*Total number of printed pages–7*

**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)*

*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.

 *Contd.*

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 ($\alpha$) and common-emitter current amplification factor ($\beta$). 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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