## 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

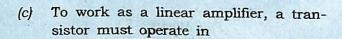
The figures in the margin indicate full marks for the questions

- 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

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- (ii) Zener diode, photodiode
- (iii) photodiode, LED
- (iv) All of the above



- (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) hie
- (ii) h<sub>oe</sub>
- (iii) hre
- (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  $\alpha$  and  $\beta$  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:

 $2 \times 5 = 10$ 

- (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.

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.

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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.

or comments or comments

A transistor is connected in common base configuration. If  $I_C = 1.9$  mA and  $I_B = 0.05$  mA, find the current amplification factor in common-base and common-emitter connection of the amplifier ( $\alpha$  and  $\beta$ , 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  $2 \text{ k}\Omega$ . If the h-parameters of the transistor are

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

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.

[ESTD 1963]

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

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.

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

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

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.

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2+1=3

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