SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Physics
B. Tech. (Sem-II)
Mid-Term Examination (Even Semester) 2024-25

Entry No: | 2 | 4 | B | E | C | 0 | 5 | 5 | | **Total Number of Pages: [02]**

Date: 18.03.2025 **Total Number of Questions: [03]**

Course Title: Engineering Physics
Course Code: PHL BS102

Time Allowed: 1.5 hours **Max Marks: [20]**

Instructions / NOTE

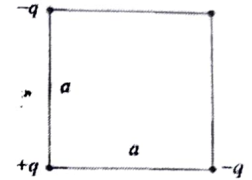
i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume any missing data to suit the case/ derivation / answer.

Section –A (Multiple Choice Questions)

Q. 1	**(i)** The condition under which the line integral of electric field $\vec{E}$ does not vanish is (a) $\vec{E}$ is irrotational (b) $\vec{E}$ is conservative (c) $\vec{E}$ is non-conservative (d) $\vec{E}$ is discontinuous	[1]	CO1
	(ii) For any vector F, the equation representing Stokes theorem is given as: (a) $\int(\vec{\nabla}\cdot\vec{F})\,d\tau = \oint(\vec{\nabla}\times\vec{F})\cdot d\vec{a}$ (b) $\int(\vec{\nabla}\cdot\vec{F})\,d\tau = \oint\vec{F}\cdot d\vec{a}$ (c) $\int(\vec{\nabla}\times\vec{F})\cdot d\vec{a} = \oint\vec{F}\cdot d\vec{l}$ (d) $\int_a^b(\vec{\nabla}T)\cdot d\vec{l} = T(b)-T(a)$	[1]	CO1
	(iii) If a uniform electric field is acting at right angles to the magnetic field in some region of space, then a charged particle q released at rest will follow (a) circular path (b) cycloid path (c) elliptical path (d) hyperbolic path	[1]	CO1
	(iv) The equation of continuity in electromagnetism represents the conservation of (a) electric charge (b) electric current (c) volume charge density (d) volume current density	[1]	CO1

P.T.O.

Section –B (Short Answer/ Numerical Type Questions)

Q. 2	**(a)** Use Gauss's law to find the electric field $(\vec{E})$ inside solid sphere of radius R carrying a charge density varies as $\rho = kr$, for the r from the centre and some constant k. Plot $\lvert\vec{E}\rvert$ vs r.	[2]	CO1, CO2
	(b) The potential in a certain region of space is given by the function xy^2z^3 with respect to some reference point. Find the y-component of the electric field at (–1, 3, 2).	[2]	CO2
	(c) Three charges are situated at the corners of a square (side a), as shown in the figure. How much work does it take to bring in another charge $+q$, from far away and place it in the fourth corner? 	[2]	CO2
	(d) Why do "*Magnetic forces do no work*". Support your answer with mathematical explanation.	[2]	CO1

Section –C (Long Answer Questions)

Q. 3	**(a)** Define line, surface and volume charge distributions. Find the electric field intensity at distance z above the center of the flat circular disk of radius a which carries a uniform surface charge σ.	[4]	CO1, CO2
	(b) What is displacement current? How does the concept of displacement current leads to the modification in Ampere circuital law?	[4]	CO1

CO1. To know the vocabulary and concepts of Physics as it applies to: Electricity and Magnetism and Modern Physics.

CO2. To develop the mathematical description of these concepts and principles to build up problem solving skills in Electrodynamics and Modern Physics

$\int E \cdot dl = -\frac{d\Phi_B}{dt}$ $\quad \nabla \times E \neq 0$ $\quad \int B \cdot dl =$ $\quad \int B dl = \nabla \times B$

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

School of Physics
B. Tech. (Sem-II)
Major Examination (Even Semester) 2024-25

Entry No: 24BEC055
Date: 22.07.2025

Total Number of Pages: [02]
Total Number of Questions: [03]

Course Title: Engineering Physics
Course Code: PHL BS102

Time Allowed: 3 hours **Max Marks: [40]**

Instructions/ NOTE:

i. Attempt All Questions. Question No. 3 has internal choice for each part.
ii. Support your answer with neat freehand sketches/ diagrams, wherever appropriate.
iii. Assume any missing data to suit the case/ derivation/ answer.

