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4 SEM TDC PHYH (CBCS) C 10

2025

(May/June)

PHYSICS

(Core)

Paper : C–10

(Analog Systems and Applications)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer (any *five*) : 1×5=5

(a) When reverse bias is applied to a junction diode

(i) potential barrier decreases

(ii) potential barrier increases

(iii) majority carrier increases

(iv) minority carrier increases

(b) Diodes which are operated under reverse bias condition are

(i) Zener diode, LED

(ii) Zener diode, photodiode

(iii) photodiode, LED

(iv) All of the above

(c) To work as a linear amplifier, a transistor must operate in

(i) the active region

(ii) the saturation region

(iii) the cut-off region

(iv) None of the above

(d) In CE arrangement, the value of input impedance is approximately equal to

(i) h_{ie}

(ii) h_{oe}

(iii) h_{re}

(iv) None of the above

(e) An OP-AMP can amplify

(i) only a.c

(ii) only d.c

(iii) both a.c and d.c

(iv) neither d.c nor a.c

(f) The relation between α and β of a transistor is

(i) $\beta = \frac{\alpha}{1+\alpha}$

(ii) $\beta = \frac{\alpha}{1-\alpha}$

(iii) $\alpha = \frac{\beta}{\beta-1}$

(iv) $\alpha = \frac{\beta}{\beta+1}$

2. Answer the following : 2×5=10

(a) Define mobility of a carrier and mention its unit.

(b) Why is silicon or germanium not used to fabricate LED?

(c) What is a load line in a transistor characteristics?

(d) What are class A and class B amplifiers?

(e) Define CMRR and slew rate of an OP-AMP.

3. (a) Explain the formation of barrier potential in a *p-n* junction. Derive an expression for the barrier potential of a *p-n* junction. 4

Or

Draw the energy band diagrams of *n*-type and *p*-type semiconductors indicating the position of Fermi level. What is the position of Fermi level of an intrinsic semiconductor?

(b) Draw the circuit diagram of a full-wave rectifier and calculate its ripple factor. 4

(Continued)

Or

Write about working and construction of photodiode. How does it differ from solar cell?

4. Explain with necessary diagram, the mechanism of current flow in an *n-p-n* transistor. 3

Or

A transistor is connected in common base configuration. If $I_C = 1{\cdot}9$ mA and $I_B = 0{\cdot}05$ mA, find the current amplification factor in common-base and common-emitter connection of the amplifier (α and β, respectively).

5. (a) Draw the small signal hybrid equivalent circuit of a basic transistor amplifier. Write the expressions for its voltage, current and power gain and input resistance of a CE transistor amplifier. 2+2=4

(b) A CE transistor amplifier is connected with a load resistance 2 kΩ. If the *h*-parameters of the transistor are

(Turn Over)

$h_{ie} = 1000\,\Omega$, $h_{re} = 10^{-4}$, $h_{fe} = 100$ and $h_{oe} = 12\times10^{-6}$ S, find the current gain. 2

6. *(a)* Explain the operation of a two-stage RC coupled CE transistor amplifier with a neat circuit diagram. 2+2=4

(b) What is negative feedback? Explain with necessary frequency response curve, how the bandwidth of an RC coupled amplifier is modified when negative feedback is used. 1+2=3

(c) Draw the block diagram of an oscillator showing the essential parts of a practical oscillator. 2

7. *(a)* Draw the basic inverting amplifier with an input resistance R_1 and a feedback resistance R_f. Assuming the OP-AMP to be ideal, write the expression for the voltage gain of the inverting amplifier. 2+1=3

(b) Explain how an OP-AMP can be used as *(i)* an adder and *(ii)* a subtractor. 3

(c) Describe the use of an operational amplifier as differentiator. 3

8. What is the function of a DAC? Write the advantage of the *R-2R* ladder type DAC over the weighted-resistor type DAC. 1+2=3

Or

Explain the working of a binary weighted resistor network. 3

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