QP Code:R262G014 | Reg. No | | | | | | | | | | | AY 25

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET UNIVERSITY)

M.Sc. (Second Semester – Regular/Supplementary) Examinations, May – 2026

24MPHPC12003 – Basic Solid State Physics

(Physics**)**

Time: 3 hrs | Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. What do you mean by Dispersion relation?	CO1	K1
b. Distinguish between Einstein and Debye models.	CO2	K2
c. What is meant by energy band?	CO3	K3
d. Define Effective mass of electron and hole?	CO4	K2
e. Write down the relation between $\vec{E}$, $\vec{P}$ and $\vec{D}$.	CO4	K2

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions	Marks	CO #	Blooms Level
2. a. Derive the equation of motion for a monoatomic linear chain and obtain the dispersion relation.	10	CO1	K3
(OR)			
b. Explain acoustic and optical modes of lattice vibrations with neat diagrams.	5	CO1	K2
c. If the velocity of sound in a solid is of the order of 10^3 ms^{-1}, compare the frequency of the sound wave λ=120 Å for (a) monochromatic system and (b) acoustic waves and optical waves in a diatomic system containing two identical atoms per unit cell of interatomic spacing 1.2 Å.	5	CO1	K3
3.a. Discuss Einstein theory of specific heat and compare it with experimental results.	8	CO2	K1
b. Calculate Einstein specific heat at high temperature for 1 mole of solid. Given that R=8.314 J/molK.	2	CO2	K3
(OR)			
c. Explain Hall effect and derive Hall coefficient for free electrons.	7	CO2	K1
d. A copper strip carries current 10 A in magnetic fields 1T with dimension of thickness 1mm and width 5mm and electron density $8.5 \times 10^{28}\ m^{-3}$. Then find out the Hall coefficient and Hall voltage	3	CO2	K3
4.a. Explain the Kronig–Penney model in detail and Discuss the assumptions, advantages and limitations of the model.	10	CO3	K2
(OR)			
b. Explain the distinction between metals, semiconductors and insulators based on band theory.	6	CO3	K1
c. Explain Bragg reflection and its role in energy gap formation.	4	CO3	K2
5.a. Derive the expression for electrical conductivity in semiconductors and Explain the role of mobility and temperature.	10	CO4	K2
(OR)			

b.	Derive the expression for intrinsic carrier concentration and explain the temperature dependence.	7	CO4	K1
c.	Calculate the electron and hole concentration in a semiconductor in thermal equilibrium, if the intrinsic carrier concentration is 1.5×10^{10} / cm^3 and holes are 36×10^4 times that of electron per cm^3.	3	CO4	K3
6.a.	Derive the Clausius–Mossotti relation and discuss its significance in dielectric materials.	8	CO4	K1
b.	The dielectric constant of a medium is 5. Electric field in the dielectric 10^5 V/m. Calculate electric displacement and polarization. Take $\varepsilon_0 = 9\times\ 10^{-12}$ F/m	2	CO4	K3
	(OR)			
c.	Derive expression for local electric field in dielectric materials.	6	CO4	K1
d.	Find the local Electric field if E= 2×10^5 V/m and P=5×10^{-5} C/m^2 ?	4	CO4	K2

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