	Section –A (Very Short Answer Questions)		
Q. 1	(i) What is the de-Broglie wavelength (in Å) of an electron accelerated through 100 V?	**[1]**	**CO1**
	(ii) What physical quantity does the curl of magnetic field $\vec{H}$ represent?	**[1]**	**CO1**
	(iii) Define Fermi level in semiconductors.	**[1]**	**CO4**
	(iv) What should be the appropriate Gaussian surface for an infinitely long straight wire?	**[1]**	**CO2**
	(v) For which property of $\vec{B}$ does its curl has non-vanishing character?	**[1]**	**CO1**
	(vi) The quantity $\lvert\psi(x,t)\rvert^2$ represents _____, where $\psi(x,t)$ is the wavefunction.	**[1]**	**CO3**
	(vii) If a charge q_o is carried from infinity to a point having electrical potential as $V(r)$, then the amount of work done will be _____.	**[1]**	**CO2**
	(viii) What type of relationship exists between density of states and energy E in 1D.	**[1]**	**CO4**
	Section –B (Short Answer/ Numerical Type Questions)		
Q. 2	(i) Write any two conclusions of the Davisson-Germer experiment.	**[2]**	**CO3**
	(ii) Show that $\vec{\nabla} \cdot \vec{B} = 0$.	**[2]**	**CO2**
	(iii) Calculate the speed of an electromagnetic wave in a medium having dielectric constant as 5 and relative permeability as 5.	**[2]**	**CO3**
	(iv) What will be the magnitude and direction of the electric field at point P between the two plates as shown in figure?	**[2]**	**CO1**
	(v) Define expectation value. How is the expectation value of momentum represented mathematically?	**[2]**	**CO3**
	(vi) What are commutators? Find the commutator $[x,\ p_x]$.	**[2]**	**CO4**
	Section –C (Long Answer Questions)		
Q. 3	(i) A uniformly charged ring of radius r and linear charge density λ lies in the XY-plane. Find the electric field at a point at perpendicular distance z above the centre of the ring. **OR** State Gauss's law in electrostatics. Use it to find the electric field due to a uniformly charged solid sphere of radius R and charge density ρ at the points (i) inside and (ii) outside the sphere.	**[4]**	**CO1, CO2**
	(ii) Define volume current density. Suppose the current density in a wire with circular cross-section of radius a is proportional to the distance s from the axis as $J = ks$ (for some constant k). Find the total current in the wire. **OR** Obtain the differential form of Faraday's law of electromagnetic induction. Give its physical significance.	**[4]**	**CO1, CO2**

P.T.O.

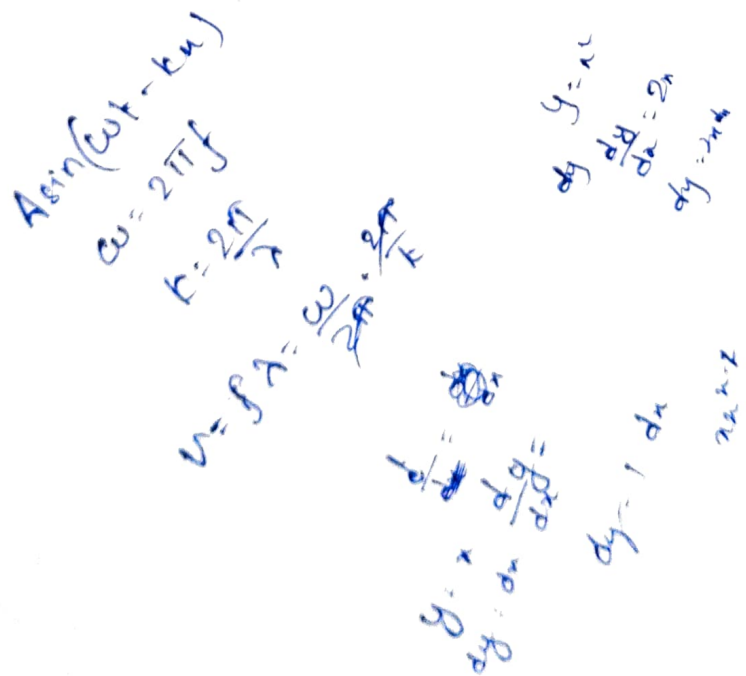
	(iii) What is the Compton Effect? Derive an expression for the Compton wavelength shift. **OR** Define phase and group velocities. Establish relation between them.	[4]	CO1, CO3
	(iv) What is wave function? Derive the time-dependent Schrödinger wave equation. **OR** Derive the energy eigenvalues for a particle confined in a one-dimensional infinite potential well of width L.	[4]	CO2, CO3
	(v) Explain the band theory of solids. How can conductors, semiconductors and insulators be classified on the basis of band theory? **OR** Define density of states and derive its expression for free electron gas confined in one dimensional box of infinite walls.	[4]	CO3, CO4

