2025

ELECTRONICS — MDC

Paper : CC-1

(Fundamental of Circuit Theory and Electronic Devices)

Full Marks : 75

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***any ten*** questions from ***Group - I, any three*** questions from ***Group - II*** and ***any four*** questions from ***Group - III.***

Group - I

1. Answer ***any ten*** questions : 2×10

(a) Define active and passive circuit elements with one example of each.

(b) What is reverse saturation current?

(c) What are the typical values of the internal resistances of an ideal voltmeter and an ideal ammeter?

(d) State Superposition Theorem.

(e) What is meant by quality factor (Q-factor) of a resonant circuit?

(f) Distinguish between intrinsic and extrinsic semiconductors.

(g) Define mobility of charge carriers.

(h) Why is silicon preferred in integrated circuit (IC) fabrication?

(i) What is Early effect?

(j) Define ripple factor of a rectifier.

(k) What is pinch-off voltage in a JFET?

(l) Define transconductance of a MOSFET.

Group - II

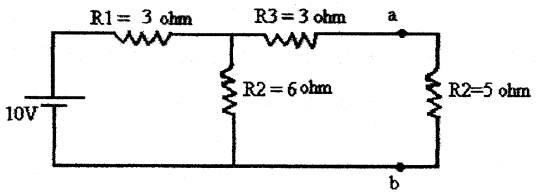
Answer ***any three*** questions.

2. (a) Derive the expression for the growth of current in a DC RL circuit at a time t after the switch is turned on.

(b) Define time constant of the RL circuit. 4+1

3. Explain the formation of a p–n junction with a suitable diagram. Discuss the concept of depletion region and barrier potential. 2+3

4. Using Kirchhoff's laws, determine the mesh currents in the following two-loop resistive circuit : 5



5. Explain the working principle of a Zener diode. How does it act as a voltage regulator? 3+2

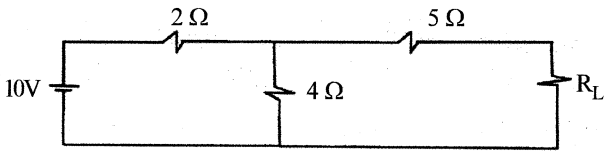
6. (a) Why is BJT called a bipolar device?

   (b) Draw the doping profiles of emitter, base and collector regions of a BJT. 2+3

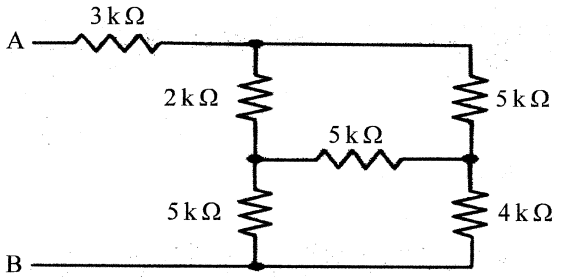
Group - III

Answer ***any four*** questions.

7. (a) Determine the Norton's equivalent of the following circuit and find the current through the load resistance (R_L), when R_L is 15 Ω.



   (b) Determine the equivalent resistance of the following circuit between A and B :



5+5

8. (a) Derive the expression for resonance frequency of a series RLC circuit.

   (b) Define bandwidth and show that bandwidth = R/L for a series resonant circuit.

   (c) What is selectivity of a resonant circuit? 4+4+2

9. (a) Draw and explain the working principle of a full wave rectifier.

(b) Compare a full wave rectifier with a bridge rectifier.

(c) What are load regulation and line regulation? 4+2+(2+2)

10. (a) Derive the relation between α and β of a transistor.

(b) A transistor has $\alpha = 0.98$. Calculate β.

(c) Explain the concept of thermal runaway in a transistor. 4+3+3

11. (a) Compare current gain, voltage gain, input and output impedances of BJT amplifiers in CB, CE and CC modes.

(b) Why JFET is called a unipolar device?

(c) Draw the circuit symbols of a p-channel and an n-channel JFET. What is the meaning of the arrow heads in the symbols? (2+2+2)+2+(1+1)

12. (a) Explain the construction and working of an n-channel enhancement MOSFET.

(b) Draw and explain its drain and transfer characteristics. 5+5
