1 (Sem–1) ECT

2024

ELECTRONICS AND COMMUNICATION TECHNOLOGY

Paper : ECT0100104

(Basic Electronic Circuit and System)

Full Marks : 45

Time : 2 hours

The figures in the margin indicate full marks for the questions.

1. Give answer to the following objective-type questions ***(any five)*** : 1×5=5

   (i) Define linear networks and non-linear networks.

   (ii) Why is the voltage across each resistor same but the current through is different in a circuit ?

   (iii) What is the resistor value of a resistor with colour bands given by green, blue, red and gold ?

(iv) What is a PN junction diode ?

(v) Define peak inverse voltage.

(vi) What is the output frequency of a half-wave rectifier ?

(vii) What is the maximum efficiency of a full-wave rectifier ?

(viii) The most commonly used semiconductor material is

(i) silicon

(ii) germanium

(iii) mixture of silicon and germanium

(iv) None of the above

(ix) For bipolar junction transistor amplifier, the _____ gain typically ranges from a level just less than 1 to a level that may exceed 1000.

(i) voltage

(ii) current

(iii) impedance

(iv) All of the above

(x) At room temperature the current in an intrinsic semiconductor is due to

(i) holes

(ii) electrons

(iii) ions

(iv) holes and electrons

(xi) What is the impedance of a bipolar junction transistor in forward and reverse bias conditions ?

(i) Low and high

(ii) Low and low

(iii) High and high

(iv) High and low

(xii) What is the range of current gain for bipolar junction transistor amplifiers ?

(i) Less than 1

(ii) 1 to 100

(iii) Above 100

(iv) All of the above

2. Give very short answer of the following : ***(any five)*** 2×5=10

(a) Find the expression of energy stored in an inductor.

(b) In a voltage divider circuit two resistors are given as $R_1 = 5K\Omega$ and $R_2 = 7K\Omega$ and are connected in series across a $15V$ supply. Calculate the voltage across R_1 and R_2.

(c) What do the terms 'load regulation' and 'line regulation' refer to in a Zener diode voltage regulator ?

(d) Define the term 'ripple factor' in the context of rectifiers. What is the ripple factor of a full-wave rectifier ?

(e) What is doping ? Which type of semiconductor is formed when silicon is doped with arsenic ?

(f) How is efficiency related to the ripple factor ?

(g) What is biasing ? What are different types of biasing ?

(h) Why are transistors called bipolar junction transistors ? Why are bipolar junction transistors called current-controlled devices ?

(i) Name different types of bipolar junction transistor configurations. How many terminals are there in a transistor ?

(j) What are active, saturation and cut-off regions of transistor characteristics ?

(k) List different types of bipolar junction transistors with proper circuit diagrams.

3. Answer the following : ***(any four)*** 5×4=20

(i) State Kirchhoff's voltage and current laws. Determine the values of R_1, R_2, I_1, I_2 and I_3 for the circuit shown in *Fig.*1 : 1+4=5

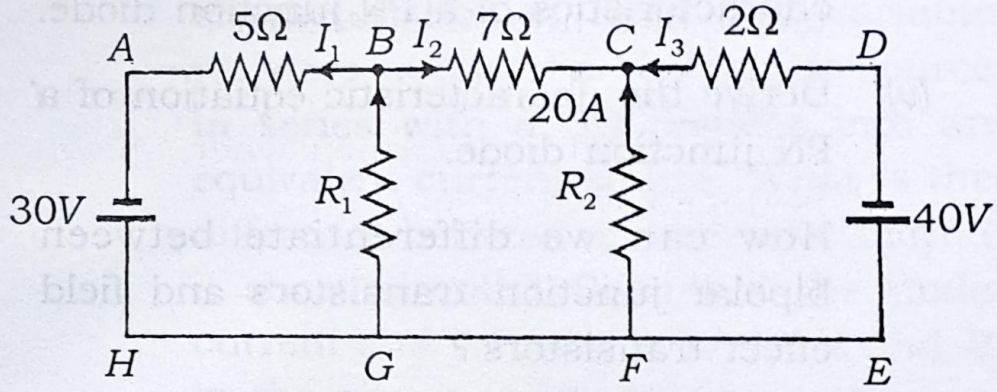

*Fig.*1

(ii) A copper wire has a length of 3*cm* and a cross-sectional area of $1\times10^{-6}m^2$. If the resistivity of copper is $1.68\times10^{-8}\Omega m$, calculate the resistance of the wire. *Fig.* 2 shows a current divider circuit. Find the current across R_1, R_2 and R_3. 2+3=5

