22/05/2025 FE SEM-II (NEP-2020)- CSE-AIML / IT / EXTC / CYBER SECURITY-SEMICONDUCTOR PHYSICS QP CODE: 10085367

Duration: $1\frac{1}{2}$ hour **Max. Maks: 45**

Note: 1. Question No. 1 is compulsory.
2. Solve any two questions from the remaining.
3. Draw diagrams where ever necessary.

Q.1. Solve any five from the following. **(3×5)**

a) The resistivity of Cu is 1.72×10^{-8} ohm-m. Calculate the mobility of electrons in Cu. Given that Number of electrons per unit volume is $10.41 \times 10^{28}/m^3$.
b) How does biasing influence the operation of a BJT in its different regions?
c) Determine the value of R_s required to self-biased a p-channel JFET with I_{DSS} = 25 mA, $V_{GS(OFF)}$ = 15 V and V_{GS} = 5V.
d) Explain the importance of surface to volume ratio in nano-technology.
e) Calculate the junction capacitance of a Ge diode whose area is 1 mm × 1mm and depletion region width is 2 μm. The relative permittivity of Ge is 16. Permittivity of free space is 8.54×10^{-12} F/m.
f) Differentiate between Enhancement Type and Depletion Type MOSFET.
g) Determine the wavelength and colour of light emitted by GaP LED of E_g = 2.25 eV.

Q.2. **(5×3)**

a) Deduce the expression for collector current and characteristics of NPN transistor in CB mode.
b) A sample of n-type of silicon has a donor density of $10^{20}/m^3$. It is used in the Hall effect experiment. If the sample of the width 4.5 mm is kept in a magnetic field of 0.55 T with current density of 500 A/m^2, find (i) Hall voltage developed in it (ii) Hall Coefficient (iii) Hall angle mobility of electrons is 0.17 m^2/V-sec.
c) Illustrate the working and advantages of Photodiode.

Q.3. **(5×3)**

a) Derive the expression for barrier potential of a p-n junction diode.
b) Explain working principle and output characteristics of the N-channel Enhancement type MOSFET.
c) Explain the effect of particle size on photoluminescence and electrical properties of nano materials.

Q.4. **(5×3)**

a) Define Fermi level. Explain and locate the shifts in Fermi level with increase in temperature in n- type semiconductor.
b) Silicon diode is subjected to a forward voltage of 0.7 V at room temperature 27 °C with a saturation current of 10^{-12} A. Calculate the forward current assuming and ideality factor of 1.
c) Compare between FET and BJT.

Q.5. **(5×3)**

a) Explain the application of Transistor as a switch in cut-off and saturation action.
b) Explain the working of a Zener diode and its application.
c) Explain electron beam lithography with key steps involved in the process and give its applications.