National Institute of Technology, Hamirpur (HP)

Mid Semester Examination - January, 2023

Course - B.Tech.

Semester - 1st

Subject Code - PH-101

Subject Name -Engineering Physics

Maximum Marks: 30

Time: 1:30Hour

All questions are compulsory (each carry equal marks)

1. Assuming that in Silver (atomic weight 107.87, density 10.49 g cm-3) there are two free electrons per atom. Calculate the free electron density in the metal and Fermi energy. Given ($h = 6.62 \times 10^{-27}\ erg - sec$, $mass\ of\ electron = 9.05 \times 10^{-28} g$, $Avagadro's\ number\ N = 6.02 \times 10^{23}$.)

2. Why Nitrogen and Helium atom are important in CO_2 Laser? Draw energy level diagram for CO_2 laser.

3. Draw energy band diagram of n-type and p-type semiconductor and their p-n junction in equilibrium under zero bias condition.

4. How semiconductor laser is different from the ordinary p-n junction diode?

5. How intermodal dispersion restrict the data speed in step index optical fibre?

6. Define attenuations/loses in optical fibre. List down different type of losses. A communication system uses an optical fibre whose attenuation is 0.5 dB/km. find the output light power if the input power is 1 mW and link length is 15 km.

7. Discuss the processes that are involved during interaction of EM waves with matter.

8. What is Fermi-Dirac distribution function? Sketch Fermi-Dirac distribution function of electron energies at T=0K, 300K and 600K.

9. How many modes can propagate in a step-index fibre with a core diameter as 40 mm, if the refractive indices of its core and cladding are 1.461 and 1.456, respectively, and the light of wavelength is 8500 Å?

10. Calculate thermal equilibrium hole concentration in silicon at T=400K. Assume that fermi energy is 0.27eV above the valence band energy. The value of $N_v = 1.04 \times 10^{19}\ cm^{-3}\ at\ T = 300K$. $Boltzmann\ constant\ k = 1.38 \times 10^{-23} J/K$.

.....Good Luck.....

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

Subject: Engineering Physics | Time: 1.5 hrs.
Code: PH-101 | 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 — Time: 1.5 hrs.
Code: PH-101 — 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 $\mathbf{B_{12}} = \mathbf{B_{21}}$. 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