Sr. No. 321307

December 2023, Reappear

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.*

($q = 1.6\times10^{19}$ C; $h = 6.62\times10^{-34}$ Js; $k_B = 1.38\times10^{-23}$ J/K; $c = 3\times10^{8}$ m/s), where symbols have their usual meanings.

PART -A

Q1 (a) What is the position of Fermi level in an intrinsic semiconductor? Explain how does its position change when acceptor atoms are added to the semiconductor? (1.5)

(b) The wavelength of light emitted by a certain LED is 600 nm. Find the energy gap in eV. (1.5)

(c) Why a photo-diode is reverse biased when used as a photodetector? (1.5)

(d) Calculate I_C and I_E for a transistor that has $\alpha = 0.98$ and $I_B = 100\ \mu A$. (1.5)

(e) What are the relative doping levels of emitter, base and collector regions in a transistor and why? (1.5)

(f) What is thermal runaway? How the emitter feedback resistor baising protects against thermal runaway? (1.5)

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

(h) Explain how a phase shift of 360^o is achieved in Harteley's oscillator circuit in order to obtain sustained oscillations? (1.5)

(i) Explain the concept of virtual ground in Op-amp. (1.5)

(j) Explain the working of an Op-amp as zero-crossing detector circuit. (1.5)

PART -B

Q2 (a) For an unbiased p-n junction, sketch the variation of the space charge, electric field and electric potential as a function of the distance across the junction giving the relevant equations. (10)

(b) Sketch and Explain the I-V characteristics of a p-n diode in forward and reverse biased condition. Calculate the forward and reverse resistance of the diode. (5)

Q3 (a) Draw the circuit diagram of a centre-tapped full wave rectifier. Sketch the input and output waveforms, and explain the circuit operation. Derive the expression for average current, rms current, and ripple factor of the circuit. (10)

(b) For a given zener voltage regulator circuit, find the range of the supply voltage (5)