Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

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	Discuss briefly the origin of magnetic moment in materials. Find the magnetic moment due to orbital motion of electrons in an atom in terms of Bohr Magneton.	**4**	**CO1**
Q2	What are active elements of a circuit? Write down the expressions for the impedance of LR, CR, LC and LCR circuits.	**4**	**CO2**
Q3	What are paramagnetic materials? Discuss the effect of temperature on paramagnetic materials	**4**	**CO1**
Q4	Discuss the mechanism of polarization in non-polar dielectric materials.	**4**	**CO1**
Q5	Briefly explain Thevenin's theorem with the help of AC and DC networks.	**4**	**CO3**
	SECTION B **(4Qx10M= 40 Marks)**		
Q6	Derive the expression for electrostatic energy stored in a discrete charge distribution $Q_1, Q_2, \ldots, Q_N$.	**10**	**CO2**
Q7	For an LC circuit, derive the expression for current in the following cases: a) No external voltage source is applied. The capacitor is charged with charge q_0 to begin with. b) An external AC voltage source, $V = V_0 \sin \omega t$, is applied.	**10**	**CO3**

	Discuss the results in both the cases. Also, draw the phasor diagram to explain the results.		
Q8	Explain the phenomenon of hysteresis in ferromagnetic materials. Define various terms like (a) Remnant Magnetization (b) Coercivity. Differentiate between soft and hard magnets based on the hysteresis.	**10**	**CO1**
Q9	State Ampere's circuital law in integral and differential forms. Using Ampere's law, find the magnetic field intensity due to an infinite sheet of current carrying a current density given as $\vec{K} = K_y\hat{J}$ Amp/m. The sheet is placed in $z = 0$ plane.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q10	a) Explain briefly the Faraday's law of electromagnetic induction and write down the expressions for transformer and motional emfs. (**5 Marks**) b) Derive the expression for mutual inductance of a coaxial solenoid in which the outer solenoid has radius r_2, number of turns N_2 and current flowing is I_2 and the inner solenoid has radius r_1, number of turns N_1 and current flowing is I_1. The length of both the solenoids is L. (**15 Marks**) **OR** a) Discuss the reasons behind Maxwell's correction in Ampere's law. Derive a mathematical expression for the correction. (**5 Marks**). (b) Consider some charge with a charge density ρ is distributed in a material with electrical permittivity ϵ and conductivity σ. Using charge conservation concept, find out ρ after a time t. Discuss the decay of ρ in the case of a conductor and insulator. (**15 Marks**)	**20**	**CO4**
Q11	Write the EMF equation for LCR circuit series circuit powered by a voltage source $v(t) = V_0 \sin \omega t$. Derive the expression for current flowing in the circuit under the action of the externally applied voltage. Discuss the conditions of resonance. Why it is called an acceptor circuit?	**20**	**CO3**