MANIPAL UNIVERSITY, MANIPAL

Fourth SEMESTER M.SC (Physics) END SEMESTER EXAMINATION, MAY. 2016

SUB: CONDENSED MATTER PHYSICS II (PHY 706.2)
(REVISED CREDIT SYSTEM)

Time: 3 Hrs.   **Max. Marks: 50**

Note: (a) Answer any FIVE full questions.

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1   (a) Discuss the Shockley-Read –Hall theory of recombination and obtain an expression for recombination rate. Discuss when a trap will act as a recombination center, electron trap and hole trap.   **[6]**

   (b)(i)For an n-type semiconductor at room temperature, the concentration varies linearly from 1×10^{18} cm^{-3} to 7×10^{17} cm^{-3} over a distance of 0.10cm.Calculate the diffusion current density if the electron diffusion coefficient is 225cm^2/s.

   (ii)Excess electrons and holes are generated at the end of a n type silicon bar(x=0).The minority carrier lifetime is 1μs, the hole diffusion coefficient is 10cm^2/s and if δn(0)=10^{15} cm^{-3} .Determine the steady state hole concentrations in the silicon for x>0.   **[4]**

2   (a) Derive the ideal I-V relationship for a p-n juntion diode.   **[6]**

   (b) A silicon abrupt junction in thermal equilibrium at 300K is doped such that E$_C$-E$_F$ =0.21ev in the n region and E$_F$-E$_V$=0.18ev in the p region. Determine impurity doping concentrations in each region and find built in potential difference. Given N$_c$=2.8×10^{19} cm^{-3} , N$_v$ =1.04×10^{19}cm^{-3} , k=1.38×10^{-23} J/K and n$_i$ =1.5×10^{10}cm^{-3} **[4]**

3   (a) Showing the simplified geometry of an n-channel p-n junction FET arrive at its current voltage relationship in terms of h$_1$ and h$_2$ .Where h$_1$ and h$_2$ are depletion widths at the source and drain ends respectively.   **[6]**

   (b)Showing the cross section view of a basic charge coupled device (CCD), describe its principle of operation.   **[4]**

4   (a) Sketch the steady state excess minority carrier concentration in a p-n junction photo diode and obtain an expression for total steady state diode photocurrent density.   **[6]**

   (b)Define population inversion. What are the three requirements that must be satisfied in order to form population inversion in a diode laser?   **[4]**

5   (a) Explain the working of a p-n junction solar cell with a block diagram. Obtain the expressions for the open circuit voltage and the voltage at which maximum power is delivered to the load.   **[6]**

   (b) Discuss punch through breakdown in a bipolar transistor.   **[4]**

6   (a) Describe with a neat diagram Czochralski method of crystal growth .   **[5]**

   (b)Describe various steps involved in the processing of a planar p-n junction diode.   **[5]**