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PHYSICS

Paper : CC-10

(Analog Systems and Applications)

Full Marks : 60

Time : 3 hours

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

1. Choose the correct answer : 1×5=5

(a) Width of depletion layer of a junction

(i) decreases with light doping

(ii) increases with heavy doping

(iii) is independent of applied voltage

(iv) is increased under reverse biased

(b) The phase shift between the input and output voltage in a common emitter small signal amplifier is

(i) 180°

(ii) 145°

(iii) 90°

(iv) 0°

(c) The dimension of ' h_{ie} ' parameter is

- (i) ohm
- (ii) mho
- (iii) dimensionless
- (iv) volt

(d) Which of the following amplifier classes has the highest linearity and the lowest distortion?

- (i) Class A
- (ii) Class B
- (iii) Class AB
- (iv) Class C

(e) If the current amplification of a transistor in the middle frequency range is I_0 , its value at lower half-power point is

- (i) $I_0 / \sqrt{2}$
- (ii) $I_0 / 2$
- (iii) $I_0 / 3$
- (iv) $I_0 / 4$

2. Answer the following questions : 2×5=10

- (a) What are drift current and diffusion current in a semiconductor?
- (b) In a common-emitter configuration, the collector leakage current in a transistor of $\beta = 50$, is $200 \mu\text{A}$. Find the leakage current when the transistor is connected in common-base configuration.
- (c) Draw a voltage divider bias circuit for a common-emitter $n-p-n$ transistor. What is stability factor?
- (d) What are Class A, Class B and Class AB amplifiers?
- (e) What do you mean by Barkhausen criterion? What kind of feedback is required for oscillators?

3. Answer any five questions : 5×5=25

- (a) Explain the working of a $p-n$ junction diode under forward bias condition and draw the $V-I$ characteristic curve of it. 4+1=5
- (b) What are different operating regions of a transistor? Explain each of them with necessary circuit and graph in common-emitter configuration. 1+4=5

(4)

- (c) A transistor in CE configuration driven by a voltage source V_s of internal resistance $R_s = 1200 \text{ ohm}$ is connected with load resistance 1200 ohm . The h -parameters according to manufacturers specifications are, $h_{ie} = 1100 \Omega$, $h_{re} = 2.5 \times 10^{-4}$, $h_{fe} = 51$, $h_{oe} = 24 \times 10^{-6} \text{ s}$. Find the current gain, input impedance, voltage gain, power gain and output impedance of the amplifier.
- (d) Draw the circuit diagram of a two-stage R-C coupled transistor amplifier and explain its operation. $2+3=5$
- (e) Explain the working principle of a feedback amplifier with necessary block diagram. Find out an expression for voltage gain with feedback. $3+2=5$
- (f) Draw the circuit diagram of a Hartley oscillator and explain its circuit operation. Write down the expression for frequency of oscillation. $2+2+1=5$
- (g) What do you mean by CMRR? What is its importance? A certain OPAMP has a differential voltage gain of 2000 and a common mode gain of 0.2. Determine CMRR and express it in dB. $1+1+1\frac{1}{2}+1\frac{1}{2}=5$

(5)

4. Answer any two questions : $10 \times 2 = 20$
- (a) Draw the circuit diagram of a full-wave rectifier and calculate the ripple factor and efficiency. Discuss the principle of function of capacitor filter at the output of a rectifier.
- (b) Describe Colpitts' oscillator circuit and explain its operation. Find an expression for the frequency of oscillations and the condition for sustained oscillations.
- (c) Draw and discuss the frequency response curve of an R-C coupled transistor amplifier.
