3 (Sem–4/CBCS) PHY HC 3

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 : 1×7=7

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

(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)*** 5×3=15

(i) The signals applied to be inverting and non-inverting terminals of a differential amplifier are $-0{\cdot}40\,mV$ and $-0{\cdot}42\,mV$ respectively. If the differential gain and the CMRR are 10^5 and $80\,dB$ 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 : 2½+2½=5

(a) Zener diode

(b) Solar cell

4. Answer the following questions : ***(any three)*** 10×3=30

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

A transistor in a CB mode, with $\alpha = 0{\cdot}98$ gives a reverse saturation current $I_{CBO} = 12\,\mu A$. When used in a CE mode, it gives the base current of $0{\cdot}2\,mA$. 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 registor 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)***

5×2=10

(a) RC phase-shift oscillator

(b) Hartley oscillator

(c) Logarithmic amplifier using OPAMP

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