UNIVERSITY QUESTION PAPER, DECEMBER–2019

B.Sc.–II (G.J.U.)

THIRD SEMESTER

PHYSICS

(Semiconductor Devices)

Time Allowed : Three Hours **Maximum Marks : 80**

Note : Question paper contains nine questions in all. Q.No. 1. is compulsory carrying eight short questions of 2 marks each. From remaining 8 questions total *four* questions are to be attempted selecting *one* question from each Section.

SECTION – A

1. (*a*) Draw energy level diagram of an *n*-type semiconductor and comment why donor level is close to conduction band. 2

(*b*) Draw V–I characteristics of a Photo Diode. 2

(*c*) b Parameter (C.E. current gain) of a transistor is 28. Find the value of a for the same transistor. 2

(*d*) Make a table showing all the four types of mode of operations of a transistor. 2

(*e*) Differentiate between Class C and Class B amplifiers on the basis of Q Point. 2

(*f*) Name the devices used for following operations : 2

(*i*) Low voltage A.C. to high voltage A.C. convertor.

(*ii*) D.C. to A.C. convertor.

(*g*) What are the values of input and output impedences for an Ideal OP-Amp ? 2

(*h*) Can we use two diodes instead of a transistor ? Justify your answer. 2

SECTION–B

2. (*a*) Explain the V–I characteristics of a Diode in forward and reverse Biasing. During reverse biasing, what are the causes of Breakdown ? Explain and differentiate between the two types of breakdowns. 10

(*b*) Wavelength of light emitted by an LED is 600 nm. Find the energy gap. 3

(*c*) Write diode equation. Hence explain different terms involved in the equation. 3

3. (*a*) Derive expressions for the following for a half wave rectifier :

(*i*) Average value of output current 4

(*ii*) R.M.S. value of output current 4

(*iii*) Ripple factor. 2

(*b*) A load of 10 kΩ is connected across the output of a full wave rectifier. Diodes are having a forward resistance of 60 Ω. If peak value of voltage supplied is 300 V. Find ripple factor. 6

SECTION–C

4. (*a*) Explain the circuit configuration of a C.B. transistor. Define its current amplification factor α. Hence derive a relation between I_C, I_B and I_{CBO}. 8

(*b*) A transistor has $\alpha = 0.94$ and a collector leakage current I_{CO} of 1 μA. Calculate I_c and I_b if $I_e = 2$mA. 8

5. (*a*) Explain Input and Output characteristics of Common Emitter Configuration. 8

(*b*) What is D.C. load line ? How is it drawn ? What is the physical significance of drawing this line ? 8

SECTION–D

6. (*a*) Draw a circuit diagram for RC coupled amplifier. Hence explain its working. Also explain the frequency response curve for low, middle and high frequencies. 10

(*b*) The voltage gain of an amplifier without feedback is 900. The gain reduces to 100 with negative feedback. Find the feedback fraction β of the amplifier. 6

7. (*a*) Explain the circuit and operation of Hartley oscillator. 8

(*b*) A certain amplifier has voltage gain of 5dB. If the input signal voltage is 0.6V, what is the output voltage ? (Given Antilog (0.25) = 1.78). 4

(*c*) What do you mean by Positive feedback ? What happens to the overall gain if $A\beta = 1$? 4

SECTION–E

8. (*a*) Explain the concept of virtual ground in an OP-Amp. What is its physical significance ? 4

(*b*) Explain open loop gain in inverting and non-inverting mode. 8

(*c*) In an inverting amplifier circuit $R_i = 3$ kΩ, $R_f = 8$ kΩ. If $V_i = 3$V, find the output voltage and input current. 4

9. (*a*) Explain the working of OP-Amp as : 12

(*i*) Non-Inverting Amplifier

(*ii*) Differentiator.

(*b*) In a non-inverting amplifier $R_i = 6$KΩ, $R_f = 15$ kΩ. Find the value of voltage gain. 4

$$1 + \frac{15}{6} = \frac{6+15}{6}$$

$$= \frac{21}{6} = 3.5$$