Regd. No.

VIGNAN'S
FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH
(Deemed to be University) - Estd. u/s 3 of UGC Act 1956

Regulation: R22C24 **Course Code: 24PY102-8**

I B. Tech II Semester Regular Examinations –May, 2025

ENGINEERING PHYSICS

(CSE)

Time: 150 Min **Max. Marks:60M**

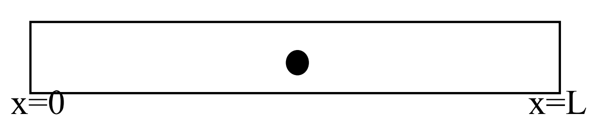
SECTION – A

Answer all Four questions **4×8M=32M**

1. a) Sketch and label the E-k diagram of a direct bandgap and indirect bandgap semiconductors and outline their differences. [5M]
   b) Identify the direct bandgap semiconductor among the following materials and justify your answer
   i) Gallium Arsenide ii) Silicon iii) Germanium iv) Aluminium [1M]
   c) Find the wavelength of the incident radiation to create the electron-hole pairs in intrinsic silicon (E_g=1.1eV) [2M]

2. a) Why do you prefer direct bandgap semiconductors rather than indirect bandgap semiconductors in light-emitting devices such as LEDs and LASERs? [1M]
   b) Explicate the essential conditions to obtain a LASER? [3M]
   c) Elucidate the working of semiconductor LASER with the help of a band diagram. [4M]

3. a) A free electron is moving inside a one-dimensional metal of length 'L' with zero potential energy as shown in below Figure. Assume that the potential energy at the ends of the metal is equal to infinity. Calculate its energy levels by applying the Schrodinger wave equation to it.



[4M]
   b) Represent pictorially, the energy level diagram for a free electron in a one-dimensional potential well. [1M]
   c) A photon of 10Å is emitted when the electron is de-excited from third excited state to ground state. Calculate the length of the potential well. [3M]

4. a) What is the Hall Effect? [1M]
   b) Explain the experimental set up for the Hall Effect and obtain the relation between Hall electric field and current density. Describe how the electron and hole mobilities are estimated using the Hall Effect? [5M]
   c) A Hall coefficient of -0.0035m^3/C is determined for a semiconductor specimen. Estimate the charge carrier type and the concentration of the charge carriers. [2M]

SECTION - B

Answer all Two questions **2×14M=28M**

5. a) Describe how one can control the conductivity of n-type and p-type semiconductors basing on the concept of doping? [6M]
   b) Graphically discuss the position of Fermi level in intrinsic, n-type and p-type semiconductors. [3M]
   c) Calculate the resistance of a pure silicon crystal of length 1 cm and 4 cm^2 area of cross section and having an intrinsic carrier concentration of 2.5×10^{16} $/m^3$. The electron and hole mobilities are 1400 cm^2/Vs and 500 cm^2/Vs respectively. Also, calculate the resistance and the majority and minority carrier concentration when the material is doped with 10^{21} Phosphorus atoms. [5M]

6. a) Based on classical free electron theory, obtain the relationship between the current density and conductivity of a metal. [6M]
   b) A uniform silver wire has $5.8*10^{28}$ conduction electrons/m^3 with a resistivity of $1.54*10^{-8}$ $(\Omega m)^{-1}$. For an electric field of 1 V/cm, calculate the relaxation time, drift velocity and mobility. [3M]
   c) Explain Fermi-Dirac probability distribution function? Discuss its variation with temperature at T = 0K and T > 0K [4M]
   d) Plot the graph explaining the variation of the Fermi-Dirac distribution function at different temperatures. [1M]