16/12/17

DOON UNIVERSITY, DEHRADUN

End Semester Examination, Second Semester, 2017-18

School of Physical Sciences

Physics Generic elective

Course: PHM-101: Fundamentals of Electronic Materials and Devices

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Time Allowed: 3Hours ***Maximum Marks: 50***

Note: Attempt All Questions from Sections A, 5 questions for section B and two questions from section C.

SECTION: A Attempt all questions ***(Marks: 2X10=20)***

1. The electronic configuration of silicon is:

   (a) $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$ (b) $1s^2, 2s^2, 2p^6, 3s^1, 3p^6$

   (c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^2$ (d) $1s^2, 2s^2, 2p^6, 3s^0, 3p^2$

2. Unit for density of state is:

   (a) $J^{-1}m^{-3}$ (b) eVm^2 (c) $eVcm^3$ (d) Jcm^2

3. The dependence of the mobility of a charge carriers in a semiconductor is given by,

   (a.) $\mu \propto 1/T$ (b) $\mu \propto 1/T^{3/2}$ (c) $\mu \propto T^{3/2}$ (d) $\mu \propto T^2$

4. For an ideal Laser, which one is the favourable process to occur?

   (a) Spontaneous emission (c) light transmission

   (b) Light absorption (d) stimulated emission

5. The unit of q/KT is

   (a) V (b) V^{-1} (c) J (d) J/K

6. A Bipolar junction transistor (BJT) is a ....controlled device.

   (a) Current (b) voltage (c) both current and voltage (d) None of the above

7. If p-n junction is forward biased, what will the order of the current in forward direction?

   (a) Ampere (b) μA (c) mA (d) nA

8. A JFET is also called ..... transister

   (a) Unipolar (b) bipolar (c) unijunction (d) none of the above

9. The solar or photo voltaic cell converts:

   a) Chemical energy to electrical energy b) Solar radiation into electrical energy

   c) Solar radiation into thermal energy d) Thermal energy into electrical energy

10. The LED is usually made of materials like,

    (a) GaAs (b) Si (c) GeAs (d) ZnO

SECTION: B Attempt any 5 questions. ***(Marks 4X5=20)***

11. Define conductor and semi-conductor on the basis of band theory. What is meant by Fermi level in semiconductor? Where does the Fermi level lie in an intrinsic semiconductor?

12. How n-type and p-type semiconductors are produce? What do you mean by deep and shallow level defects in semiconductors? Diagrammatically show the energy levels of pure semiconductor, semiconductor with donor impurity and semiconductor with acceptor impurity.

13. What is photodiode? What is the difference between a regular p-i-n photodiode and hetrojunction photodiode? Describe with the help of schematic.

14. What is LED? Diagrammatically explain the terms, inter-band, intra-band and defect transitions in the material?

15. (i) Draw an energy versus bond length diagram for 6 Li atoms.

    (ii) Consider a Si sample doped with $N_d = 1 \times 10^5$ donor atoms. Assume that the intrinsic carrier concentration $n_i = 1.5 \times 10^{10}$ /cm^3. In the sample is additionally doped with $N_a = 1x\ 10^{18}$/cm^3 acceptor atoms, calculate the approximate number of electron/cm3 in the sample at 300 K.

16. (i) Obtain the expression for conductivity in a semiconductor. What is the unit of mobility?

    (ii) A heavily doped n-type semiconductor has the following data:

    Hole electron mobility ratio = 0.4. Doping concentration = 4.2×10^8 atoms/cm^3

    Intrinsic carrier concentration = 1.5×10^4 atoms/cm^3. Calculate the ratio of conductivity of the n-type semiconductor to that of intrinsic semiconductor of same material.

SECTION: C Attempt any two questions ***(Marks: 5X2=10)***

1. Derive the expression for the concentration of charge carriers in an intrinsic semiconductor function of energy gap and temperature.

2. Explain the working principle of a solar cell with the help of schematic. Show the I-V characteristic of a solar cell and define the term open circuit voltage and short-circuit current and open circuit current.

3. What is a transistor? What are the different types of a transistor? Show the basic structure of MOSFET and explain its working.