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3 (Sem-4/CBCS) PHY HC3

2024

PHYSICS

(Honours Core)

Paper : PHY-HC-4036

(*Analog Systems and Applications*)

Full Marks : 60

Time : Three hours

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

1. Answer the following questions as directed :

$1 \times 7 = 7$

(i) For a PN junction, barrier potential _____ with increase in junction temperature. (Fill in the blank)

Contd.

(ii) Zener breakdown occurs in heavily-doped junction, whereas avalanche breakdown occurs in lightly-doped ones. *(Write True or False)*

(iii) LEDs emit light only when ____ biased. *(Fill in the blank)*

(iv) The leakage currents in a transistor are due to ____ carriers. *(Fill in the blank)*

(v) Multistage amplifiers are used in order to achieve greater

(a) voltage gain

(b) power gain

(c) frequency response

(d) All of the above *(Choose the correct option)*

(vi) For class A operation of an amplifier, Q-point is located at the ____ of the load line. *(Fill in the blank)*

(vii) The analog to digital converter are employed in

(a) voltmeter

(b) wattmeter

(c) energy meter

(d) digital multimeter

(Choose the correct option)

2. Give short answer of the following questions :

2×4=8

(i) Define ripple as referred to in a rectifier circuit. What is meant by filter?

(ii) What does common-mode rejection ratio (CMRR) of a differential amplifier physically signify? Express CMRR in dB form.

(iii) Draw a fixed-bias circuit of a transistor.

(iv) Explain the need for regulated power supply.

3. Answer the following questions : (any three)
 $5 \times 3 = 15$

(i) The signals applied to be inverting and non-inverting terminals of a differential amplifier are -0.40mV and -0.42mV respectively. If the differential gain and the CMRR are 10^5 and 80dB respectively, find the total output voltage. 5

(ii) Explain with circuit diagram how an op-amp can be used as an adder or summing amplifier. 5

(iii) Define common-base current amplification factor (α) and common-emitter current amplification factor (β). Derive the relation between them.

$$2+3=5$$

(iv) Using h-parameter, draw the two-generator form of the equivalent circuit. Define the four h-parameters. Why are the h-parameters very useful for circuit analysis ? $2+2+1=5$

(v) Write short notes on : $2\frac{1}{2}+2\frac{1}{2}=5$

(a) Zener diode
(b) Solar cell

4. Answer the following questions : (any three)

$$10 \times 3 = 30$$

(i) Sketch the output characteristics of a transistor in its CB mode. Explain the active, cut-off and saturation regions.

(ii) A transistor in a CB mode, with $\alpha = 0.98$ gives a reverse saturation current $I_{CBO} = 12\mu\text{A}$. When used in a CE mode, it gives the base current of 0.2mA . Calculate its total collector current in a CE mode. $6+4=10$

(ii) Draw circuit diagram of a full-wave bridge rectifier and explain its operation. What are its ripple factor, maximum rectification efficiency and peak inverse voltage ? $7+3=10$

(iii) Explain the term 'feedback'. What are positive and negative feedbacks? Derive an expression for the voltage gain of an amplifier with feedback. Give the advantages of negative feedback.

$$2+2+3+3=10$$

(iv) Draw a circuit diagram of a single-stage CE transistor amplifier as well as its equivalent circuit. Derive the expressions for current gain and voltage gain of such an amplifier.

$$4+6=10$$

(v) With the help of a neat diagram, explain the working of a weighted register DAC. What are its advantages and disadvantages? Write any two major applications of D/A converters.

$$4+(2+2)+2=10$$

(vi) Write short notes on: **(any two)**

$$5 \times 2 = 10$$

(a) RC phase-shift oscillator

(b) Hartley oscillator

(c) Logarithmic amplifier using OPAMP