GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
PHYSICS-II
PH401

TIME ALLOTTED: 3 HOURS   FULL MARKS: 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)
Answer any *ten* from the following, choosing the correct alternative of each question: 10×1=10

			Marks	CO No.
1.	(i)	Which one of the following functions is an eigen function of the operator $\frac{d^2}{dx^2}$? a) x b) x^2 c) e^{-x^2} d) cos x	1	CO1
	(ii)	If E_1 be the energy of the ground state of a one dimensional potential box of length L and E_2 be the energy of the ground state when the length of the box is halved, then a) $E_2=2E_1$ b) $E_2=E_1$ c) $E_2=4E_1$ d) $E_2=3E_1$	1	CO1
	(iii)	Spin of "photon" particle a) integer multiple of 'h' b) half integer multiple of 'h' c) spin is not defined d) zero	1	CO1
	(iv)	The susceptibility of diamagnetic material is negative as a) Magnetic dipole moments are oppositely directed b) It arises because of induced effect c) Its Curie temperature is -ve d) It arises at infinitely high temperature	1	CO3
	(v)	Which of the following material is used for making permanent magnet ? a) Platinum cobalt b) Alnico c) Carbon steel d) All of the above	1	CO3

(vi)   Dielectrics materials inserted between the capacitor plates   1   CO3
     a)   Increase the electric field
     b)   Increase capacitance
     c)   Decrease capacitance
     d)   Decrease electric field

(vii) Electronic Polarizability of a monatomic gas atom is proportional to   1   CO3
     a) R
     b) R^2
     c) R^3
     d) R^4
     R is the atomic radius.

(viii) Electrons within a solid, moving under the influence of   1   CO2
     a) constant potential
     b) zero potential
     c) periodic potential
     d) linear potential

(ix)   The periodicity of Bloch function is   1   CO1
     a) same as that of potential
     b) half of that of potential
     c) double of that of potential
     d) no relation between them

(x)   The strongest material is   1   CO1
     a) graphite
     b) diamond
     c) graphene
     d) iron

(xi)   Example of zero dimensional nano material   1   CO1
     a) Quantum Dot
     b) Quantum well
     c) Quantum wire
     d) graphite

(xii) According to Sommerfeld theory of electron conduction in metal, electrons   1   CO1
     obey
     a) M.B statistics
     b) F.D. statistics
     c) B.E. statistics
     d) does not obey any statistics

GROUP – B
(Short Answer Type Questions)
Answer any *three* from the following: 3×5=15

		Marks	CO No.
2.	If the wave function $\psi(x)$ of a quantum mechanical particle is given by $$\psi(x) = a \sin \frac{n\Pi x}{L} \text{ for } 0 \le x \le L$$ $$= 0 \text{ otherwise}$$ then find the value of x where the probability of finding the particle is maximum. Show that the first excited state of a free particle in a cubicle box has three-fold degeneracy	5	CO2
3.	Evaluate $[L_x, L_y]$	5	CO4
4.	Explain the behavior of dielectric in an alternating field in different frequency range. Hence show that dielectric loss is proportional to the imaginary part of complex dielectric constant in an alternating field.	5	CO3
5.a)	What is Bohr Magneton ? Give the expression and value of it.	3	CO3
b)	Why technologically all important materials are either Ferromagnetic or Ferrimagnetic ?	2	CO3
6.	What is nuclear binding energy? Draw the binding energy vs. mass number graph	5	CO4

GROUP – C
(Long Answer Type Questions)
Answer any *three* from the following: 3×15=45

		Marks	Co No.
7. a)	Define macrostate and microstate.	3	CO1
b)	Derive the expression for average energy in a metal at T=0K temperature	7	CO3
c)	Three distinguishable particles each of which can be in one of the E, 2E, 3E, 4E energy states have total energy 6E. Find all possible number of distributions of all particles in the energy states. Find the number of microstates in each case.	5	CO4
8. a)	What is `local field' in a dielectric ? Establish Clausius-Mossoti relation for a solid dielectric in static field.	6	CO3
b)	What is ferroelectric effect ? Draw the hysteresis curve with proper labelling.	5	CO3
c)	Calculate the induced dipole moment /volume of He gas if it is placed in an electric field of 6000 v/m. The Atomic polarizability of He is 0.18 x 10-40 F-m2 and density of He is 2.6 x 10 25 atoms/m^3.	4	CO3
9. a)	Explain qualitatively the phenomenon of paramagnetism using Langevin function & corresponding Langevin curve and hence obtain Curie law.	5	CO3
b)	How is it modified for ferromagnetic case ? Discuss using Weiss molecular field theory.	3	CO3
c)	How do you compare the behavior of soft and hard magnetic materials using Hysteresis Curves. Hence give examples of two such materials in each case.	3	CO3
d)	Saturation magnetic induction of Ni is 0.65 Wb/m^2 . If the density of Ni is 8906 kg/m^3 and its atomic weight is 58.7, calculate the magnetic moment of the Ni atom in Bohr Magneton.	4	CO3

10.	a)	What was the correction made by Sommerfeld over the classical Lorentz-Drude theory?	6	CO1
	b)	According to Sommerfeld's theory, show that electrons in a solid have discrete set of energies.	2	CO4
	c)	Name a system in which free electron theory is applicable.	2	CO1
	d)	According to free Electron Theory, show that the resistivity of a metal varies with square root of Temperature.	5	CO3
11.	a)	State Bloch theorem.	2	CO1
	b)	Starting from the equation found from the "Kronig-Penney model", show that the energy of particle becomes discrete if the barrier strength becomes infinite.	3	CO4
	c)	Draw Energy (E) vs. Wave vector (k) graph for electrons moving within periodic potential. Explain the nature of the graph.	5	CO4
	d)	Explain the application of nano materials in different fields.	3	CO2
	e)	What is nuclear fission and nuclear fusion?	2	CO1

4th
sem.