CO1. To know the vocabulary and concepts of Physics as it applies to: Electricity and Magnetism and Modern Physics.

CO2. To develop the mathematical description of these concepts and principles to build up problem solving skills in Electrodynamics and Modern Physics

CO3. To gain confidence to develop methods in Quantum Mechanics to understand Physics problems in real-life situations to benefit their future career.

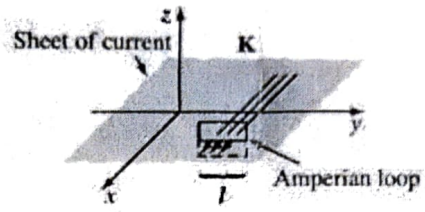
CO4. To apply Modern Physics concepts for understanding problems related to free electron theory and band theory of solids.



SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Physics
B. Tech. 2nd Semester, Minor-II Exam
Course Title: Engineering Physics

Course Code: PHL BS102 **Time: 1hr**
Total Marks: 20 **Date: 15-04-24**
Note: *Attempt all questions. Each question carries 04 marks.*

Q. No.1:(a): Find the magnetic field of an infinite uniform surface current K = K x^, flowing over the x y plane? **[2 Marks]**



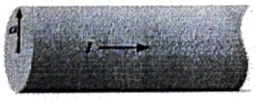
(b): Obtain differential form of Faraday's Law $\nabla X E = -\partial B \partial t$ **[2 Marks]**

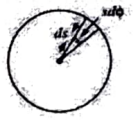
OR

Discuss briefly the limitation of amperes circuital law and derive the modified Ampere's Circuital law. **[4 Marks]**

Q. No.2: **(a)**Consider current **I** is uniformly distributed over a wire of circular cross section, with radius **a**. Find the volume current density **J**. **[2 Marks]**

(b): Suppose the current density in the wire is proportional to the distance from the axis, **J** = **ks** (for some constant k). Find the total current in the wire. **[2 Marks]**



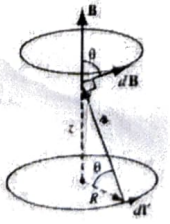


OR

(a) Write the electric field and magnetic field in terms of scalar and vector potential. **[2 Marks]**

(b) Write the biot- Savart law for surface current and volume current. **[2 Marks**

Q. No.3: Find the magnetic field a distance z above the center of a circular loop of radius **R,** which carries a steady current **I** ? **[4 Marks]**



Q. No.4: State and derive the equation of continuity. **[4Marks]**

Q. No.5: Find the magnetic field a distance s from a long straight wire carrying a steady current **I,** using Biot-Savart Law. **[4 Marks]**

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

School of Physics

B. Tech. 1st Semester, Minor-1 Exam

Course Title: Engineering Physics

Course Code: PHL BS102

Total Marks: 20 **Time: 1hr**

Note: *Attempt any 05 questions. Each question carries 04 marks.* **Date: 27-02-24**

