

National Institute of Technology Hamirpur (HP)
Department of Physics
End Semester Examination (January 20, 2021)

Subject: Engineering Physics
Code: PH-101

Time: 1.5 hrs.
Total Marks = 30

Note: **Attempt all the questions. Attempt any one part in question No. 8.**

1. How much kT above the Fermi level, the probability of filling energy state will be 10%. (2)
2. Plot Fermi function versus energy at absolute zero and room temperature. What does the Fermi function signifies. (2)
3. Discuss concept of effective mass. Why the carrier mass in semiconductors is considered different from the free electron mass. (2)
4. Of the two semiconductors with different band gaps which will have more conductivity. Explain your answer with justification. (2)
5. Show position of Fermi level in intrinsic semiconductor. Explain how the position of Fermi level varies with doping of semiconductor. (2)
6. Discuss formation of metal-semiconductor contact and explain its nature with respect to current conduction. Under which situation we can have rectifying metal-semiconductor contact. (4)
7. Estimate intrinsic carrier concentration (per cc) in germanium having bandgap of 0.72eV at 300K assuming carrier effective mass to be equal to the free electron mass. Take appropriate values of other constants you need. (4)
8. Derive expression for density of states in solid. (4)

OR

With the help of energy level diagram explain the working of helium neon laser.

9. A photon enters through an atomic medium. Discuss various type of interactions that may takes place between the photon and the atoms inside the medium. (4)
10. Derive relationship between the Einstein's coefficients and discuss significance of these relations. (4)

Good Luck

National Institute of Technology Hamirpur (HP)
Department of Physics and Photonics Science
Mid Semester Examination (February 2, 2021)

Subject: Engineering Physics
Code: PH-101

Time: 1.5 hrs.
Total Marks = 30

Note: Attempt all the questions.

1. What is Fermi-Dirac distribution function? Sketch Fermi-Dirac distribution function and density of states function as function of electron energies at 0K and 300 K. (3)
2. At any temperature, how much kT above the Fermi level, the probability of filling energy state will be 25%. (3)
3. Estimate the Fermi energy (in eV) of aluminium which has face centered cubic crystal structure with lattice parameter of 4.05 Angstroms. (3)
4. What percent of total number of electrons will be filled up to $0.75E_F$ (three quarter of the Fermi energy) in any metal at zero Kelvin. If required, take Fermi energy as calculated above in question number 3. (3)
5. Draw energy band diagram of n-type and p-type semiconductor and their p-n junction in equilibrium under zero bias condition. Show built in barrier and the depletion region in this energy band diagram. (3)
6. A photon is moving through an atomic medium. Discuss various type of interactions that may takes place between the moving photon and the atoms of the medium. (3)
7. The result that the Einstein's coefficients $B_{12} = B_{21}$. Explain how it shows the requirement of population inversion in achieving light amplification (3)
8. With the help of suitable diagram explain the role of helium in helium-neon laser. (3)
9. Describe working of carbon dioxide lasers. Mention any one of its applications. (3)
10. How a p-n diode used in semiconductor laser differs from the conventional p-n diode used in electronic circuits. (3)

Good Luck