LAIKIPIA UNIVERSITY

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

SECOND YEAR EXAMINATION FOR THE DEGREE BACHELOR OF SCIENCE (COMPUTER SCIENCE)

PHYS 223: BASIC ELECTRONICS

STREAM: R ***TIME: 2 HRS***

DAY: WED [11.30AM – 1.30PM] ***DATE: 14/12/2022***

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

INSTRUCTIONS TO CANDIDATES:

This paper consists of Five Questions.

Question ONE is Compulsory. Answer Question one and any other two questions.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used / calculated must be stated clearly.

QUESTION ONE.

(a) A direct current of 4 A flows into a previously uncharged 20 mF capacitor for 3 ms. Determine the pd between the plates. (3 marks)

(b) Two parallel plates having a pd of 200 V between them are spaced 0.8 mm apart. What is the electric field strength? Find also the flux density when the dielectric between the plates is: (4 marks)

i) air

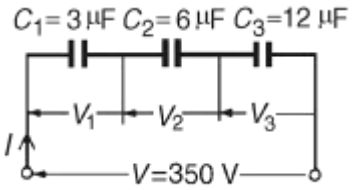
ii) polythene of relative permittivity 2.3

(c) Capacitances of 3 mF, 6 mF and 12 mF are connected in series across a 350 V supply. Calculate (6 marks)

i. The equivalent circuit capacitance

ii. The charge on each capacitor

i) the pd across each capacitor.



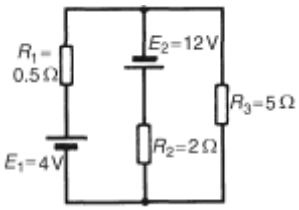
(d) Determine, using Kirchhoff's laws, each branch current for the network shown in Figure below (6 marks)

(e) For the circuit shown in Figure below, find, using the superposition theorem. (6 marks)

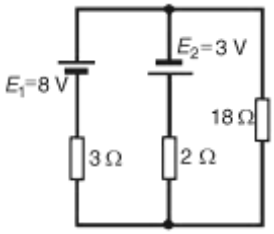
i) The current flowing in and the pd across the 18 Ω resistor

ii) The current in the 8 V battery

iii) The current in the 3 V battery.



f) For the network shown in Figure (a) below, determine the current in the 0.8 Ω resistor using The´venin's theorem. (5 marks)

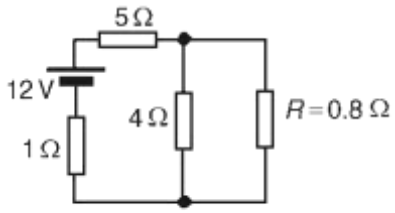


QUESTION TWO (20 marks)

(a) State the maximum power transfer theorem (3 marks)

(b) A d.c. source has an open-circuit voltage of 30 V and an internal resistance of 1.5 Ω. State the value of load resistance that gives maximum power dissipation and determine the value of this power. (5 marks)

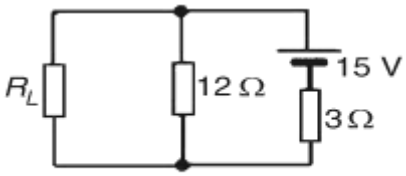
c. Find the value of the load resistor R_L shown in the Figure (a) below that gives maximum power dissipation and determine the value of this power. (6 marks)



(a)

d. The circuit diagram of the Figure below shows dry cells of source e.m.f. 6 V, and internal resistance 2.5 Ω. If the load resistance R_L is varied from 0 to 5 Ω in 0.5 Ω steps, calculate the power dissipated by the load in each case. Plot a graph of R_L (horizontally) against power (vertically) and determine the maximum power dissipated.

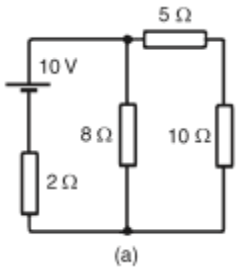
(6 marks)



(a)

QUESTION THREE (20 marks)

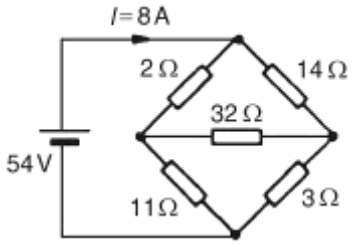
(a) Use Norton's theorem to determine the current flowing in the 10 Ω resistor for the circuit shown in Figure (a) below. (6 marks)



(a)

(b) Differentiate between Kirchhoff's Current and Voltage Law. (4 marks)

(c)For the bridge network shown below, determine the currents in each of the resistors. (6 marks)



(d)Describe at least FOUR ways that you can increase the capacitance of a capacitor. (4 marks)

QUESTION FOUR (20 marks)

(a) An alternating voltage is given by v = 75 sin(200πt - 0.25) volts. Find;- (6 marks)

i) the amplitude
ii) the peak-to-peak value
iii) the rms value
iv) the periodic time
v) the frequency
vi) the phase angle (in degrees and minutes) relative to 75 sin 200πt

(b) A coil has an inductance of 40 mH and negligible resistance. Calculate its inductive reactance and the resulting current if connected to: (4 marks)

i. a 240 V, 50 Hz supply

i) a 100 V, 1 kHz supply.

(c) A coil of inductance 318.3 mH and negligible resistance is connected in series with a 200 Ω resistor to a 240 V, 50 Hz supply. Calculate (6 marks)

(i) the inductive reactance of the coil
(ii) the impedance of the circuit
(iii) the current in the circuit
(iv) the p.d. across each component
(v)the circuit phase angle.

(d) A filter in the form of a series L–R–C circuit is designed to operate at a resonant frequency of 5 kHz. Included within the filter is a 20 mH inductance and 10 Ω resistance. Determine the bandwidth of the filter. (4 marks)

QUESTION FIVE (20 marks)

(a) Electrical equipment in an office takes a current of 13 A from a 240 V supply. Estimate the cost per week of electricity if the equipment is used for 30 hours each week and 1 kWh of energy costs Ksh. 7 (5 marks)

(b) Calculate the cross-sectional area, in mm^2, of a piece of copper wire, 40 m in length and having a resistance of 0.25 Ω. Take the resistivity of copper as 0.02×10^{-6} Ω m (5 marks)

(c) The following three impedances are connected in series across a 40 V, 20 kHz supply: (i) a resistance of 8 Ω, (ii) a coil of inductance 130 mH and 5 Ω resistance, and (iii) a 10 Ω resistor in series with a 0.25 mF capacitor. Calculate (6 marks)

a. the circuit current
b. the circuit phase angle
c. the voltage drop across each impedance.

(d) A series circuit comprises a coil of resistance 2 Ω and inductance 60 mH, and a 30 mF capacitor. Determine the Q- factor of the circuit at resonance. (4 marks)