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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)**
2×5=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)**
5×4=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 $0.6V_{rms}$ while another power supply B delivers 20V DC with a ripple of $2mV_{rms}$. 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 10pF 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 1V is applied at the input terminals of

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

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

(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 3dB 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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