2016

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 briefly : 1×7=7

(a) Why are semiconductor diodes called non-linear device?

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

(c) What should be the biasing of emitter-base and collector-base junctions of a transistor to operate it in active region?

(d) In class A transistor amplifier, what proportion of the input-cycle the transistor conducts?

(e) What should be the value of input resistance of an ideal operational amplifier?

(f) What is the cut-off frequency beyond which the ionosphere does not reflect electromagnetic waves?

(g) In AM transmission, what proportion of total power is carried away by the carrier wave for 100% depth of modulation with 600 watts of total power?

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

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

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

(c) What do you understand by sequential circuits? Give one example.

(d) What are the relative advantages and disadvantages of negative feedback in transistor amplifiers?

3. Draw the circuit diagram of a common-emitter transistor amplifier with self- or emitter-biasing configuration. State the advantages of self-biasing circuit. Derive the relationship between common-emitter current amplification factor (β) and common-base current amplification (α). 1+1+3=5

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

Or

Draw the symbolic representation with proper biasing for each of the following electronic devices when in operation :

(a) Zener diode

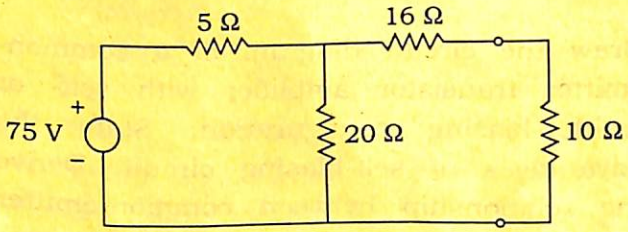
(b) Varactor diode

(c) LED

(d) Photodiode

How does LED differ from ordinary *p-n* junction diode? 5

5. Transform the following circuit into Thevenin's equivalent circuit and hence find the value of *(a)* Thevenin's equivalent impedance, *(b)* Thevenin's equivalent voltage source, and *(c)* load current and power in 10 Ω resistance : 5



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

(a) Derive the *h*-parameters of transistor. Draw the *h*-parameter equivalent circuit of transistor CE amplifier.

(b) Draw the block diagram of a feedback amplifier and find an expression for overall gain of such amplifier. Define positive and negative feedback.

(c) What are the fundamental differences in operation of class A, class B and class C amplifiers explaining with the help of dynamic curves. Which one of them has maximum power conversion efficiency? Draw the circuit diagram of a push-pull amplifier. 3+1+1=5

(d) The open-loop gain of a feedback amplifier is 200 and feedback factor is $\beta = 0 \cdot 5$. Assuming negative feedback, determine—

(i) desensitivity factor (D);

(ii) close-loop gain.

If the open-loop gain changes by +10%, find the percentage (%) change in the close-loop gain and its value. 1+1+3=5

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

(a) What are the characteristics of an ideal operational amplifier? Explain the concept of virtual ground in an operational amplifier. Draw the basic integrator and differentiator circuits of operational amplifier. 2+2+1=5

(b) Give the basic non-inverting circuit of an operational amplifier and derive the expression for voltage gain of such circuit. Find the output of the non-inverting operational amplifier for $V_{in} = 5 \cdot 5$ mV, $R_f = 90$ kΩ and $R_1 = 10$ kΩ. 1+2+2=5

(c) State why NAND and NOR gates are called universal gate. Give the truth table of NAND and NOR gates. Draw the diagram to show how OR, AND and NOT gates can be constructed using NAND gates only. 1+1+3=5

(d) Convert the decimal numbers 256·50 and 128·25 to its binary equivalent and find the difference using 2's complement method. Add the binary numbers 1011·10 and 111·01. Verify the result by converting them to decimal equivalent. 2+2+1=5

(e) Define FSK and PSK methods of digital transmission. Draw the block diagram of any one of them. 4+1=5

8. Answer any *two* questions of the following : 5×2=10

(a) Draw the block diagram of the analog communication system. State with the help of diagram any one method of generation of AM signal. Write the advantages of FM transmission over AM transmission. 1+2+2=5

(b) A 400 watts carrier is amplitude modulated to a depth of 100%. Calculate the total power in case of AM and SSB techniques. How much power saving (in watts) is achieved for SSB compared to AM? 2+2+1=5

(c) (i) Draw the block diagram of super-heterodyne AM receiver.

(ii) The instantaneous voltage of an AM wave is given by

$$V_{AM} = 20(1 + 0 \cdot 5 \sin 2\pi \times 10^3 t) \sin 2\pi \times 10^6 t \text{ volts}$$

Find the amplitude and frequency of two sidebands. 2+3=5

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

(i) Norton's theorem

(ii) Multivibrator

(iii) *R-S* flip-flop

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