2022
B.A./B.Sc.
Third Semester
CORE – 7
PHYSICS
Course Code: PHC 3.31
(Analog Systems & Applications)

Total Mark: 70 *Pass Mark: 28*
Time: 3 hours

Answer five *questions, taking* one *from each unit.*

UNIT–I

1. (a) Explain the two types of extrinsic semiconductors. 2
   (b) Explain the barrier formation in PN junction diode. 3
   (c) Pure silicon at 300 K has equal electron and hole concentration of 1.5×10^{16} per m^3. Doping with indium increases n_h to 4.5×10^{22} per m^3. Calculate n_e in the doped silicon. 2
   (d) Derive the expression for barrier potential of a PN junction diode. 7

2. (a) Briefly explain the resistance in a PN junction diode. 3
   (b) Explain the I-V characteristics of PN junction diode. 4
   (c) Derive the expression for space charge width of a PN junction diode. 7

UNIT–II

3. (a) What is ripple factor? Derive the expression for DC, rms, efficiency and ripple factor of a full wave rectifier. 1+5=6
   (b) Explain the working of a Zener diode and its role in voltage regulation. 4
   (c) A transistor using potential divider network biasing has the following values: $R_1 = 50\,k\Omega, R_2 = 10\,k\Omega, R_E = 1\,k\Omega, V_{CC} = 12\,V$ and $V_{BE} = 0.1\,V$. Find I_C. 2

(d) A full bridge rectifier uses two diodes. The forward bias resistance of each diode is 25Ω. The transformer rms secondary voltage is $50\sqrt{2}$ volt and load resistance of 1475Ω. Find: 1+1=2

(i) Mean load current

(ii) RMS value of load current

4. (a) Explain the working of a full wave rectifier. Explain the role of C filter in the signal rectification. Draw circuit diagrams wherever necessary. 3+2=5

(b) What is a Zener diode? Explain how it can be used as a voltage regulator. 1+4=5

(c) Plot a neat output characteristic graph of a CE transistor and hence explain: 4

(i) Active region

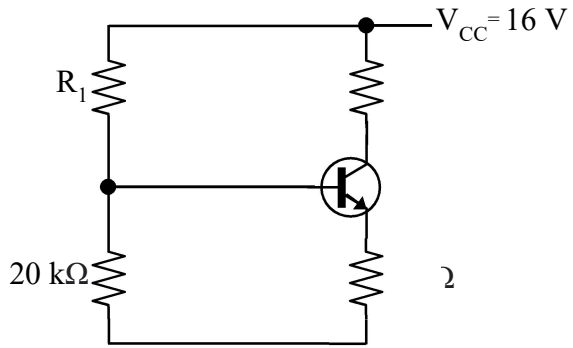
(ii) Cut-off region

(iii) Saturation region

UNIT–III

5. (a) Explain the working of a CE amplifier with the help of circuit diagram. Plot the output characteristics of a CE biased amplifier with input and output signals. 4+2=6

(b) An n-p-n transistor circuit has $\alpha = 0.985$, $V_{BE} = 0.3$ V. If $V_{CC} = 16$ V, calculate R_1 and R_C to test the Q point at $I_C = 2$ mA, $V_{CE} = 6$V. 4



(c) What is the significance of Q-point? Differentiate between class A and class B power amplifiers. 1+3=4

6. (a) Using h-parameters, derive the expression for current gain (A_i), voltage gain (A_v) input impedance (Z_i) and output impedance (Z_o). 6

(b) Explain the R-C working of coupled amplifier with the help of circuit diagram. Also, explain the frequency response curve of R-C coupled amplifier 3+3=6

(c) What is the significance of 3 dB point in context of amplifier? 2

UNIT–IV

7. (a) Explain positive feedback and negative feedback of an amplifier. 2

(b) Explain in detail the different advantages of a negative feedback amplifier. 8

(c) In a negative feedback amplifier, $A = 100$, $\beta = 0.04$. Find: 4

(i) Gain with feedback
(ii) Output voltage
(iii) Feedback voltage
(iv) Loop gain

8. (a) What do you mean by feedback in amplifiers? 2

(b) With the help of a circuit diagram describe the operation of a Colpitts oscillator. Derive the expression for the frequency produced by the Colpitts oscillator. 3+7=10

(c) A Colpitts oscillator have $L = 100\,\mu H$, $C_1 = 0.005\,\mu F$, $C_2 = 10\,\mu$. Find the oscillation frequency. 2

UNIT–V

9. (a) Explain with proper circuit diagram, the application of op amp as a/an: 8

(i) Integrator
(ii) Adder
(iii) Differentiator
(iv) Log amplifier

(b) With the help of a block diagram explain the basic elements of an operational amplifier (op amp). State the characteristics of an ideal op amp. 6

10. (a) Define common mode rejection ratio (CMRR), slew rate and virtual ground. 3

(b) Determine the output voltage of an op amp for input voltages of $V_{i1} = 150\ \mu V$, $V_{i2} = 140\ \mu V$. The amplifier has a differential gain of $A_d = 4000$ and CMRR = 100. 3

(c) With the help of a circuit diagram explain the function of an inverting amplifier. Derive an expression for voltage gain of an inverting amplifier. 5

(d) For an ideal inverting amplifier with $R_1 = 1\ k\Omega$, and $R_f = 1\ M\Omega$, determine: 3

(i) Voltage gain

(ii) Input resistance

(iii) Output resistance
