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Paper Code : EC301 Electronic Devices

UPID : 003460

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer *any ten* of the following : [1 x 10 = 10]

(I) During the reverse biased of the diode, the back resistance decrease with the _____ of the temperature.

(II) The amount of photo generated current increases slightly with an increase in _____ .

(III) The capacitance of a reverse biased PN junction _____as reverse bias is decreased.

(IV) In a PN junction with no external voltage, the electric field between acceptor and donor ion is called _____.

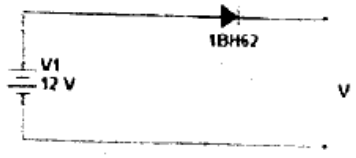
(V) The free electron density in a conductor is (1/1.6) x 10^{22} /cm^3 the electron mobility is 10 cm^2/Vs. Calculate the value of resistivity _____ .

(VI) If Φs and ΦF denotes respectively the surface & Fermi potential, strong inversion takes place in n channel MOSFET, when _____.

(VII) The greatest wavelength of photons that a photodiode built of a semiconductor with a bandgap of 2eV can detect is around _____nm.

(VIII) Example of direct band gap semiconductor is _____ .

(IX) When the diode is reverse biased with a voltage of 6V and V_{bi}=0.63V. Calculate the total potential.



(X) BJT is used as a switch is operated in _____ region.

(XI) The gate to source voltage of a MOSFET with threshold voltage 400mV in saturation is 900mV for drain current of 1mA . The drain current for V_{GS} = 1400mV is _____.

(XII) Which type of photodetector is based on the principle of internal photoemission?

Group-B (Short Answer Type Question)

Answer *any three* of the following : [5 x 3 = 15]

2. What are direct band gap & indirect band gap semiconductors? Draw E-K diagram for Si and GaAs. [5]
3. Derive the expression for drain current for an ideal MOSFET at saturation. [5]
4. Draw and explain the output characteristics of BJT in CB configuration. [5]
5. What is meant by dc operating point or Q point in a transistor characteristic? What is load line? [5]
6. If the transconductance parameter is 2mA/V2 for V_{GS} = 1V & Vt = 0.5 V calculate the linear resistance r_{DS}. Also mention the region of operation if V_{DS} = 1V. [5]

Group-C (Long Answer Type Question)

Answer *any three* of the following : [15 x 3 = 45]

7. (a) Write down the mathematical expression for Fermi-Dirac probability function and plot f(E) Vs E_f for three different temperatures T= 0K, 300 K & 2000 K. [5]

   (b) Explain different scattering mechanisms in semiconductor devices. [5]

   (c) Explain with E-K diagram, why LED emits light but pn-junction does not? [5]

8. (a) Which of the two semiconductor materials between Si or Ge has larger conductivity at room temperature and why? [5]

   (b) What is an Ohmic contact? [3]

   (c) Can a Schottky diode be used as Ohmic contact ? Explain in brief. [5]

(d) Draw the symbol and I-V characteristics of a Zener diode. [2]

9. (a) Explain the various modes of operation possible in a BJT. [5]

(b) With the help of circuit diagram describe the operation of BJT in CE configuration. [10]

10. (a) Explain the band bending and channel inversion in case of NMOS. [10]

(b) What is channel length modulation. [5]

11. (a) What is mobility and conductivity. Define effective mass. Derive relationship between energy & momentum. [5]

(b) Define mobility and write down its unit. Also give an expression that relates the mobility and diffusivity of carriers in a semiconductor. State the significance of this equation. [5]

(c) A Si sample A is doped with 10^{18} atoms/cm^3 of Boron. Another sample B of identical dimensions is doped with 10^{18} atoms/cm^3 of Phosphorus. The ratio of electron to hole mobility is 3. The ratio of conductivity of sample A to sample B. [5]

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