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MANIPAL
ACADEMY of HIGHER EDUCATION

DEPARTMENT OF SCIENCES MAHE.

IV SEM M.Sc (PHYSICS)

Exam Date: 23-04-2018

END SEMESTER EXAMINATION

CONDENSED MATTER PHYSICS II (706.2)

TIME : THREE HOUR MAXIMUM MARKS: 50

NOTE: ANSWER ANY FULL FIVE QUESTIONS

1A. Discuss the SHR theory and obtain expression for the recombination rate and explain when a trap will act as a recombination center. 6M

1B. Explain the terms predeposition and drive-in in the diffusion technique giving the example of diffusion of phosphorus in silicon. 4M

2A. Derive ideal current-voltage relationship of a pn junction diode. 6M

2B. Draw energy band diagram and minority carrier distribution in an npn transistor in the forward active mode. 4M

3A. With a neat energy band diagram explain how a metal- n semiconductor contact behaves like an ohmic contact. 3M

3B Explain the term inversion in relation to MOS structure and explain qualitatively I_D versus V_{DS} characteristics for n-channel enhancement mode MOSFET . 4M

3C. Compare Schottky Barrier diode and pn junction diode. 3M

4A. Discuss the action of the phototransistor. 4M

4B. Explain the terms radiative and nonradiative transitions with necessary diagrams. 3M

4C. What conditions to be met for population inversion to occur in diode Laser. 3M

5A Explain the working principle of pn junction solar cell. Obtain expressions for short circuit current and open circuit voltage. 5M

5B. Calculate open circuit voltage at 300 K for a silicon pn junction solar cell with the following parameters: $n_i = 1.5\times 10^{10}$ cm^{-3}, $N_a = 5\times 10^{18}$ cm^{-3}, $N_d = 10^{16}$ cm^{-3}, $D_n = 25$cm^2 /s , $D_p = 10$cm^2 /s, $\tau_{no} = 5\times 10^{-7}$ s , $\tau_{po} = 10^{-7}$ s and $J_L = 15$mA/cm^2. 5M

6A Explain working and construction of an LED. 5M

6B. With a neat diagram describe how storage and transfer of charges takes place in a CCD. 5M