1 (Sem–1) ECT

2023

ELECTRONICS AND COMMUNICATION TECHNOLOGY

Paper : ECT–0100104

(Basic Electronic Circuit and System)

Full Marks : 45

Time : Two hours

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

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

   (i) What are the current carriers in pnp transistor ?

   (ii) For a transistor if $\beta = 100$ and $I_C = 10\,mA$, then what is the value of I_E.

   (iii) What is the relation between β and α ?

(iv) Define supernode in case of circuit analysis.

(v) What are the basic circuit elements ?

(vi) What is reverse saturation current of diode ?

(vii) Calculate the ripple frequency of the output waveform of a bridge rectifier when fed with a 60 Hz sine wave.

(viii) At the base-emitter junction of a transistor, the correct option will be

(a) reverse bias

(b) a wide depletion layer

(c) low resistance

(d) None of the above

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

(a) What is a Zener diode and Zener voltage ?

(b) What do you mean by a filter circuit ? Why filter is used in rectifier circuit ?

(c) Draw the input and output characteristics of a transistor in common base configuration.

(d) What do you mean by transistor biasing? Why do we need to stabilize the transistor circuit ?

(e) What are stability factor and thermal run-away ?

(f) Mention the various types of FET. How many terminals are available in a JFET ? Mention their name.

(g) What is the difference between JFET and bipolar transistor ?

(h) What do you mean by OPAMP ? Draw the block diagram of it.

(i) What do you mean by electric current ? Mention the different types of it.

(j) How much energy does a 150 W electric bulb consume in *three* hours ?

3. Give short answer of the following : 5×4=20

(any four)

(i) What are the four types of dependent sources in electrical circuits ? Explain each of them.

(ii) Evaluate the value of I_x, I_y and I_z in the circuit shown in Fig.1 below :

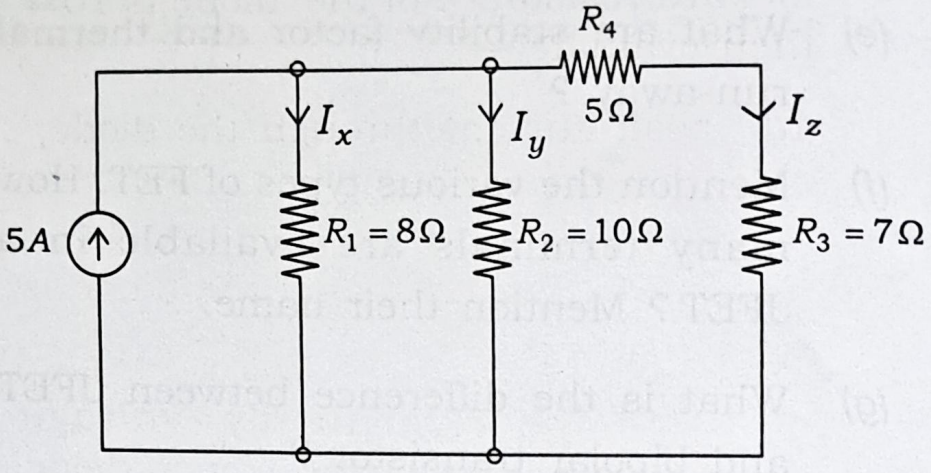

Fig.1

(iii) What are drift current and diffusion current in semiconductor ? Find the current through the diode in the circuit given in Fig. 2 by considering the diode to be ideal.

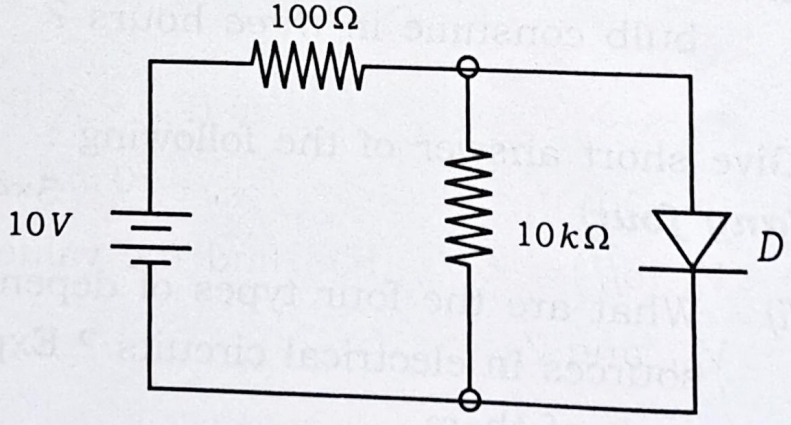

Fig.2

(iv) An AC voltage of 20 V peak value is connected in series with a silicon diode with a load resistance of $1\,k\Omega$. If the forward resistance of the diode is 10Ω then evaluate —

