GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2020-2021

Physics – II (Backlog)

PH301

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)	The number of possible arrangements of two fermions in 3 cells is a. 9 b. 6 c. 3 d. 1	1	CO1
	ii)	Quantum dot is a a. 1-D structure b. 2-D structure c. 0-D structure d. Bulk	1	CO1
	iii)	In a region of constant potential a. the electric field is uniform. b. the electric field is zero. c. there can be no charge inside the region. d. both (b) and (c) are correct.	1	CO1
	iv)	In three dimension the momentum operator is a. $\mathbf{p} = -\frac{\hbar}{i}\nabla$ b. $\mathbf{p} = -\frac{i\hbar}{\nabla}$ c. $\mathbf{p} = \frac{\hbar}{i}\nabla$ d. $\mathbf{p} = \frac{\hbar}{i}$	1	CO1
	v)	Hall effect cannot be observed in a. conductor b. insulator c. semiconductor d. any one of these	1	CO1

vi)	Which of the following materials show 1-D confinement? a. CNT b. Graphene c. Graphite d. Fullerene	1	CO1
vii)	Commutator bracket of of [x, p] is a. +iħ b. - iħ c. -1 d. +1	1	CO4
viii)	In free space, the Poisson equation becomes a. Maxwell equation b .Ampere equation c. Laplace equation d. Steady state equation	1	CO1
ix)	Phonon obeys a. MB statistics b. BE statistics c. FD statistics d. Classical statistics	1	CO1
x)	RAM is a a. primary storage device b. magnetic storage device c. Semiconductor storage device d. Optional storage device	1	CO1
xi)	∇.B=0 indicates that a. magnetic monopole does exist in nature b. nothing can be concluded about magnetic poles c. magnetic monopole does not exist in nature d. none of these	1	CO1
xii)	A material with one dimension in Nano range and the other two dimensions are large is called ___________ a. Micro-material b. Quantum wire c. Quantum well d. Quantum dot	1	CO1

GROUP – B

(Short Answer Type Questions)

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

			Marks	**CO No**
2.	a)	Estimate value of is $\left[x, \hat{\frac{\partial}{\partial x}}\right]$	2	CO2
	b)	Calculate expectation value of linear momentum $\langle p \rangle$ for $\psi(x)=\sqrt{\frac{2}{L}}\sin\frac{\pi x}{L}$, 0<$\lvert x \rvert$<L and $\psi(x)$=0 $\lvert x \rvert$>L.	3	CO2

3.	a)	What is Ampere's circuital law. Obtain its differential form.	3	CO1
	b)	What is the limitation of it ? How is it corrected?	2	CO2
4.	a)	Find the state of polarization when x- and y- components of electric fields are (i) $E_x = E_0 \sin(\omega t+kz)$ and $E_y = E_0 \cos(\omega t+kz)$ (ii) $E_x = E_0 \cos(\omega t+kz)$ and $E_y = (E_0/\sqrt{2}) \cos(\omega t+kz+\pi)$	4	CO2
	b)	State Brewster's law	1	CO1
5.	a)	Interpret the physical importance of the Fermi Dirac distribution function at T>0K.	3	CO 3
	b)	A particle of mass m is moving along +x axis from 0<x towards x>0 and faces a finitely high potential energy barrier of height $V(x)= V_0$ at x = 0 . V(x) = 0 for x<0 and $V(x) = V_0$ for $x \geq 0$. If energy of the particle, E is less than V_0 is it possible for the particle to be present in region $x \geq 0$? If yes how and what is the name of this effect.	2	CO 2
6.	a)	Prove that the first excited state of a free particle in cubical box has three fold Degeneracy	3	CO 2
	b)	Show that $(1+d/dx)^2 = 1+2d/dx+d^2/dx^2$	2	CO 3

GROUP – C
(Short Answer Type Questions)

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

			Marks	**CO No**
7.	a)	A particle of mass m is moving along +x axis and is restricted to move between x=0 and x=a, there two infinitely high potential energy barrier at x= 0 and x=a	5	CO 1
	b)	Also obtain corresponding energy eigen values.	2	CO 1
	c)	Plot the ground state and 1st excited state of the system.	3	CO2
	d)	In ground state find out the average position of the particle.	3	CO2
	e)	State the area of application of superposition principle of Quantum Mechanics	2	CO2
8.	a)	Explain Fermi Distribution Function at zero and non zero temperatures (with figure).	4	CO1
	b)	Find out the numbers of possible arrangements of 3 particles in 3 shells according to I. MB statistics II. BE statistics III. FD statistics	8	CO1
	c)	Write down the expression of Pauli spin matrices.	3	CO 2
9.	a)	Using Biot-Savart's law, show that no isolated magnetic monopole exist.	4	CO1
	b)	If the vector potential $\mathbf{A} = (x^2 + y^2 - z^2)\,\mathbf{j}$ at position (x, y, z) find the magnetic field at (2, 2, 2).	2	CO2
	c)	Starting from Maxwell's equations in a charge free medium, obtain the wave equations for magnetic field.	4	CO2

	d)	Using the plane wave solution, show that e.m. wave is transverse in character.	5	CO2
10.	a)	Find out the expression for potential drop and electric field between two plates of a parallel plate capacitor.	6	CO2
	b)	Write down Gauss's law in electrostatics and derive its differential form.	4	CO2
	c)	What is Hall effect? Which force is playing important roll in this effect?	4	CO2
	d)	What is bit?	1	CO2
11.	a)	Explain the term electric flux. What are the dimension and unit of it?	3	CO2
	b)	For an electric potential $V(x,y,z)=\frac{1}{\sqrt{2x^2+4y^2+3z^2}}$ calculate the electric field at (1,1,1)	4	CO2
	c)	Estimate electric field of cylindrical sphere capacitor applying Laplace equation (i) outside the sphere (ii) on the surface of the sphere (iii) in side the sphere.	6	CO3
	d)	Express Gauss's law in differential form. Explain its physical significance	2	CO2