 80\ \Omega$, $R_3 = 100\ \Omega$, $R_4' = 70\ \Omega$, $R_4'' = 70\ \Omega$, $R_6' = 24\ \Omega$, $R_6'' = 16\ \Omega$, $R_5 = 150\ \Omega$, $E_2 = 100$V, $E_3 = 150$V, $I_2 = 0$ A, $I_3 = 1$ A, find the value of all currents (I_1 to I_6) using Nodal method where reference node is taken as V_d (fig 3a).

16 marks

b) Write 4 ways of representing a.c. Voltage, given by a magnitude of 5V and frequency 50 Hz.

4 marks

QUESTION FOUR — 20 marks

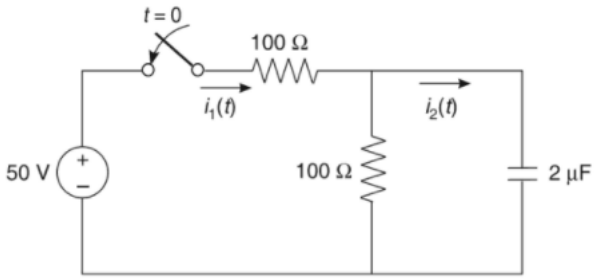

Fig 4a.

a) Solve for $I_1(t)$ and $I_2(t)$ in the circuit shown when the switch is closed at t=0, using the Laplace Transformation method (fig 4a)

15 marks

b) Find the current I_1, I_2, and I_3 shown in the circuit (fig.4b), If V=120 B, R_1=18 Ω, R_2=30 Ω, R_3=2 Ω.

5 marks

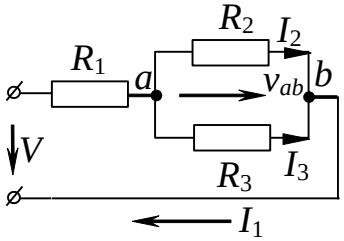

Fig 4b.

QUESTION FIVE — 20 marks

a) Find the values of currents in the circuit (Fig 5a) using the Nodal method given that E_1=20V, E_2=24 V, E_3=12 V, R_1=R_3=R_4=2 Ω, R_2=8 Ω, R_5=R_6=4 Ω. And taking φ_1=0 (reference node)

8 marks

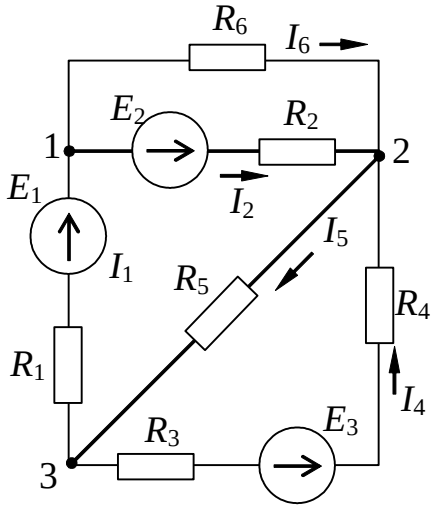

Fig 5a.

b) For Fig 5b, Let the switch be closed at t=0 so that the series RL circuit is excited by the DC voltage V. Find the equation for the current using the Classical method.

8 marks

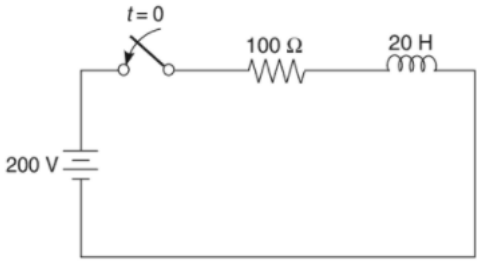

Fig 5b.

c) Discuss the steps to achieve Thevenin equivalent circuit.

4 marks