



UNIVERSITY EXAMINATIONS

SECOND SEMESTER 2023/2024 ACADEMIC YEAR

**FIRST YEAR EXAMINATION FOR THE DEGREE OF
BACHELOR OF COMPUTER SCIENCE**

COMP 126: PRINCIPLES OF ELECTRONICS

STREAM: R

TIME: 2 HRS

DAY: THURSDAY [8.30 – 10.30 A.M]

DATE: 11/04/2024

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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Mission: To serve students and society through research, education, scholarship, training, innovation, outreach and consultancy

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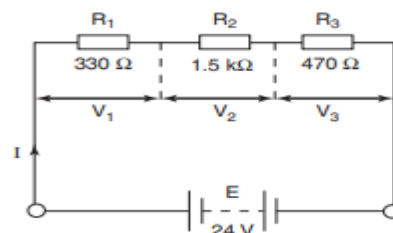
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INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS**QUESTION ONE**

- a) Given a circuit with a resistance of 50 ohms and a current of 2 amps, calculate the voltage across the circuit. b. A resistor has a voltage drop of 12 volts across it and a current flowing through it of 0.5 amps. Calculate the resistance of the resistor. **(4 Marks)**
- b) In a circuit with three resistors connected in series and a 12-volt battery, if one resistor has a voltage drop of 4 volts and another resistor has a voltage drop of 6 volts, calculate the voltage drop across the third resistor. b. In a circuit with two loops and two batteries, one with a voltage of 9 volts and the other with a voltage of 6 volts, calculate the total voltage drop across the circuit. **(5 Marks)**
- c) Calculate the total resistance of three resistors connected in series with values of 10 ohms, 20 ohms, and 30 ohms. b. Calculate the total resistance of three resistors connected in parallel with values of 10 ohms, 20 ohms, and 30 ohms. **(4 Marks)**
- d) A current of 200 mA flows through a resistance of 750 ohms for a time of 5 minutes. Calculate (a) the p.d. developed, and (b) the energy dissipated. **(4 Marks)**
- e) In a series circuit with three resistors of 5 ohms each, calculate the total resistance. b. In a parallel circuit with three resistors of 5 ohms each, calculate the total resistance. **(4 Marks)**
- f) Calculate the capacitance of a capacitor that has a charge of 6 microcoulombs and a voltage of 12 volts. b. A capacitor is connected in series with a resistor in an RC circuit. If the resistance is 100 ohms and the capacitance is 0.01 farads, calculate the time constant. **(4 Marks)**
- g) For the circuit shown below calculate (a) the circuit resistance, (b) the circuit current, (c) the p.d. developed across each resistor, and (d) the power dissipated by the complete circuit **(5 Marks)**

$$E = 24\text{V}; R_1 = 330\ \Omega; R_2 = 1500\ \Omega; R_3 = 470\ \Omega$$



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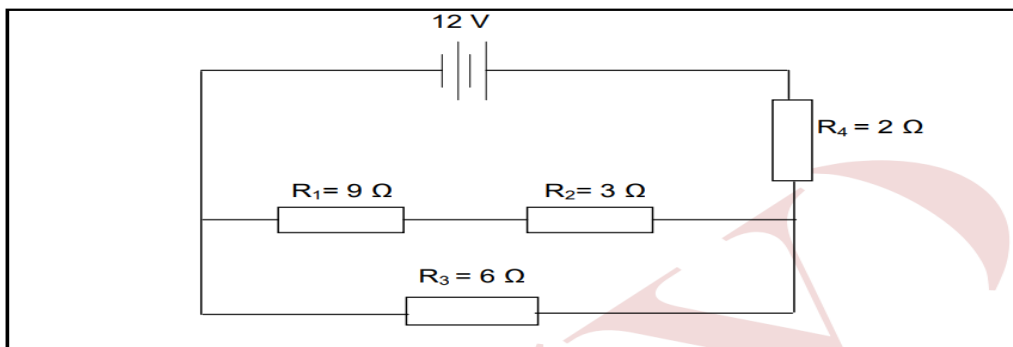
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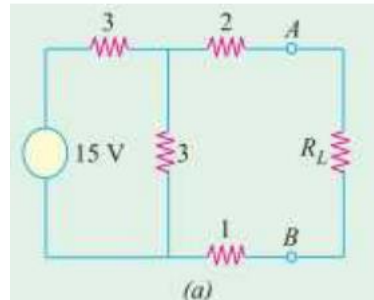
QUESTION TWO (20 MARKS)

