THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND COMMUNICATIONS ENGINEERING

SECOND SEMESTER EXAMINATION (2022)

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 ALL FIVE (5) questions.
- 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 **Basic Circuit Analysis Techniques** **[10 marks]**

Kirchhoff's current law (KCL) is applied in nodal analysis, while Kirchhoff's voltage law (KVL) in mesh analysis of circuits.

(a). Determine I_b in the circuit in Fig. 1 using nodal analysis. **[5 marks]**

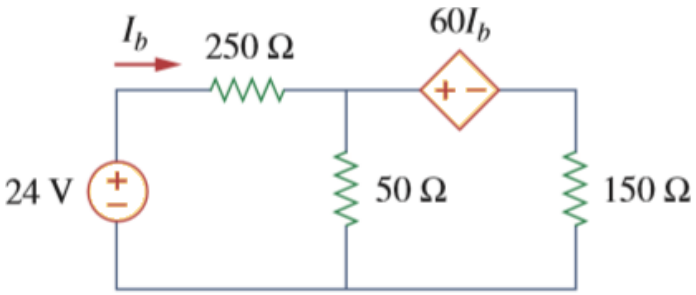

Fig. 1(a)

(b) Solve for the current I in the circuit of Fig. 1(b) using Thevenin's theorem. **[5 marks]**

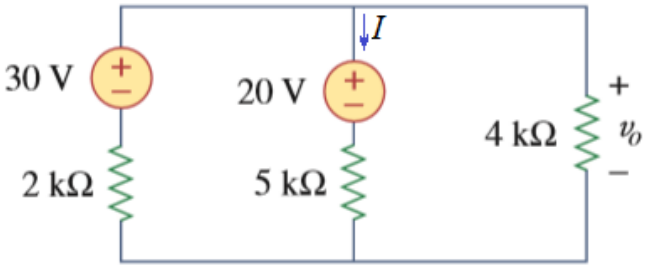

Fig. 1(b)

Question 2 **Second-order Circuits**

Derive the second-order differential equation for the circuits shown in Fig. 2. **[10 marks]**

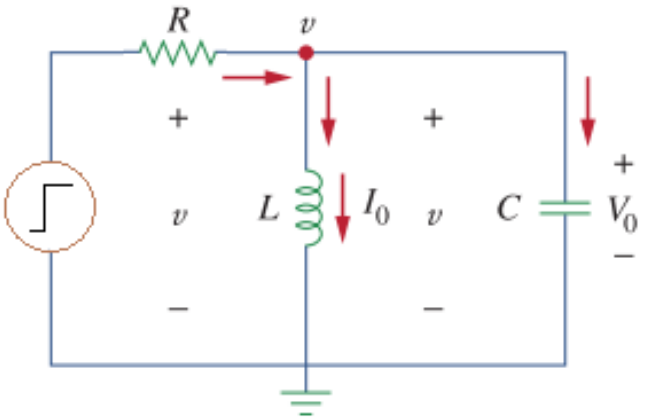

Fig. 2

Question 3 **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 4 **Three-Phase Circuits** **[10 marks]**

Calculate the line currents in the three-wire Y-Y system of Fig. 4.

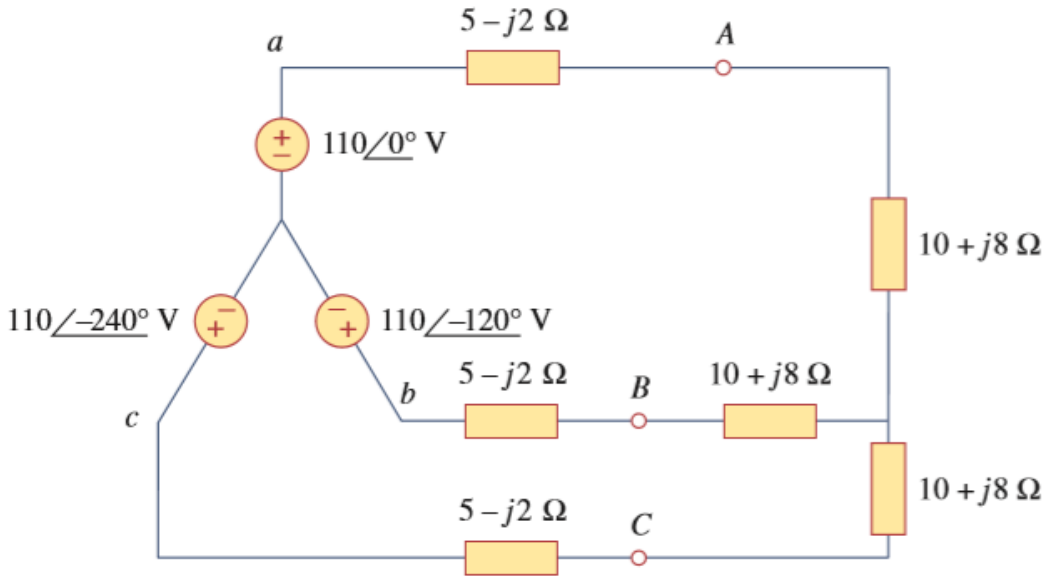

Fig. 4

Question 5 **Impedance and Admittance** **[10 marks]**

Find current I_o in the circuit shown in Fig. 5.

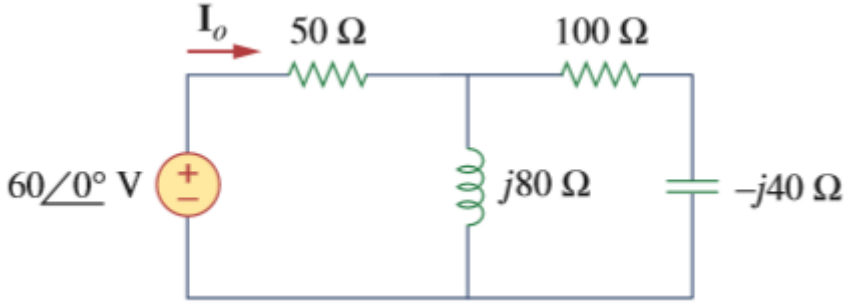

Fig. 5