Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2022

Course: Electricity & Magnetism — **Semester: II**

Program: BSc (H) Physics — **Time : 03 hrs.**

Course Code: PHYS 1013 — **Max. Marks: 100**

Instructions:

- There are 3 Sections such as Section A, B & C.
- Section A is compulsory, however, Section B & Section C have internal choices.
- Scientific calculator is allowed

SECTION A

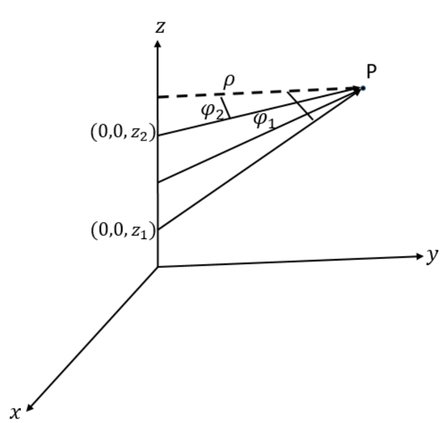
(5Qx4M=20Marks)

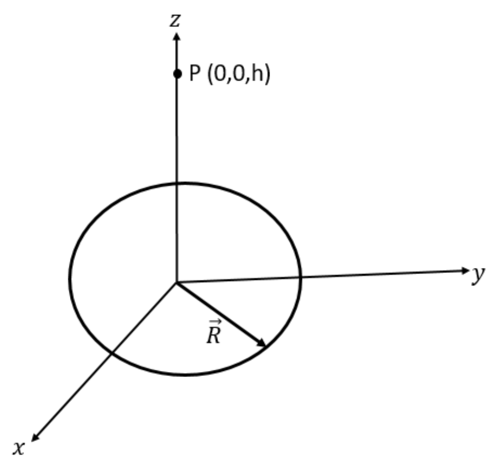
S. No.		Marks	CO
Q1	For electrostatic field $(\vec{E})$ and potential (V), establish the following relationship: $$\vec{E} = -\vec{\nabla}V$$	**4**	**CO1**
Q2	Discuss the origin of spin magnetic moment, and find an expression for this in terms of Bohr Magneton	**4**	**CO2**
Q3	Differentiate between polar and non-polar dielectrics. Briefly explain the polarization process in non-polar dielectrics.	**4**	**CO1**
Q4	The potential due to a dipole is given as: $$V = \frac{\vec{p}\cdot\hat{r}}{4\pi\epsilon_0 r^2}$$ where $\vec{p}$ is the dipole moment. Find the Electric field at any point P(r, θ, φ) in space.	**4**	**CO2**
Q5	Find an expression for the energy stored in a capacitor of capacitance C, which is charged to a potential difference of γ.	**4**	**CO2**

SECTION B

(4Qx10M= 40 Marks)

Q6	What is a phasor diagram? Derive the current flowing in an RC circuit powered by the voltage source $v(t) = V_0 \sin \omega t$. Discuss the current and voltage phasors using a phasor diagram.	**10**	**CO3**
Q7	What are the characteristics of an ideal solenoid?	**10**	**CO2**

	Considering a solenoid of length l, total number of turns as N, and current flowing in the solenoid as I, derive the magnetic field at the center of the solenoid. If the solenoid is kept in a medium having permeability as μ_m, find the magnetic flux density due to the solenoid		
Q8	Write statements for Poisson and Laplace's equations. State and prove first Uniqueness Theorem.	**10**	**CO1**
Q9	Derive the capacitance of two concentric spherical shells having inner radius as β and outer radius as d. Outer shell is uniformed charged with charge $-Q$ and inner sphere is uniformly charged with a charge $+Q$. **OR** Derive the capacitance of two concentric cylindrical surfaces having inner radius as a and outer radius as b. The height of the cylindrical capacitor is β. Outer surface is uniformed charged with charge $-Q$ and inner surface is uniformly charged with a charge $+Q$	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q10	A finite conductor carrying a current I is placed along $z-a$xis. The length of the conductor is $l = z_2 - z_1$, where $(0,0,z_1)$ and $(0,0,z_2)$ are the coordinates of bottom and top most points of the conductor, respectively (see the figure below). Prove that the magnetic field intensity at any point P in space is given as: $$\vec{H} = \frac{I}{2\pi\rho}(\sin\varphi_1 - \sin\varphi_2)\hat{\varphi}$$ The symbols are shown in the given diagram; φ_1, φ_2 are the angular positions of bottom and top most points of the finite conductor w.r.t. ρ.  Using the expression for the magnetic field intensity for finite current carrying conductors, derive the magnetic field intensity for an infinite current conductor.	**20**	**CO4**

	OR State Ampere's circuital law in integral and differential forms. Using Biot-Savart Law, find the magnetic field intensity at point P (0,0,h) along $z-$ axis due to a circular loop of radius R placed in the plane $z = 0$. The loop is carrying a current I. Discuss the magnetic field at the center of the circular loop. 		
Q11	What are active elements of a circuit? Write down the expressions for the impedance of LR, CR, LC and LCR circuits. Derive the current flowing in an LR circuit powered by ac voltage source $v(t) = V_0 \sin \omega t$ with the help of EMF equation. Using the phasor diagram also, derive the resultant current in the circuit.	**20**	**CO3**