2023

B.A./B.Sc.

Fourth Semester

CORE – 10

PHYSICS

Course Code: PHC 4.31(R)

(Analog Systems & Applications)

Total Mark: 70 *Pass Mark: 28*

Time: 3 hours

Answer five questions, taking one from each unit.

UNIT–I

1. (a) What is an energy level diagram? Explain the energy-level diagram for hydrogen. 1+3=4
   (b) Explain why a semiconductor acts as an insulator at 0° K and why it's a conductivity increases with increasing temperature. 3
   (c) Define drift velocity. With the help of a proper circuit diagram derive an expression for electron drift velocity. 2+5=7

2. (a) The seven lowest energy levels of sodium vapour are 0, 2.10, 3.19, 3.60, 3.75, 4.10 and 4.26 eV respectively. A photon of wavelength 3300 Å is absorbed by an atom of the vapour.
      (i) What are all the possible florescent lines that may appear?
      (ii) If three photons are emitted and one of these is 11,380 Å line, what are the wavelength of the other two photon? 2+2=4
   (b) Explain the barrier formation in a PN junction diode. 3
   (c) Explain in detail the difference in current flow mechanism in a forward and reverse-biased diodes. 7

UNIT–II

3. (a) With a circuit diagram explain the input signal rectification by a centre-tapped rectifier. What is it's rectification efficiency? 4+2=6
   (b) Explain the principle and structure of a LED. 4
   (c) Explain the VI characteristics of CC transistor. 4

4. (a) What is a Zener diode? Explain how it can be used as a voltage regulator. 2+4=6
   (b) Obtain the ripple factor of a bridge rectifier. 3
   (c) Plot a neat output characteristic of CB-Transistor and hence explain:
      (i) Active region
      (ii) Cut-off region
      (iii) Saturation region 5

UNIT–III

5. (a) Define stability factor. Calculate the stability factor for CB and CE circuits. 2+4=6
   (b) Draw the circuit diagram of a transistor with voltage divider bias. Explain the working and hence show that the DC bias circuit is independent of B. 2+4=6
   (c) Differentiate between a class A and a class B amplifier. 2

6. (a) Give a detailed analysis of a single stage CE amplifier using hybrid model. What is it's output impedence? 4+2=6
   (b) With proper circuit diagram explain the operation of a two-stage RC coupled amplifier. Also explain its frequency response. 8

UNIT–IV

7. (a) What is the advantage of negative feedback over positive feedback in an amplifier. 2
   (b) In a negative-feedback amplifier, A = 100, B = 0.04 and V_i = 50 mV. Find
      (i) gain with feedback
      (ii) output voltage
      (iii) feedback factor
      (iv) feedback voltage 4
   (c) Explain the principle and working of a RC pahse-shift oscillator. Obtain an expression for the oscillation frequency. 8

8. (a) Explain in brief the effect of negative feedback on the gain and bandwidth of the amplifier. 4

(b) With a proper circuit diagarm explain a Hartley oscillator and it's operator. Also, find it's operation frequency. 8

(c) A Colpitt's oscillator having $L = 100\,\mu H$, $L_{RFC} = 0.5\,mH$, $C_1 = 0.005\,\mu F$, $C_2 = 0.01\,\mu F$, and $C_C = 10\,\mu F$, find the oscillation frequency. 2

UNIT–V

9. (a) For an op-amp having a slew rate of $SR = 2$ V/μs, what is the maximum closed-loop voltage gain that can be used when the input signal varies by 0.5 V in $10\mu s$. 3

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

(c) Explain with proper circuit diagram, the application of op-amp as
(i) differentiator
(ii) log amplifier 5

(d) With proper circuit explain in brief the operation of an n-bit R-2R resistor ladder. 3

10. (a) Show the circuit and explain how to measure A_V and R_i of an op-amp. 2

(b) Draw the schematic diagram of an ideal inverting op-amp with voltage-shunt feedback impedances Z and Z', and indicate the virtual-ground model for calculating the gain. 4

(c) A 5 mV, 1 kHz sinusoidal signal is applied to the input of an op-amp integrator for which R = 100 K and $C = 1$ μF. Find the output voltage. 3

(d) For an ideal inverting amplifier with $R_1 = 1K$ and $R_f = 1M$, determine
(i) voltage gain
(ii) input resistance
(iii) output resistance 3

(e) Define weighted network with a circuit diagram. 2