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Total Pages : 4

235303

December, 2019
B.Sc. (H) Physics Semester-III
Analog Systems & Applications (BPH-303)

Time : 3 Hours]   [Max. Marks : 75

Instructions :

1.   *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*

2.   *Answer any four questions from Part-B in detail.*

3.   *Different sub-parts of a question are to be attempted adjacent to each other.*

4.   *Use of non-programmable scientific calculator is allowed.*

   $(q = 1.6 \times 10^{19}$ C; $h = 6.62 \times 10^{-34}$ Js;

   $k_B = 1.38 \times 10^{-23}$ J/K; $c = 3 \times 10^8$ m/s),

   where symbols have their usual meanings.

PART - A

1.   (a)   Determine the concentration of free electrons and holes in a sample of germanium at 300 K which has equal donor and acceptor concentrations of 10^{15} atoms/cm^3. Is this a p- or n-type germanium?   (1.5)

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(b) Draw the energy band diagrams of n-type and p-type semiconductors and show the donor level, acceptor level and Fermi level in each. (1.5)

(c) A P-N diode has a PIV rating of 20 V. What does it mean? (1.5)

(d) Why LEDs are not manufactured by Si or Ge semiconductors? (1.5)

(e) Show that $I_C = \beta I_B + (1 + \beta) I_{CBO}$, where the symbols have their usual meanings. (1.5)

(f) Discuss the Barkhausen criteria for sustained oscillations. (1.5)

(g) What are the advantages of negative feedback in amplifiers? (1.5)

(h) Draw the pin-out diagram of Op-amp IC-741. (1.5)

(i) Why feedback is needed in Op-amp circuits? (1.5)

(j) Why R-2R ladder D/A convertor circuit is preferred over the weighted resistor type circuit? (1.5)

PART - B

2. (a) Discuss the space charge & variation of junction field of a p-n diode. With suitable diagrams, explain the I-V characteristics of a p-n diode. (10)

(b) Describe the concept of drift velocity and mobility of carriers in semiconductors. How lattice scattering and impurity scattering affect the mobility? (5)

3. (a) Explain the working of a bridge FWR with the help of suitable circuit diagram. Draw the input & output waveforms. Calculate the efficiency and ripple factor of the circuit. (10)

(b) For the circuit given below, if $I_{z(min)} = 0$ A, what should be the value of $R_{L(min)}$ so that zener is in breakdown region. (5)
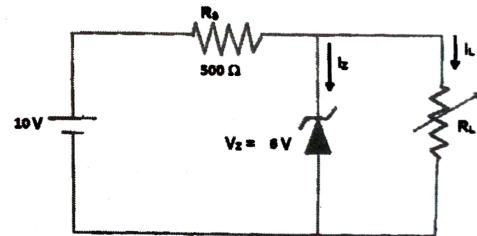
4. (a) With suitable circuit diagram of n-p-n transistor in CE configuration, draw and discuss the input and output I-V characteristics and obtain (i) input resistance, (ii) output Resistance, and (iii) current gain. (10)

(b) Define DC load line and the operating point of a transistor. Why is it called the Q-point. In a CE transistor circuit, if $V_{CC} = 12$ V, $R_C = 6$ kΩ, draw the DC load line. What will be the Q-point if zero signal base current is 20 μA and $\beta = 50$? (5)

5. Draw the circuit diagram of a two stage RC coupled amplifier. What is the role of blocking capacitors in this circuit? Discuss the voltage gain in low, middle and high frequency regions. How the bandwidth of the circuit is determined? (15)

6. (a) With suitable circuit diagram, explain the working of RC-phase shift oscillator and obtain the expression for the frequency. How the positive feedback is obtained in the circuit? (10)

(b) Determine the operating frequency and the feedback fraction for a Colpitt's oscillator, if $C_1 = 0.001$ μF, $C_2 = 0.01$ μF, $L = 15$ μH. (5)

7. (a) Draw the circuit of an Op-amp as integrator and find an expression for its output. Draw the outpu. waveform when the input to the integrator is a square wave. (10)

(b) Define the CMRR and Slew rate. Discuss the concept of virtual ground in OP-amp circuits. (5)