BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

AEH 103

Department Of Engineering and Physics
Bachelor of Science (Honours) in Agricultural Engineering
Electrical and Electronic Principles

3 HOURS (100 MARKS)

INSTRUCTIONS

Answer any **FOUR** questions. Each question carries 25 marks.

Question 1
    a. Distinguish between conventional current and electrical current.   **[2 marks]**
    b. A circuit consists of four 100 W lamps connected in parallel across a 230 V supply. Inadvertently, a voltmeter has been connected in series with the lamps. Determine the voltmeter reading if the resistance of the voltmeter is 1500 Ω and that of the lamps under the conditions stated is six times their value when burning normally.   **[8 marks]**
    c. With the aid of diagrams, describe five sources of electricity.   **[15 marks]**

Question 2
    a. For the circuit shown in Figure 1, determine
       i.   Charges on the capacitors,   **[6 marks]**
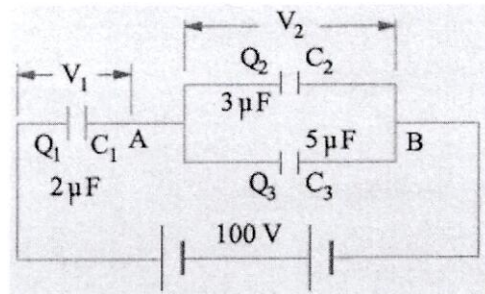   ii.   Potential difference across the capacitors.   **[4 marks]**

Figure 1

    b. Explain five reasons behind high current losses in alternating current circuits than in direct current circuits.   **[15 marks]**

Question 3
    a. Explain the effects of temperature on resistances of pure metals and semi-conductors.   **[4 marks]**
    b. A piece of silver wire has a resistance of 1 Ω. Calculate the resistance of manganin wire of one-third the length and one-third the diameter, if the specific resistance of manganin is 30 times that of silver.   **[9 marks]**
    c. With the aid of neat sketches, explain the four effects of an electric current.   **[12 marks]**

Question 4

a. Explain the Kirchhoff's laws as used in direct current circuits. **[6 marks]**
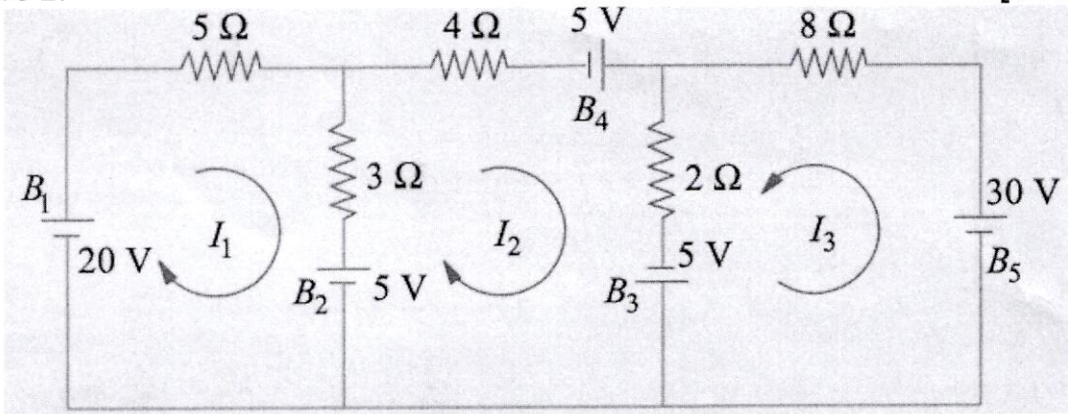b. Determine the current supplied by each battery in the circuit shown in Figure 2. **[10 marks]**

Figure 2

c. In the circuit of Figure 3, find current through 1-Ω resistor using:
   i.   The Thevenin's theorem and **[4 marks]**
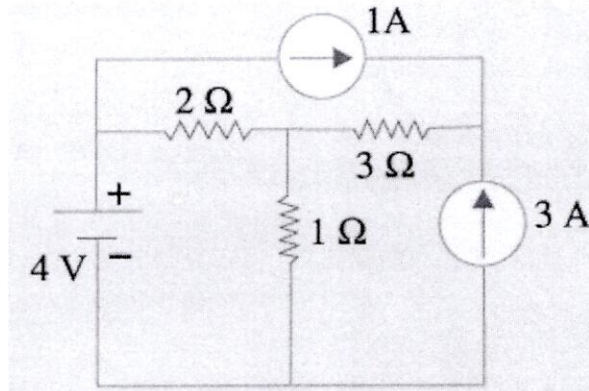   ii. The Superposition theorem. **[5 marks]**

Figure 3

Question 5

a. An hydro-electric station has a turbine of efficiency 86% and a generator of efficiency 92%. The effective head of water is 150 m. Calculate the volume of water used when delivering a load of 40 MW for 6 hours. **[8 marks]**
b. The small identical conducting spheres have charges of 2.0×10^{-9} C and -0.5×10^{-9} C respectively. When they are placed 4 cm apart, calculate:
   i.   the force between them, **[4 marks]**
   ii. the force between them when they are brought into contact and then separated by 4 cm. **[5 marks]**
c. A 120-μF capacitor is connected across a 415-V, 50-Hz supply. Calculate:
   i.   the reactance offered by the capacitor, **[3 marks]**
   ii. the maximum current and **[2 marks]**
   iii. the r.m.s. value of the current drawn by the capacitor. **[3 marks]**

Question 6

a. With the aid of diagrams, describe the two types of bipolar junction transistors. **[8 marks]**

b. Simplify and prepare a truth table for a Boolean function given as

$$Z = ABC + AB\bar{C} + A\bar{B}C$$

[5 marks]

c. Write the Boolean expressions and work out the truth tables for the logic circuits in Figure 4 and Figure 5.
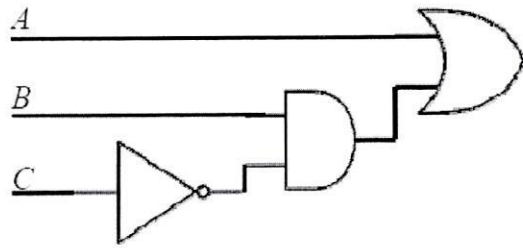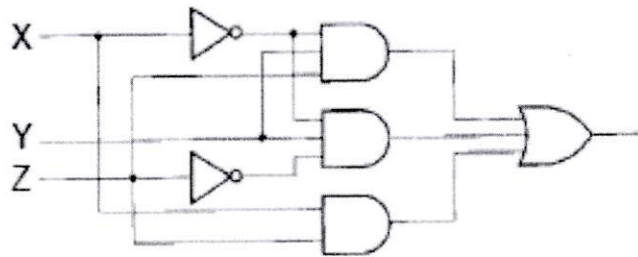
[12 marks]

Figure 4

Figure 5

End of paper