UG/2nd Sem/Phys/H/19

2019

B.Sc.

2nd Semester Examination

PHYSICS (Honours)

Paper - C3T

Full Marks : 40 Time : 2 Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer any *five* questions : 5×2=10

(a) The total charge in a sphere of vadius r about the centre of a spherial charge cloud of radius a is $\frac{qr^2}{a^2}\left(e^{-r/a} - e^{-\frac{2r}{a}}\right)$

Find out the corresponding field & potential.

(b) What is the signicance of displacement current density in regard to Ampere's law.

[Turn Over]

(c) The dieloectric constant of as monoatomic gas at NTP is 1.000538. Calculate the dipole moment induced in each atom when the gas is placed in an external electric field of 30 kV/m.

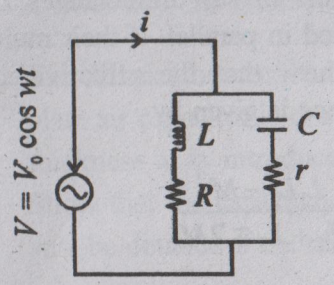
(d) A parallel plate capacitor of plate area A and plate seperation d is charged to as *pd* of v_0. It is now disconnected from source of pd and then its plate seperation is increased to 3*d*. Calculate work done for this.

(e) A solenoid 1m long and radius 4 cm has 1000 turns and is carrying a current of 1A. Find the magnetic field at the centre.

(f) The magnetic intensity in certain material having permability $\mu = 5\mu_0$ is given by $\vec{H} = 2\hat{i} + 5\hat{j} - 8\hat{k}$. Calculate the susceptibility of the material, magnetization $\vec{M}$ and the magnetic induction $\vec{B}$.

(g) In certain region of space the electric field is given by $\vec{E} = \hat{j}E_0 \text{ Cos } (wt - kx)$. Find the corresponding megnetic field $\vec{B}$.

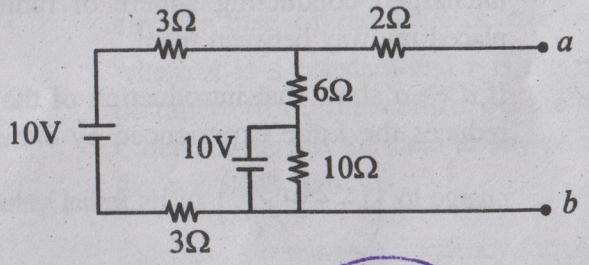
(h)



Find the resonance frequency of the circuit.

2. Answer any *four* questions : 4×5=20

(a) Find the Thevenin's and Norton's equivalent circuit for the circuit.



(b) Two coils of self inductances L_1 and L_2 are connected in parallel. If their mutual inductance is M show that the effective/equivalent self inductance is given by

$$L_{eff} = \frac{L_1 L_2 - M^2}{L_1 + L_2 \mp 2M}$$

(c) If $\vec{B}$ is uniform show that $\vec{A} = -\frac{1}{2}(\vec{r} \times \vec{B})$, where $\vec{r}$ is the position vector of the point. Check that $\vec{\nabla}.\vec{A} = 0$ and $\vec{\nabla} \times \vec{A} = \vec{B}$.

(d) Two similar point charge q, q are kept seperated by a distance $2d$ in air. Now an insulated uncharged conducting sphere of radius a is placed midway between them.

If $d >> a$ show that introduction of the sphere reduces the force experienced by either point charge to $\left(1 - 24a^5/d^5\right)$ of its initial value.

(e) Write down the difference between 'dead beat' and ballastic galvanometer. What do you mean by critical damping and log decrement.

(f) Calculate the capacitance of a spherical capacitor consisting of two concentric spheres of radii a and b. The space being filled with a dielectric of relative permitivity ϵ_r.

Answer any *one* question. 1×10=10

3. (a) (i) The distance between the plate of a parallel plate air capacitor is d. A dielectric slab of thickness x is introduced in the air gap. Show that the capacitance of the capacitor will be doubled if the dielectric constant of the material of the slab is $k = 2x/(2x-d)$.

(ii) Derive the necessary formula for Torque on a current loop in a uniform magnetic field. 5+5=10

4. (a) (i) The surface density of charge on a thin circular dise of radius R is $\sigma(r) = Ar$, where A is a constant and r is the radial distance from the centre of the disc. Calculate the electric field at any point on the axis of the disc.

(ii) Calculate the resonant frequency for parallel resonant circuit. 5+5=10