THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND COMMUNICATIONS ENGINEERING

SECOND SEMESTER EXAMINATION (2023)

EE223 – CIRCUIT THEORY

ELECTRICAL ENGINEERING – YEAR 2 (DEGREE)

TIME ALLOWED: 3 HOURS

INFORMATION FOR STUDENTS:

- You have TEN (10) minutes to read the paper. You must NOT begin writing during this time.
- All answers must be written in the ANSWER BOOK supplied. COMPLETE THE DETAILS REQUIRED ON THE FRONT COVER OF YOUR ANSWER BOOK. DO THIS NOW.
- Drawing instruments and calculators are permitted.
- Answer ANY FIVE (5) out of the EIGHT (8) questions provided. Chosen question of your preference can be done in any order. (First FIVE (5) questions will be marked if more than FIVE questions are being answered.
- All questions carry equal TEN (10) marks each. Total marks is out of FIFTY (50).
- If you are found cheating in the examination, the penalties specified by the University shall apply.
- Switch OFF all mobile phones.

Question 1 **Capacitors and Inductors** **[10 marks]**

a) The voltage across a 200mH inductor is given by:

$v(t) = 3t^2 + 2t + 4\ V \qquad for\ \ t > 0$

Determine the current *i(t)* through the inductor. Assume that i(0) = 1A (5 marks)

b) At $t = 0$, the voltage across a 25-mF capacitor is 10V. Calculate the voltage across the capacitor for $t > 0$ when current $5t$ mA flows through it. (5 marks)

Question 2 **KVL,KCL and Equivalent Resistance** **[10 marks]**

a) Obtain v1 and v3 in the circuit given below in Figure 1 (5 marks)

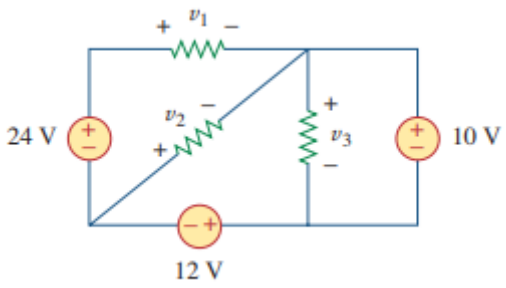

Figure 1

b) Find the equivalent resistance Rab in the circuit of figure 2. (5 marks)

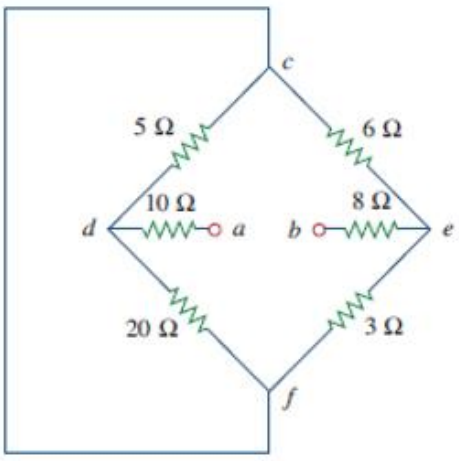

Figure 2

Question 3 **Second-order Circuits** **[10 marks]**

Derive the second-order differential equation for the circuits shown in Figure 3. (10 marks)

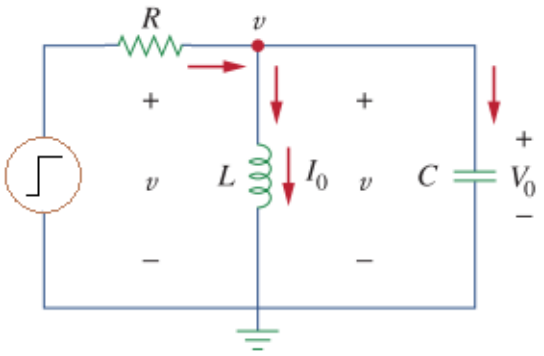

Figure 3

Question 4 **Impedance and Phasors** **[10 marks]**

Calculate the value of Z_{ab} in the network given below in figure 4. (10 marks)