Q. No.1: Evaluate the following integrals using the properties of Dirac Delta function: [4 Marks]

(i): $\int_{-\infty}^{\infty} \delta(x)\, dx$

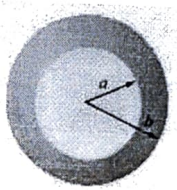
(ii): $\int_{-2}^{2} (2x+3)\, \delta(3x) dx$

(iii): $\int_{-1}^{1} 9x^2\, \delta(3x+1) dx$

(iv): $\int_{-\infty}^{\infty} \ln(x+3)\, \delta(x+2) dx$

Q. No.2: Consider a thick spherical shell carries charge density: [4 Marks]

$\rho = \frac{k}{r^2}$; (a ⩽ r ⩽ b)



Calculate the electric field in the three regions (i): $r < a$, (ii): $a < r < b$ (iii): $r > b$.

Q. No.3: Consider a long cylinder carrying a charge density that is proportional to the distance from the axis: **ρ = ks,** for some constant k. Find the electric field inside and outside the cylinder? [4 Marks]

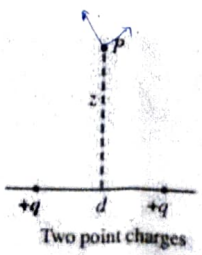
Q. No.4: Derive an expression for work done to assemble a group of point charges. [4 Marks]

Q. No.5: Find the electric field at a distance z above the midpoint of a straight-line segment of length of 2L carrying uniform line charge λ? [4 Marks]

Q. No.6: Calculate electric field inside and outside of uniformly charged sphere of radius **R** carrying charge density **ρ**? [4 Marks]

Q. No.7: (a): Write mathematical form of Stokes and Gauss divergence theorem? [2 Marks]

(b): Calculate potential at a distance z above the canter of the charge distributions as shown in figure? [2 Marks]



Two point charges

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

School of Physics

B. Tech. (Sem-II)

Major Examination (Even Semester) 2024-25

Entry No: 2 3 b e c 0 0 6

Date: 22.07.2025

Total Number of Pages: [02]

Total Number of Questions: [03]

Course Title: Engineering Physics

Course Code: PHL BS102

Time Allowed: 3 hours **Max Marks: [40]**

Instructions/ NOTE:

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ii. Support your answer with neat freehand sketches/ diagrams, wherever appropriate.

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	Section –A (Very Short Answer Questions)		
Q. 1	**(i)** What is the de-Broglie wavelength (in Å) of an electron accelerated through 100 V?	**[1]**	**CO1**
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	(iii) Define Fermi level in semiconductors.	**[1]**	**CO4**
	(iv) What should be the appropriate Gaussian surface for an infinitely long straight wire?	**[1]**	**CO2**
	(v) For which property of $\vec{B}$ does its curl has non-vanishing character?	**[1]**	**CO1**
	(vi) The quantity $\lvert\psi(x,t)\rvert^2$ represents _____, where $\psi(x,t)$ is the wavefunction.	**[1]**	**CO3**
	(vii) If a charge q_o is carried from infinity to a point having electrical potential as $V(r)$, then the amount of work done will be _____.	**[1]**	**CO2**
	(viii) What type of relationship exists between density of states and energy E in 1D.	**[1]**	**CO4**
	Section –B (Short Answer/ Numerical Type Questions)		
Q. 2	**(i)** Write any two conclusions of the Davisson-Germer experiment.	**[2]**	**CO3**
	(ii) Show that $\vec{\nabla} \cdot \vec{B} = 0$.	**[2]**	**CO2**
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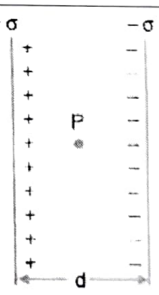
	(ii) Define volume current density. Suppose the current density in a wire with circular cross-section of radius a is proportional to the distance s from the axis as $J = ks$ (for some constant k). Find the total current in the wire. **OR** Obtain the differential form of Faraday's law of electromagnetic induction. Give its physical significance.	**[4]**	**CO1, CO2**



P.T.O.

