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PHYSICS

(Major)

Paper : 5.4

(Electronics)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer the following questions very briefly :

$1 \times 7 = 7$

(a) What is meant by race-around condition in flip-flop?

(b) What is surface leakage current in a junction diode?

(c) The basic principle of a power amplifier does not violate the law of conservation of energy. Explain.

(d) What is current gain of a transistor?

(e) In an amplitude modulation, the value of modulation index m_a is equal to 1. What is the physical meaning of it?

(f) What is the condition that must be satisfied in order to receive the maximum power by a two-terminal network from another network?

(g) There are two basic conditions for oscillation in a feedback amplifier. What are these basic conditions?

2. Answer the following questions :   2×4=8

(a) Distinguish between Zener breakdown and Avalanche breakdown in semi-conductor diodes.

(b) Determine the current I_D and the voltage v_0 in the circuit of Fig. 1, if the voltage drop across the diode is 0·7 volt.
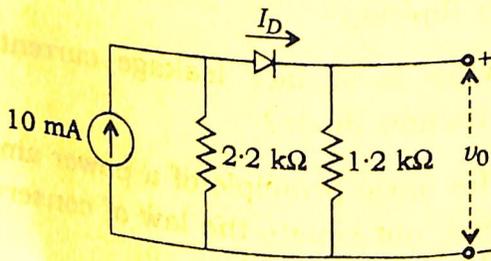

Fig. 1

(c) What could be the possible reasons for reduction in voltage gain of transistor R-C coupled amplifier at high frequency?

(Continued)

(d) Mention one advantage and one disadvantage of single sideband transmission.

3. What do you mean by a clamping circuit? Draw the circuit diagram of a d.c. restorer. How does the circuit function?   1+2+2=5

Or

Explain why half-wave rectifier is called a poor device for rectification. Derive an expression for efficiency of such rectifier.   2+3=5

4. What is the basic principle of power amplifier? Draw the circuit diagram of a class B push-pull power amplifier using power transistor and derive an expression for the efficiency. What is the percentage of maximum efficiency?   1+3+1=5

Or

How can a transistor be considered as a two-port of four-terminal device? What are the variables related to input and output ports in case of a transistor? Establish the relations of h parameters with these variables for small input a.c. signal and hence draw the h parameter a.c. equivalent circuit.   1+2+2=5

(Turn Over)

5. Transform the circuit in Fig. 2 into Thevenin's equivalent circuit, where R_L is load resistance. Calculate the Thevenin's equivalent impedance and voltage. Draw the Norton's equivalent circuit. 2+2+1=5
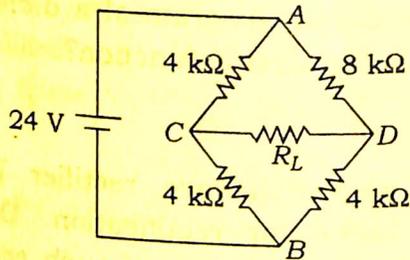

Fig. 2

6. Answer any *two* questions from the following : 5×2=10

(a) Convert the decimal numbers $128 \cdot 25_{10}$ and $100 \cdot 75_{10}$ to its binary equivalent and find the difference using 2's complement method. Add binary numbers $1100 \cdot 11_2$ and $1011 \cdot 01_2$. Verify the result by converting them to decimal numbers. 3+1+1=5

(b) Define the critical frequency of an ionospheric layer. Show that the critical frequency f_c is related to the peak electron concentration N_p of the reflecting layer by $f_c = 9\sqrt{N_p}$ (in SI unit). 2+3=5

(c) Fig. 3 shows an OP-AMP circuit with capacitor C in between inverting input and output. Express v_0 in terms of v_1 and v_2. 5
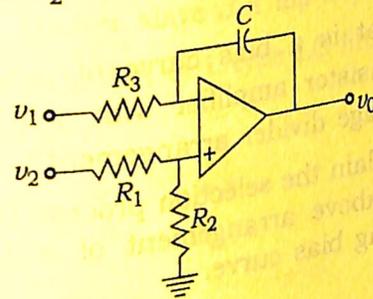

Fig. 3

(d) If an amplifier is to be unstable and oscillate it must satisfy the Nyquist criterion. What is Nyquist criterion? Explain its significance. 5

7. Answer any *two* questions from the following : 5×2=10

(a) Define ASK, FSK and PSK methods of digital communication. Draw the diagrams of any two of them in response to a modulating signal. 3+2=5

(b) What are the different types of CRO? Lissajous figures can be employed to measure the phase difference between two signals. Briefly explain how this is measured. 2+3=5

(c) What is amplitude modulation? Show that in amplitude modulation two sidebands are equispaced with respect to carrier frequency. $1+4=5$

(d) What is a bias curve of a CE mode transistor amplifier with self-bias and voltage divider arrangement?

Explain the selection process of Q point in above arrangement of a transistor using bias curve. 5

8. Answer any *two* questions from the following : $5 \times 2 = 10$

(a) What is discriminator? What are the processes for FM wave detection? Give a sketch of frequency response curve of the Foster-Seely detector. $1+3+1=5$

(b) Show that NOR gate is equivalent to bubbled AND gate. IC 7400 is a Quad 2-input NAND gate. It is possible to obtain AND, OR, NOT gates from this IC. How? $2+3=5$

(c) What is an integrated circuit? Describe the photolithographic etching process used in IC fabrication. $1+4=5$

(d) Write short note on any *one* of the following : 5

(i) Microprocessor

(ii) Master slave *J-K* flip-flop

(iii) Function of L-type LC filter

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