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**1 (Sem-4) PHY 3**

**2025**

**PHYSICS**

Paper : PHY0400304

**(Analog Electronics)**

Full Marks : 45

Time : 2 hours

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

1. Answer the following questions :  $1 \times 5 = 5$ 
  - (a) What is the output frequency of a full wave rectifier where input frequency is 100Hz?
  - (b) In \_\_\_\_\_ amplifier, the collector current flows for less than half cycle of the input signal.
  - (c) What type of amplifier is used to reject hum and static voltage induced into its input leads?

- (d) The change in the output wave shape from input wave shape in an amplifier is called \_\_\_\_\_ .
- (e) State the biasing method of a photodiode.

2. Answer the following questions : **(any five)**  
 $2 \times 5 = 10$

- (a) Why does the frequency response of a RC coupled amplifier decrease with increasing frequency after cutoff?
- (b) How is electrostatic deflection caused in a CRO?
- (c) What happens when the feedback resistance of an operational amplifier is replaced by a (i) capacitor (ii) diode? Write an expression for the output voltage in each case.
- (d) Why is a diode called a non-linear device?
- (e) Define CMRR. What is the significance?
- (f) Explain Q point of a transistor.
- (g) What is static and dynamic resistance of a diode?

- (h) State the principle behind light emitting diodes.
- (i) State the role of coupling capacitors and bypass capacitor in a two stage RC coupled amplifiers.
- (j) State the characteristics of an ideal Op-Amp.

3. Answer the following questions : **(any four)**

$$5 \times 4 = 20$$

(a) 1+2+2=5

- (i) Draw the circuit diagram of a full wave rectifier circuit with a filter.
- (ii) Draw and explain the nature of signal at various stages.
- (iii) A power supply A delivers 15V DC with a ripple of  $0.6 V_{rms}$  while another power supply B delivers 20V DC with a ripple of  $2m V_{rms}$ . Which power supply is better and why?

(b) 1+1+3=5

- (i) Define faithful amplification of a transistor amplifier.
- (ii) How is faithful amplification obtained in CE configuration?

- (iii) Draw the characteristics of a transistor amplifier and show the active, cutoff and saturation region. Why does these region's occur?
- (c) How does negative feedback effect the input and output impedance of an amplifier? How is the change profitable in practice?  $2+3=5$
- (d)  $2+2+1=5$
- (i) What is Barkhausen Criteria for continuous undamped oscillations?
- (ii) How is this criteria met in RC phase-shift oscillator?
- (iii) A phase-shift oscillator uses  $10\mu F$  capacitor. Find the value of  $R$  to produce a frequency of  $1000kHz$ .
- (e)  $2+2+1=5$
- (i) Draw the characteristic of Zener diode. How does this differ from a normal diode?
- (ii) On what does the breakdown voltage depend on and how can this voltage be changed?
- (iii) How is a Zener diode biased and why?

(f) Why is CE configuration used in 90–95% of all the transistor applications?

(g) A sinusoidal signal whose amplitude is  $1\text{ V}$  is applied at the input terminals of

(i) An inverting amplifier of  $R_1 = 1\text{ k}\Omega$ ,  $R_F = 2\text{ k}\Omega$ .

(ii) A non-inverting amplifier with  $R_1 = 1\text{ k}\Omega$ ,  $R_F = 2\text{ k}\Omega$ .

(iii) A comparator circuit.

Draw the output in each case if  $R_F$  is the feedback resistance and the power supply is  $V_{CC} = \pm 10\text{ V}$ . What is the function of negative feedback from the analysis?

3+2=5

(h)

1+1+3=5

(i) What is  $3\text{ dB}$  frequency or half power frequency?

(ii) What does half power frequency denote?

(iii) Explain the condition of distortionless amplification based on frequency response.

4. Answer the following questions : **(any one)**  
10

(a) 2+3+5=10

- (i) What is stabilization in amplifiers ?
- (ii) Why is stabilization required ? Explain.
- (iii) Compare stability of Fixed Bias and Voltage Divider bias explaining the reason behind this.

(b) 5+5=10

- (i) How does the energy band diagram of a  $P-N$  junction change in forward bias and reverse biased condition ?
- (ii) How is the current across the junction caused for the two conditions ? Explain with required diagrams.

(c) 2+3+5=10

- (i) What are  $h$  parameters ?
- (ii) Draw the  $h$  parameter equivalent circuit for a CE configuration.
- (iii) Find expressions for input and output impedance of an amplifier as a function of the  $h$  parameter.

(d)

2+2+6=10

- (i) Define Slew Rate of an OP-AMP.
- (ii) What is the use of slew rate in applications of OP-AMPs?
- (iii) It is required to design a circuit using OP-AMP to obtain the output

$$V_{out} = (2V_1 + 3V_2 - 4V_3)$$

draw a circuit to obtain the output if  $V_1$ ,  $V_2$  and  $V_3$  are the inputs.

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