B.Sc. 2nd Semester (Honours) Examination, 2019 (CBCS)

Subject : Physics

Paper : CC-III

Time: 2 Hours **Full Marks: 40**

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: 2×5=10

(a) Show that electric field is conservative in electrostatics.

(b) A current is sent through a hanging coiled spring. What changes do you expect and why?

(c) If $\vec{J}$ is the current density in a region, show that Ampere's law can be stated as $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$.

(d) Will an atom having a spherically symmetric charge distribution be polar or non-polar? Explain.

(e) Show that the capacitance of an isolated spherical conductor of radius R_1 surrounded by an adjacent concentric layer of dielectric with permittivity ϵ and outside radius R_2 is $\frac{4\pi\epsilon_0\epsilon R_1}{\left\{1+(\epsilon-1)\frac{R_1}{R_2}\right\}}$.

(f) What do you mean by parallel resonant circuits? Why is it called the rejector circuits?

(g) A coil of cross-sectional area A and n number of turns is rotating in a magnetic field of intensity H. Show that the induced *e.m.f.* across the ends of the coil is $nAH\omega$, where ω is the angular velocity of the coil.

(h) What is Curie point? Magnetic behaviour of magnetic substances decreases with increasing temperature. Explain.

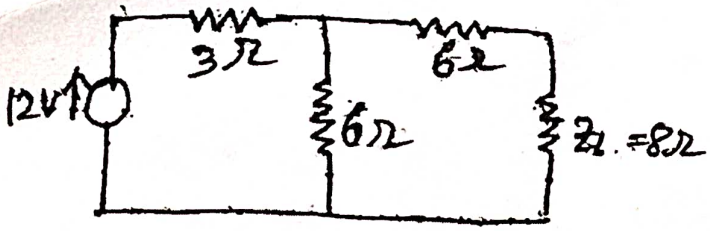
2. Answer *any two* questions: 5×2=10

(a) Show that the mutual potential energy between two coplanar-magnetic dipoles of moments M_1 and M_2 is equal to $\frac{M_1 M_2}{r^3}(\sin\theta_1 \sin\theta_2 - 2\cos\theta_1 \cos\theta_2)$ where r is the distance between their centres and θ_1 and θ_2 are the angles which the line joining their centres makes with the axes of the dipoles respectively.

(b) Find the boundary conditions prevailing at the interface of two dielectrics, assuming no free charge to be present.

(c) A torroidal coil has 1200 turns, average length of core 80cm and cross-sectional area 60cm^2. If 1·5A current flows through it, compute magnetic induction, field total flux and energy density inside the coil, in SI units (Assume an empty core).

(d) Convert the following linear network into Thevenin's and then into Norton's equivalent network and show that the power delivered to the load in both the cases is same.



3. Answer *any two* questions: 10×2=20

(a) (i) Derive Poisson's and Laplace's equation from Gauss's theorem.

(ii) Apply the Laplace's equation to obtain the capacitance of a parallel plate capacitor.

(iii) Why does a soap bubble expand upon electrification? 4+4+2=10

(b) (i) What do you mean by an electric dipole?

(ii) Find the expressions for the potential and intensity of electric field due to such a dipole at a distance r from the centre of the dipole.

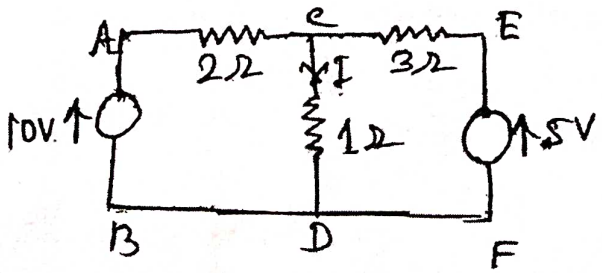
(iii) A dipole of moment M_1 is fixed at the origin and another coplanar dipole of moment M_2 is placed at the position vector $\vec{r}$ and it is free to rotate. Show that for equilibrium $\tan\theta_1 = -2\tan\theta_2$, where θ_1 and θ_2 are the angles made between $\vec{r}$ and $\overrightarrow{M_1}$ and $\overrightarrow{M_2}$ respectively.

(iv) Find the magnetic field due to a dipole of magnetic moment $1{\cdot}2\text{A-}m^2$ at a point $1m$ away from it in a direction making an angle of 60° with the dipole-axis. 1+5+2+2=10

(c) (i) Write down Maxwell's electromagnetic field equations and explain the physical significance of each.

(ii) How can you explain hysteresis loss? Explain the behaviour of different varieties of iron in terms of the hysteresis curve. (2+4)+(2+2)=10

(d) (i) State the superposition theorem. Use the superposition theorem to find the current I in branch CD in the following circuit.



(ii) What do you mean by critical damping resistance in a ballistic galvanometer? A condenser charged to 3V is discharged through a ballistic galvanometer which gives a first throw of 10 cm, corrected for damping. The current sensitivity of the galvanometer is $2{\cdot}5 \times 10^{-8}$ A/cm and the time period is 10 seconds. Find the capacitance of the condenser. (1+3)+(2+4)=10
