Name:

Enrolment No:

UPES
UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: B.Sc. Physics Hons — **Semester: II**
Program: Electricity and Magnetism — **Time 03 hrs.**
Course Code: PHYS1013 — **Max. Marks: 100**

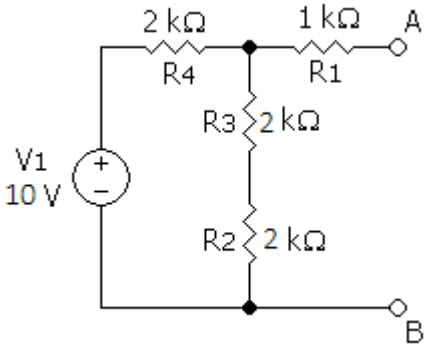
Instructions: All questions are compulsory. Values of constants are given at the end of paper.

SECTION A

S. No.		Marks	CO
Q 1	Define Magnetic flux and state Gauss's law of Magnetism.	**4**	**CO1**
Q2	The parallel plates of an air filled capacitor are 1.0 mm apart. Compute the plate area if the capacitance is 1.0 Farad.	**4**	**CO2**
Q3	State Laplace's and Poisson's equations.	**4**	**CO1**
Q4	Explain Kirchhoff's laws of AC Circuits with circuit diagrams.	**4**	**CO2**
Q5	State Faraday's law and Lenz's law. Explain the existence of both magnetic and electric fields in a time varying scenario.	**4**	**CO1**

SECTION B

Q6,7 and 8 are compulsory, with an internal choice in Q9

Q6	(a) State and explain Thevenin's theorem. (b) Apply the Thevenin's theorem to calculate the Thevenin's equivalent voltage V_{TH} and resistance R_{TH} and draw the Thevenin's equivalent circuit. 	**5** **5**	**CO2** **CO3**
Q7	Describe Ampere's circuital law and apply the law to calculate the value of magnetic field of a long solenoid.	**10**	**CO2**
Q8	State Maxwell's Equations in static and time varying fields in their differential and integral forms and explain their physical significance.	**10**	**CO1**

Q9	A moving conducting loop is placed in a time varying magnetic field. Using Faraday's law compute the emf of the loop. **OR** Describe the working of a moving coil Ballistic Galvanometer and establish the relation between the charge flowing and the ballistic throw θ of the galvanometer.	**10** **10**	**CO2** **CO2**
	Section C **Q10 is compulsory, with an internal choice in Q11**		
Q10	(a) A solenoid is having 20 turns and current of 5 amp is flowing in it. Determine the magnetic field due to this solenoid. Plot and analyze the variation of magnetic field, when (i) no. of turns are varied from 20 to 40 and 60, (ii) current is varied from 5 amp to 10 amp and 15 amp. (b) A spherical conductor of radius 12 cm has a charge of 1.6×10^{-7} C distributed uniformly on its surface. Calculate the electric field against the distance for following cases (i) at a point 18 cm from the center (ii) 14 cm from the center	**10** **10**	**CO4** **CO3**
Q11	(a) Deduce continuity equation using charge conservation law. Introduce the concept of displacement current to make Ampere's law consistent with non-steady currents. (b) Two capacitors having capacitances C_1 and C_2 with charges Q_1 and Q_2 are connected by a wire. Show that the loss of energy due to sharing of charges is given by $\frac{1}{2}\frac{C_1C_2}{C_1+C_2}$¿ where V_2 and V_2 are the potentials on two capacitors initially. **OR** (a) An electric dipole consists of two opposite charges of magnitude 2.0×10^{-6} Coulomb separated by 2.0 cm. The dipole is placed in an external field of 2.0×10^5 Newton/Coulomb. Calculate (1) the maximum torque on the dipole, (2) the work done to turn the dipole through 180°, starting from a position θ = 0°, where θ is angle between applied magnetic field and dipole. (b) Calculate the potential due to a dipole of dipole moment 4.5×10^{-10} C-m at a distance of 1 meter from it, (1) on its axis, and (2) on its perpendicular bisector.	**10** **10** **10** **10**	**CO3** **CO3** **CO3** **CO3**

