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END TERM EXAMINATION

SECOND SEMESTER [B.TECH] MAY-JUNE 2025

Paper Code: BS-106 **Subject: Applied Physics-II**

Time: 3 Hours **Maximum Marks: 60**

Note: Attempt five questions in all including Q.No.1 which is compulsory. Select one question from each unit.

Q1 Attempt **any four**:- **(5x4=20)**

a) What are Matter waves? How Davison and Germer demonstrated their existence in the laboratory?

b) Compare the salient features of Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Distribution Functions.

c) Calculate lattice constant for a rock salt lattice having Mol. Weight 58.45kg/kmol and density=2180kg/m3.

d) Describe the use of the Zener diode as a voltage regulator.

e) An electron and a proton are moving with the same velocity. Find the ratios of their (i) de-Broglie wavelengths, (ii) phase velocity and (iii) group velocity.

UNIT-I

Q2 a) State Heisenberg's uncertainty principle. Give experimental proof and hence explain why electrons cannot exist inside the atomic nucleus. **(5)**

b) The eigen-function for a particle trapped in a 1-D box of width a cm is given by $\psi(x)=(2/a)1/2\sin(n\pi x/a)$. Find the expectation values of (i) position and (ii) momentum in the ground state. **(5)**

Q3 a) Give Physical Interpretation of wave function ψ and hence explain the condition for orthonormal wave function. **(2)**

b) Compare the de-Broglie wavelengths for (i) a 1.0mg grain of sand blown by the wind at a speed of 20 m/s and (ii) and a 40 KeV electron used in a certain electron microscope. What inference will you draw from the above comparison? **(3)**

c) Define Tunnel Effect and hence prove that the approximate transmission probability for a particle to tunnel through a barrier is $T=e^{(-2k_2L)}$ where $k2= [2m(U-E)]^{1/2}/\hbar$ and U is the height of the barrier, E is the energy of the particle, L is the width of the barrier and $\hbar$ is the plank constant. **(5)**

UNIT-II

Q4 a) What are symmetric and anti symmetric wave functions? Explain in terms of Bose-Einstein and Fermi-Dirac statistics with suitable examples. **(5)**

b) Using Maxwell Boltzmann statistics, Derive an expression for the average energy of an ideal gas. **(3)**

c) Verify that the rms speed of the ideal gas molecule is about 9% greater than its average speed. **(2)**

Q5 a) Explain features of black body spectrum. **(4)**

b) Describe features of the Fermi-Dirac distribution function at different temperatures and hence define Fermi level. **(4)**

c) Write a short note on Dying stars. **(2)**

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UNIT-III

Q6 a) Draw (1 1 0) and (1 0 0) planes in a cubic unit cell. **(2)**

b) Evaluate the packing fraction of BCC and FCC closed-packed structures. **(4)**

c) write a short note on the Diamond lattice. **(4)**

Q7 a) Derive Bragg's law of crystal diffraction. Discuss Laue method of crystal structure determination. **(4)**

b) What are point defects? Differentiate between Schottky and Frenkel defects. **(4)**

c) The powder of BCC structured crystal is studied with X-rays of wavelength 2Å. The (210) reflection is observed at Bragg's angle 35°. Calculate lattice parameter. **(2)**

UNIT-IV

Q8 a) Explain the salient features of the Kronig-Penny model and hence E vs K diagram. **(5)**

b) Explain the Characteristics of a PN diode using a band diagram. **(5)**

Q9 a) Differentiate between Intrinsic and extrinsic semiconductors. Show that the Fermi level lies midway between the valence and conduction band for intrinsic semiconductors. **(7)**

b) Write a short note on Light emitting diode (LED). **(3)**

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