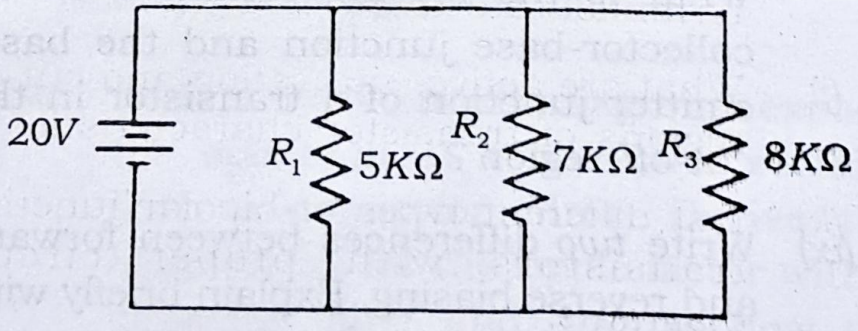

Fig. 2

(iii) Explain the working principle of half-wave rectifier with proper circuit diagram and wave form.

(iv) Discuss briefly about the I-V characteristics of a PN junction diode.

(v) Derive the characteristic equation of a PN junction diode.

(vi) How can we differentiate between bipolar junction transistors and field effect transistors ?

(vii) State the three differences among active region, saturation region and cut-off region. Deduce the relationship between α and β.

(viii) Determine the value of α when $\beta = 100$. What is the most frequently encountered transistor configuration ? What is the biasing condition of the collector-base junction and the base-emitter junction of a transistor in the cut-off region ?

(ix) Write *two* differences between forward and reverse biasing. Explain briefly with the help of appropriate circuit diagrams.

4. Answer the following : ***(any one)*** 10

(a) A circuit has 6 branches and 5 nodes. Calculate the number of meshes present in the circuit. What are the characteristics of fixed and variable resistors ? Convert a 15 *V* voltage source in series with a 5Ω resistor into an equivalent current source. What is the difference between an open circuit and a short circuit ? Calculate the node current and voltages at nodes *A* and *B* in the circuit in *Fig.* 3.

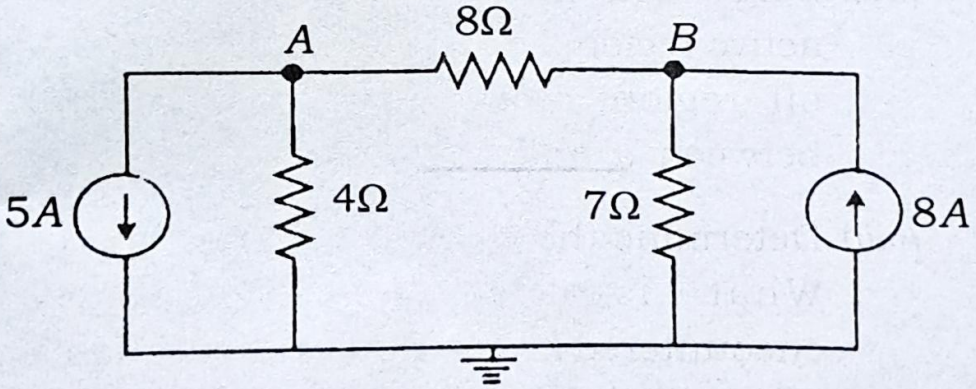

Fig. 3

(b) With a neat circuit diagram, explain the operation of a half-wave rectifier with a capacitor filter. Derive the expressions for the ripple factor with a capacitor filter and discuss how the parameters affect the ripple factor.

(c) Explain how a Zener diode can be used for voltage regulation. Include its I-V characteristic and working principle.

(d) Describe the operation of bipolar junction transistor as a switch in the cut-off and saturation regions with appropriate circuit diagram. In a common base configuration, the collector current is $0.95\,mA$, and the base current is $0.05\,mA$. Find the value of α.