Values of Constants:

Constant	Standard Values
permeability of free space (μ_o)	1.257 x 10^{-6} henry/meter
Permittivity of free space (ε_o)	8.854 x 10^{-12} Farad/meter
Rest mass of an Electron	9.11 × 10^{-31} kg
Charge of electron	1.6 × 10^{-19} C
Mass of proton	1.67 × 10^{-27} kg

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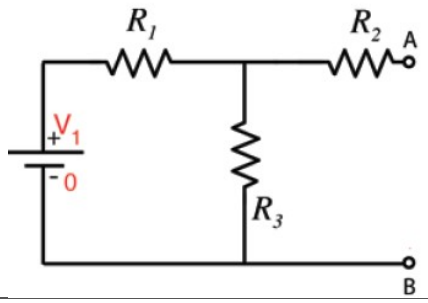
SECTION A

S. No.		Marks	CO
Q1	A 10 cm long wire carrying current of 10 amp. is held at an angle 30° with the direction of uniform magnetic field of strength 1 weber/meter^2. Compute the force acting on the wire	4	CO2
Q2	Define magnetization and distinguish between paramagnetic and diamagnetic materials.	4	CO1
Q3	State Gauss Divergence and Stokes theorem.	4	CO1
Q4	Describe Kirchhoff's laws of AC Circuits with circuit diagrams.	4	CO1
Q5	A long straight wire carries a current of 50 ampere. Compute the magnetic field on an electron travelling at a distance of 5.0 cm from the wire.	4	CO2
SECTION B **Q6,7 and 8 are compulsory, with an internal choice in Q9**			
Q6	(a) State and explain Norton's theorem. (b) Apply the Norton's theorem to calculate the Norton's resistance and Norton's current, given V_1= 10 V, R_1 = 1 Ω, R_2 = 2 Ω, R_3 = 4 Ω and draw the Norton's equivalent circuit.	5 5	CO1 CO3

			
Q7	(a) Define electric potential and establish the relation $E = -\nabla V$ (b) Deduce continuity equation by using charge conservation law.	**5** **5**	**CO2** **CO2**
Q8	Show that electrostatic energy of a uniformly charged sphere, U, is given by- $U = \frac{3}{5}\frac{Q^2}{4\Pi E_{0r}}$ Where, Q is the total charge on the sphere of radius r.	**10**	**CO3**
Q9	Derive Ampere's law in case of time varying fields. **OR** Describe the working of a moving coil Ballistic Galvanometer and establish the relation between the charge flowing and the ballistic throw θ of the galvanometer.	**10**	**CO2**
SECTION-C **Q10 is compulsory, with an internal choice in Q11**			
Q10	(a) A solenoid is having 10 turns and current of 2 amp is flowing in it. Determine the magnetic field due to this solenoid. Plot and analyze the variation of magnetic field, when (i) no. of turns are varied from 10 to 20 and 30, (ii) current is varied from 2 amp to 5 amp and 10 amp. (b) A spherical conductor of radius 10 cm has a charge of 1.6×10^{-7} C distributed uniformly on its surface. Calculate the electric filed (1) at a point 12 cm from the center (2) 16 cm from the center	**10** **10**	**CO4** **CO3**

Q11	(a) Deduce the Gauss's law in differential form and apply it to calculate the electric field due to an infinite line charge.	**10**	**CO3**
	(b) Define Electric dipole and show that electric potential, V, due to a dipole at any point is given by $V = \frac{1}{4\Pi E_0}\frac{p\cos\theta}{r^2}$ volts, where p is electric dipole moment, r is the distance of the point and θ denotes the direction.	**10**	**CO3**
	OR		
	(a) Derive the expression of torque on a current carrying coil in a uniform magnetic field.	**10**	**CO3**
	(b) Apply Biot-Savart law to calculate the magnetic field due to a current flowing in a straight wire	**10**	**CO3**

Values of Constants:

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permeability of free space (μ_o)	1.257 x 10^{-6} henry/meter
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