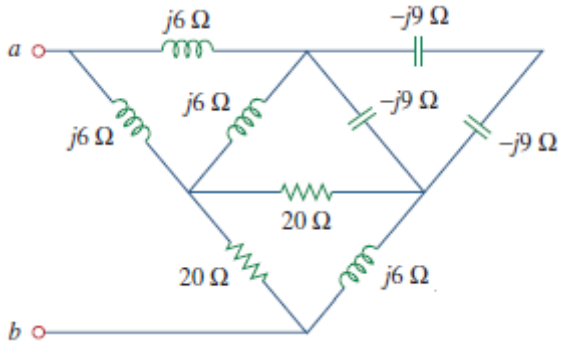

Figure 4

Question 5 **RLC voltage and current** **[10 marks]**

a) A parallel RLC circuit has the node equation

$$\frac{dv}{dt} + 50v + 100\int v\,dt = 110\cos(377t\text{-}10^{o})\text{ V}$$

Determine v(t) using the phasor method. You may assume that the value integral at t = -∞ is zero. (5 marks)

b) The loop equation for a series *RLC* circuit gives.

$$\frac{di}{dt} + 2i + \int_{-\infty}^{t} i\,dt = \cos 2t\text{ A}$$

Assuming that the value of the integral at t = -∞ is zero, find i(t) using the phasor method. (5 marks)

Question 6 **Power Analysis** **[10marks]**

Power analysis is of paramount importance. The instantaneous power, in watts, is the power at the instant of time and the average power, in watts, is the average of the instantaneous power over one period.

Oscilloscope measurements indicate that the peak voltage across a load and the peak current through it are, respectively, $210\angle 60°$ V and $8\angle 25°$A. Determine: (a) the real power (b) the apparent power (c) the reactive power (d) the power factor.

Question 7 **Three-Phase Circuits** **[10 marks]**

Calculate the line currents in the three-wire Y-Y system of Figure 5 below.

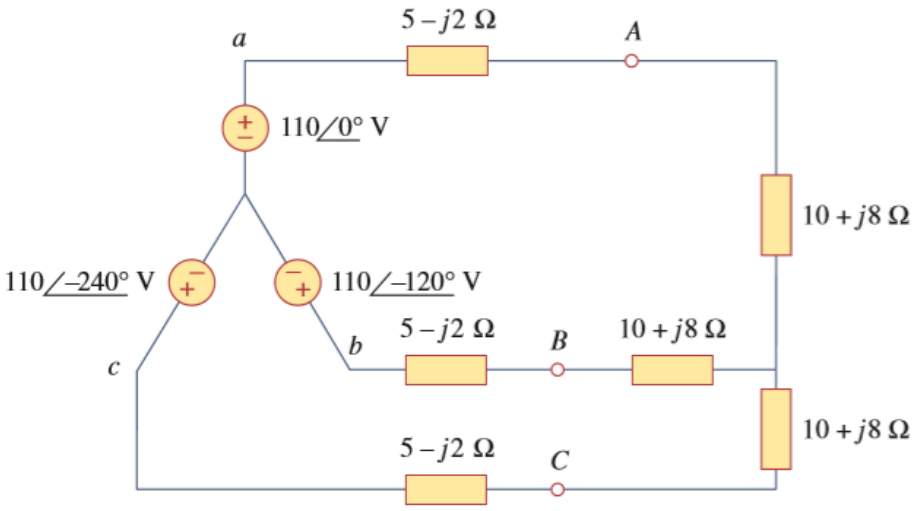

Figure 5

Question 8 **KVL and Nodal Analysis** **[10 marks]**

Determine v_o in the circuit shown in Figure 6.

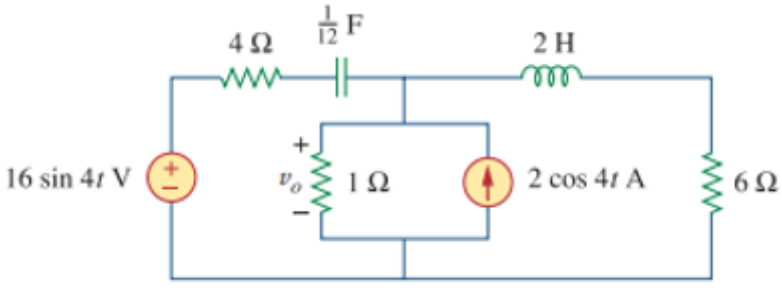

Figure. 6