FACULTY OF EXPLORATION AND EARTH SCIENCES

DEPARTMENT OF SURVEYING AND GEOMATICS

ELECTRICAL PRINCIPLES

ESG 1206 / EMG 1203 / EMN 1203

Final Examination Paper

September 2023

This examination paper consists of 5 pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Mr. K. Garapo

INSTRUCTIONS

1. Answer all questions in Section A and any three questions from Section B.
2. Begin each solution for a new question on a new page and show all working.
3. Section A consists of a **four** question carrying **10 marks** each.
4. Section B consists of **four** questions carrying **20 marks** each.
5. Use of calculators is permissible.

Additional Requirements

None

MARK ALLOCATION

Questions	Marks
Question 1	**10**
Question 2	**10**
Question 3	**10**
Question 4	**10**
Question 5	**20**
Question 6	**20**
Question 7	**20**
Question 8	**20**
Total Attainable	**100**

SECTION A (40 Marks): Answer all questions

Question 1

Given that the delta and star circuits shown in Figure A1 are equivalent, determine the values of L_a, L_b and L_c, given that $L_1 = 200$ mH, $L_2 = 500$ mH and $L_3 = 300$ mH. [10]

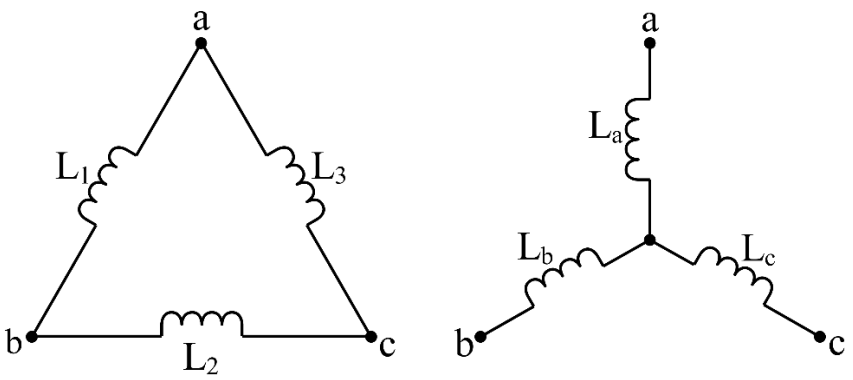

Figure A1

Question 2

Given the circuit shown in Figure B3, apply the superposition theorem to determine the current flowing through the 10 Ω resistor. [10]

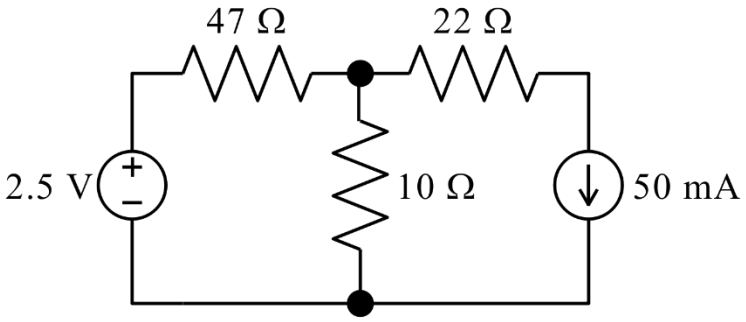

Figure A2

Question 3

a) State the truth tables for each of the following two-input logic gates:

i) NAND, [3]

ii) NOR. [3]

b) Draw the logic circuit described by the following logic equation: $O = AB + \overline{B}\overline{C}$ using basic two-input logic gates. [4]

Question 4

Determine the total power dissipated by three 68 Ω resistors when connected to a 440 V, 3-phase supply in the configurations:

i) star, [5]

ii) delta. [5]

SECTION B (60 Marks): Answer any three questions

Question 5

Use mesh analysis to determine the current flowing through each of the seven resistors in the planar circuit shown in Figure B1. [20]

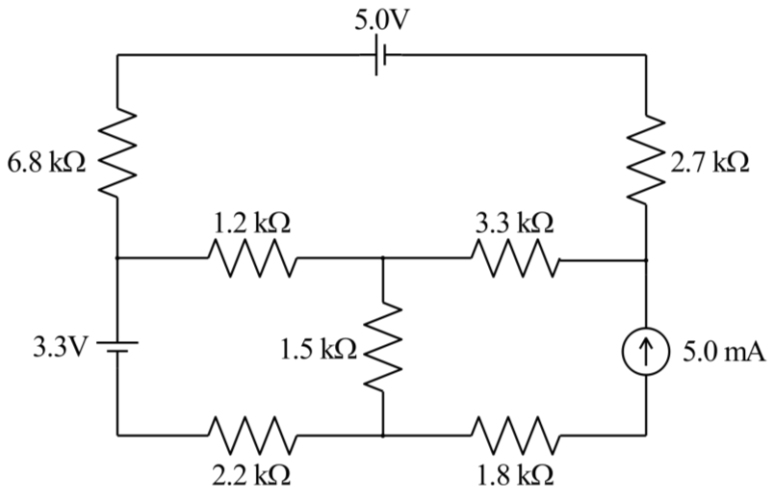

Figure B1

Question 6

Given the circuit of an ideal OPAMP, as shown in Figure B2, determine the output V_{out}, [20]