	(iii) What is the Compton Effect? Derive an expression for the Compton wavelength shift. **OR** Define phase and group velocities. Establish relation between them.	**[4]**	**CO1, CO3**
	(iv) What is wave function? Derive the time-dependent Schrödinger wave equation. **OR** Derive the energy eigenvalues for a particle confined in a one-dimensional infinite potential well of width L.	**[4]**	**CO2, CO3**
	(v) Explain the band theory of solids. How can conductors, semiconductors and insulators be classified on the basis of band theory? **OR** Define density of states and derive its expression for free electron gas confined in one dimensional box of infinite walls.	**[4]**	**CO3, CO4**

CO1. To know the vocabulary and concepts of Physics as it applies to: Electricity and Magnetism and Modern Physics.

CO2. To develop the mathematical description of these concepts and principles to build up problem solving skills in Electrodynamics and Modern Physics

CO3. To gain confidence to develop methods in Quantum Mechanics to understand Physics problems in real-life situations to benefit their future career.

CO4. To apply Modern Physics concepts for understanding problems related to free electron theory and band theory of solids.

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SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

School of Physics

B. Tech. 1st Semester, Major Exam

Course Title: Engineering Physics

Course Code: PHL 1012 **Time: 3hr**

Total Marks: 50 **Date: 27-12-2023**

Note: Attempt any 04 questions from section B. Each question carries 10 marks

Section A:

Q. No.1: Choose the correct option of the following: [10 Marks]

i) The idea of dual nature of light for all microscopic particles was given by:

a) Planck b) Einstein c) de-Broglie d) none of these

ii) For relativistic motion of a particle, the phase velocity will be equal to

a) c b) v/2 c) 2c/v d) 2v/c

iii) Schrodinger wave equation is applicable to

a) non-relativistic motion b) relativistic motion c) neither for a nor b d) both a and b

iv) Who observed that a time varying magnetic field gives rise to an electric field?

a) Maxwell b) Ampere c) Oersted d) Faraday

v) Maxwell corrected which one of the following laws?

a) Ampere's b) Faraday's c) Gauss' d) None of these

vi) Conductivity of insulator is

a) high b) low c) variable d) None of these

vii) Position of Fermi level in intrinsic semiconductor is

a) Below the conduction band b) Above valance band

c) Midway of the conduction and valance bands d) None of these

viii) In Compton effect, the maximum change in wavelength will be for photo scattering at an angle

a) 0^0 b) 90^0 c) 180^0 d) 45^0

ix) In Davisson-Germer experiment, intensity was maximum for accelerating voltage equal to

a) 50 b) 54 c) 30 d) 70

x) Lorentz force is based on

a) Dot product b) Cross product

c) Both dot and cross products d) Independent of both dot and cross products

Section B:

Q. No.2: (a) Solve time independent Schrodinger's equation for a particle in one dimensional box. Show that its energy is given as:

$$E = \frac{n^2\pi^2\hbar^2}{2ml^2}$$

[7 Marks]

(b) Prove the commutator [x, p] = $i\hbar$, where x and p, are position and momentum operators.

[3 Marks]

Q. No. 3: (a)Find the magnetic field, both inside and outside the wire, if the current is distributed in such a way that J is proportional to s, the distance from the axis.? [6 marks]

(b): Obtain the differential form of faradays law $\nabla X E = -\frac{\partial B}{\partial t}$ and write its integral form

[4 Marks]

Q. No. 4: Suppose the electric field in some region is found to be $\vec{E} = kr^3\hat{r}$, in spherical coordinates (k is some constant)

(a): Find the charge density ρ [6 Marks]

(b): Find the total charge contained in a sphere of radius R, centered at the origin. [4 Marks]

Q. No.5: (a) Obtain the time-dependent and time-dependent Schrödinger wave equation for a particle [5 Marks]

(b): Classify metals, semiconductors and insulators on the basis of energy bands in detail

[5 Marks]

Q. No.6: (a): Explain Compton effect and obtain expression for change in wave length in Compton effect. [5 Marks]

(b): Explain Drude Lorentz free electron theory in detail? [5 Marks]