NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

Department of Physics

First series Examination, Feb. 2015

B Tech Elective

PH 4022 INTRODUCTION TO OPTOELECTRONICS

Time: 1Hr. *Max. Marks: 20*

Answer all questions

1. What are the components that contribute to the reverse current in a pn junction. Write down the Shockley equation for reverse current. (1)
2. Explain the meaning of Bloch wave function and indicate its significance in electron movement in a semiconductor crystal. Hence explain the idea of effective mass. (2)
3. What is the built in potential for a PN junction. Write down simple expressions for built in potential and the resulting electric field in an unbiased junction. Sketch the variation of this electric field in the SCL indicating the maximum field position. What is the significance of this maximum electric field point? (3)
4. Sketch diagrams representing (a) Energy bands (b) Density of States, (c) Probability function, and (d) energy density of electrons in the conduction bands of a semiconductor (3)
5. Sketch the variation of this electric field in the SCL indicating the maximum field position. What is the significance of this maximum electric field point? (1)
6. Explain the most useful definition of Fermi Energy for explaining the band tilt of a semiconductor in an applied field (1)
7. Name two direct and one indirect band gap semiconductor coming in the category of group III-V indicating their energy band gap values at 300K (1)
8. In terms of permittivity , show that by doping a solid one can create an optoelectronics device. (1)
9. With neat sketches, explain Extended states and Band Tale states (2)
10. Show that we can neglect the light's magnetic force compared to its electric force, and (b) why light waves are transverse. (2)
11. Write down the Semiconductor Maxwell equations and give their physical meaning (1)
12. The average intensity of direct sunlight is around 1400 W/m2. What is the average force on a fully absorbing surface of area 2.00 m^2? (1)
13. From **E** and **B** find an expression for the velocity of light in terms of permittivity and permeability of free space (1)

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