- a) A thermistor has a resistance of 100 ohms at 25°C and a resistance of 50 ohms at 50°C. Calculate its temperature coefficient. b. Calculate the resistance of a copper wire that has a length of 10 meters and a diameter of 2 millimeters, given that the resistivity of copper is 1.68×10^{-8} ohm-meters. **(4 Marks)**
- b) Explain each of the following terms: Emf of cells and Terminal voltage **(4 Marks)**
- c) Explain the application of Ohm's law in the calculation of resistance, current and voltage in direct current circuits. The use of formulae to evaluate power and energy **(4 Marks)**
- d) Explain the application of Kirchhoff's voltage and current laws together with a demonstration of potential and current division using circuit simulation software. **(4 Marks)**
- e) Refer to the circuit diagram below and calculate: **(4 Marks)**
- The total resistance of the circuit The total current of the circuit
 - The current flowing through the 9 Ω resistor
 - The total current of the circuit if the 3 Ω resistor is open-circuit

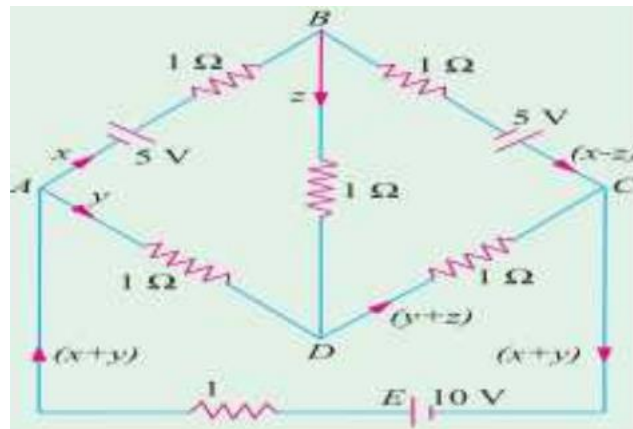
**QUESTION THREE (20 MARKS)**

- a) Two capacitors of 30 μF and 10 μF are connected in series across a 12 V supply. Calculate The total capacitance and The potential difference across the 10 μF capacitor **(4 Marks)**
- b) Explain the concept of balanced load. **(2 Marks)**
- c) What are the advantages of 3 phase circuits over single phase circuits? **(2 Marks)**
- d) What is the difference between a conductor and an insulator? **(2 Marks)**
- e) Explain the difference between AC and DC voltage. **(2 Marks)**

- f) In the network shown below (a), find the value of R such that maximum possible power will be transferred to R_L . Find also the value of the maximum power and the power supplied by source under these conditions. **(4 Marks)**



- g) State and explain Kirchoff's laws. Determine the current supplied by the battery in the circuit shown below **(4 Marks)**



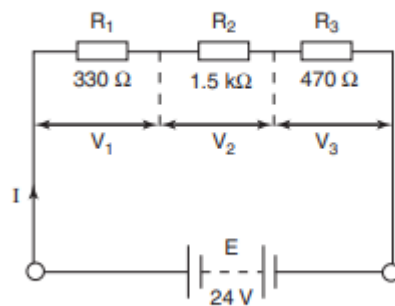
QUESTION FOUR (20 MARKS)

- a) Design a voltage divider circuit using resistors to obtain a specific output voltage from a given input voltage, considering factors such as load impedance and tolerance. **(4 Marks)**
- b) Discuss the principles behind the operation of operational amplifiers (op-amps) and their applications in various electronic circuits, such as amplifiers, filters, and integrators. **(4 Marks)**
- c) Compare and contrast the characteristics and applications of different types of semiconductor diodes, including rectifier diodes, Zener diodes, and light-emitting diodes (LEDs). **(4 Marks)**
- d) Discuss the principles of operation of digital-to-analog converters (DACs) and analog-to-digital converters (ADCs) and their applications in signal processing and communication systems. **(4 Marks)**
- e) Discuss the advantages and disadvantages of digital signal processing (DSP) compared to analog signal processing. **(4 Marks)**

QUESTION FIVE (20 MARKS)

- a) For the circuit shown below calculate (a) the circuit resistance, (b) the circuit current, (c) the p.d. developed across each resistor, and (d) the power dissipated by the complete circuit **(8 Marks)**

$$E = 24\text{V}; R_1 = 330\ \Omega; R_2 = 1500\ \Omega; R_3 = 470\ \Omega$$



- b) Two resistors are connected in series across a battery of emf 12 V. If one of the resistors has a value of 16 Ω and it dissipates a power of 4 W, then calculate (a) the circuit current, and (b) the value of the other resistor. **(4 Marks)**
- c) A Wheatstone Bridge type circuit is shown below Determine (a) the p.d. between terminals B and D, and (b) the value to which R4 must be adjusted in order to reduce the current through R3 to zero (balance the bridge). **(8 Marks)**