(a) peak current through the diode;

(b) peak output voltage.

What will be the values if the diode is assumed to be ideal ?

(v) What do you mean by voltage regulation ? Explain how Zener diode maintains constant voltage across the load.

(vi) What are inverting and non-inverting input of a differential amplifier ? Write down some of the important characteristics of an OP-AMP. Write the expression for the output voltage of a differential amplifier.

(vii) What is pinch-off voltage (V_P) ? A JFET has the $I_D = 5\,mA$. If $I_{DSS} = 10\,mA$ and $V_{GS}(off) = -6\,V$, then find the value of V_{GS} and V_P.

(viii) Design a base resistor bias circuit for a CE amplifier so that operating point is $V_{CE} = 8\,V$ and $I_C = 2\,mA$. A $15\,V\,dc$ supply and a silicon transistor with $\beta = 100$ is given. Assume that $V_{BE} = 0.6\,V$. Calculate the value of the load resistance which may be employed in the circuit.

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

(a) What are the different types of capacitors ? Derive the expressions for series and paralled combination of capacitors.

(b) Explain the unbiased, forward biased and reverse biased condition of PN junction diode with proper energy level diagram. What are static and dynamic resistance of a PN junction diode ?

(c) Explain the working principle of a halfwave rectifier. Find out the efficiency and ripple factor of halfwave rectifier.

(d) What are the key steps that should be followed when applying nodal analysis method to solve complex electrical networks ? Find out the node voltages in the circuit shown in Fig. 3 below :

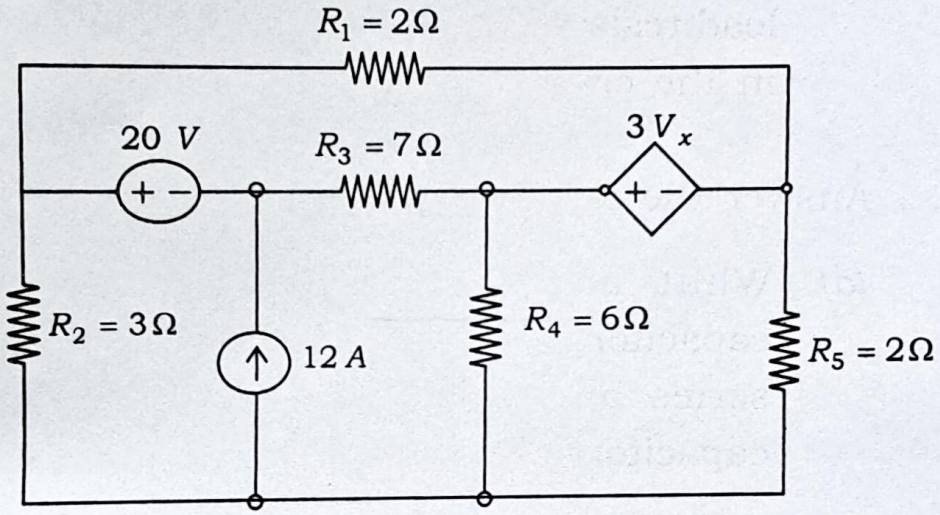

Fig.3

(e) Establish the following relations :

(i) $I_C = \alpha I_E + I_{CBO}$

(ii) $\beta = \dfrac{\alpha}{1-\alpha}$

(iii) $\alpha = \dfrac{\beta}{\beta + 1}$

(iv) $I_C = \dfrac{\alpha}{1-\alpha} I_B + \dfrac{1}{1-\alpha} I_{CBO}$

Also, define α and β.