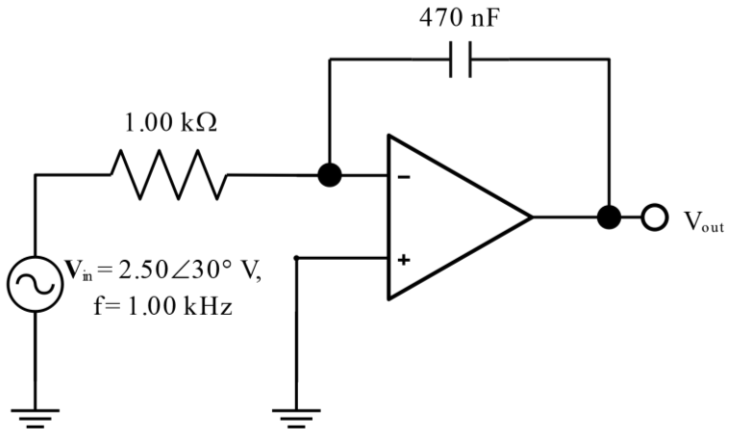

Figure B2

Question 7

Given the oscillogram shown in Figure A2, answer the questions that follow.

a) Determine the i) *peak voltage*, ii) *period* and iii) *frequency* of the AC component of the signal. [9]

b) Determine the value the DC component of the signal. [5]

c) The voltage phasor of the AC component of the signal. [6]

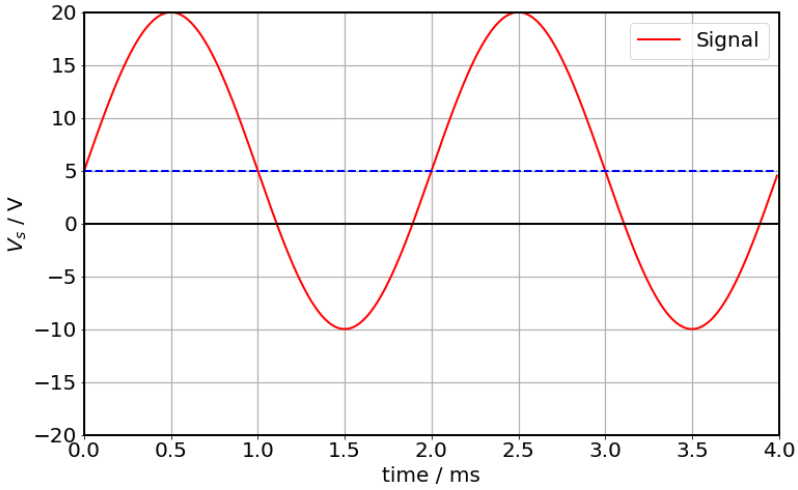

Figure B3

Question 8

a) Determine Norton's equivalent circuit for the planar circuit shown in Figure B4, given that Z_L is the load of interest. [15]

b) Deduce the value of Z_L for maximum power to be transferred to the load. [5]

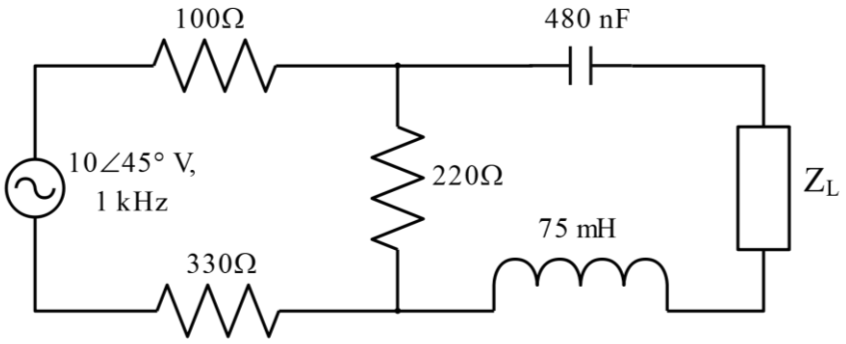

Figure B4