GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2021
PHYSICS-II
PH401

TIME ALLOTTED: 3HR **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)	Dielectrics materials are used in between the capacitor plates to a) Increase the electric field b) Increase capacitance c) Decrease capacitance d) Decrease electric field	1	CO1
	(ii)	In the absence of an external electric field in a dielectric substance, the electric dipoles are a) Parallel b) Alternatively anti-parallel c) Randomly oriented d) None of the above	1	CO2
	(iii)	Magnetic moment of atom arises due to a) The spin of electrons b) The angular momentum of electrons c) The spin of nucleus d) All of the above	1	CO2
	(iv)	Magnetic hysteresis means a) B lags behind H b) H lags behind B c) B lags behind M d) M lags behind H	1	CO1
	(v)	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) $E_2=2\ E_1$ b) $E_2= E_1$ c) $E_2=4\ E_1$ d) $E_2=3\ E_1$	1	CO3

(vi)	A gas has two indistinguishable particles in 3 separate quantum states obeying BE statistics. The numbers of microstates are a) 6 b) 9 c) 3 d) 2	1	CO2
(vii)	For T 〉 0K, the probability of occupancy of an electron at Fermi level is a) $\frac{1}{2}$ b) 0 c) 1 d) none of these	1	CO1
(viii)	The expectation value $\langle x \rangle$ for a one dimensional potential box of length L in the ground state is a) $\frac{L}{4}$ b) $\frac{L}{2}$ c) $\frac{L}{8}$ d) 0	1	CO2
(ix)	Nucleus with higher mass number (heavy nucleus) is a) Stable b) Unstable c) Cannot be radioactive d) None of the above	1	CO2
(x)	Magnitude of average binding energy per nucleon is a) 6MeV b) 5 MeV c) 8 Mev d) 9 Mev	1	CO1
(xi)	According to band theory of solid, electrons are moving inside a metal under a) Constant potential b) zero potential c) periodic potential d) exponential potential	1	CO2
(xii)	According to Lorentz- Drude theory, electrons obey a) M-B statistics b) F-D statistics c) B-E statistics d) F-D statistics and B-E statistics both	1	CO2

GROUP – B

(Short Answer Type Questions)

Answer any ***three*** from the following: **3×5=15**

			Marks	**CO No**
2.	(a)	What is local field for a solid dielectric ?	2	CO2
	(b)	Hence derive Clausius-Mossotti relation under static field.	3	CO1

3.		Explain qualitatively the phenomenon of paramagnetism using Langevin function & corresponding Langevin curve & obtain Curie law.	5	CO3
4.	(a)	Distinguish between three statistics.	3	CO2
	(b)	What is the classical limit of quantum mechanics.	2	CO3
5.		Show that there is a finite probability of tunneling for a particle moving with energy $E < V_0$ where V_0 is the height of the potential barrier.	5	CO3
6.	(a)	What is the potential felt by an electron in a solid due to the presence of positive ion? Show graphically the nature of the periodic potential inside the solid. Explain the region of maximum potential energy and minimum potential energy.	3	CO1,CO4
	(b)	State Bloch theorem	2	CO1
7.	(a)	State a few applications of Nano material	1	CO3
	(b)	What is nuclear binding energy? Draw a graph showing the variation of binding energy per nucleon with respect to mass number. From the graph explain which nuclei are the most stable and why. Also, explain the significance of the peaks present in the graph.	4	CO1,CO5

GROUP – C

(Long Answer Type Questions)

Answer any ***three*** from the following: **3×15=45**

			Marks	**CO No.**
7.	(a)	Derive $\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$, where symbols have their usual meaning.	3	CO2
	(b)	Explain qualitatively the behaviour of dielectrics under alternating field in different frequency range.	5	CO1
	(c)	Show that the dielectric loss is proportional to the imaginary part of complex dielectric constant.	5	CO1
	(d)	What is piezoelectricity ?	2	CO3
8.	(a)	What are the two hypotheses of Weiss Molecular field theory?	3	CO3
	(b)	Draw & Explain Ferromagnetic Hysteresis curve identifying coercive force and remanent flux density. How do you compare the behavior of soft and hard magnetic materials using such diagrams.	4	CO3
	(c)	Saturation magnetic induction of a material is 0.54 Wb/$\mathbf{m^2}$. If the density of it is 6597 kg/$\boldsymbol{m^3}$ and its atomic weight is 32.7, calculate the magnetic moment of each atom of the material in Bohr Magneton.	4	CO3

9.	(a)	Three particles each of which can be in one of ϵ, 2ϵ, 3ϵ , 4ϵ energy states have total energy 6ϵ. Find all possible number of distributions of the particles in the energy states if the particles obey (i) M-B statistics (ii) B-E statistics (iii) F-D statistics	6	CO3
	(b)	Apply F-D statistics to find total number of free electrons in a metal at 0^0K temperature.	5	CO3
	(c)	What are bosons and fermions? Give examples	4	CO2
10.	(a)	If the wave function $\psi(x)$ of a quantum mechanical particle is given by $\psi(x) = a\sin\frac{n\Pi x}{L}$ for $0 \le x \le L$ $= 0$ *otherwise* then find the value of x where the probability of finding the particle is maximum.	5	CO3
	(b)	Prove that the first excited state of a free particle in a cubicle box has three-fold degeneracy What do you mean by Hermitian operator?	5	CO2
	(c)	Find $\langle x \rangle$ for a particle in a one dimension potential box in ground state.	5	CO3
11.	(a)	What is "Free electron gas model"? What are the postulates made by Lorentz and Drude in developing free electron gas model? In case of electron conduction in metal, what are the forces acting on the electron? How does drift velocity is reached?	5	CO1,CO4, CO2
	(b)	Find out a relationship between resistivity and temperature for a metal	5	CO3
	(c)	Starting from the equation of Kronig- Penney model, $P\frac{\sin \alpha a}{\alpha a} + \cos \alpha a = \cos ka$ Show that particle becomes free and energy of particle becomes continuous if 'P' becomes zero and particle is bound if $P \to \infty$	5	CO4