

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. THIRD SEMESTER EXAMINATION, DECEMBER 2012

SECOND YEAR

Physics (General)

Date : 18/12/2012

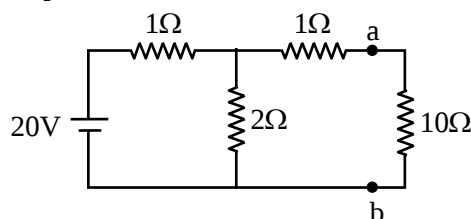
Time : 11 am – 1 pm

Paper : III

Full Marks : 50

Answer any five questions:

1. a) What do you mean by 'quantization of charge'? 2
b) How many excess electrons are there on a body of charge $-1C$? 2
c) Describe Millikan's oil drop experiment to determine the charge of an electron. 6
2. a) Starting from Coulomb's law establish Gauss law in electrostatics. 5
b) An amount of charge q is distributed uniformly inside a sphere of radius a . Applying Gauss law find the electric field at any internal point. Hence calculate the corresponding potential. Assume that the potential on the surface is $\frac{q}{4\pi\epsilon_0 a}$. 5
3. a) What do you mean by the electric dipole? Find the electric potential due to an electric dipole. 4
b) Derive an expression for capacitance of a cylindrical capacitor. 3
c) A p.d. of 400 V is applied across the series combination of two capacitors $10\mu F$ and $30\mu F$. Find the p.d. across the $30\mu F$ capacitor and also the energy stored in it. 3
4. a) State and prove maximum power transfer in a resistive network. 5
b) Distinguish between a voltage source and a current source. 2
c) Find the Thevenin's equivalent of the circuit to the left of a, b as shown below: 3



5. a) What is Lorentz force? Write down its expression. 2
b) Show that the magnetic force acting on a moving charged particle is a non-work force. 3
c) State Ampere's circuital law. Apply it to find the magnetic field due to a long conductor carrying steady current. 5
6. a) Define co-efficient of self and mutual inductance. 2
b) Derive an expression for the self inductance of an infinite solenoid. 3
c) An air-core solenoid of length 1 m, radius 2 cm has 1000 turns. Calculate its self inductance. 2
d) Show that the magnetic energy stored in an inductor is $\frac{1}{2}LI^2$ where I is the current through it. 3
7. a) State and explain Kirchhoff's laws for electric circuits. 4
b) A coil of inductance $10H$ and resistance 10Ω is connected to a steady voltage of 100 V at time $t=0$. Find the time taken for the current to reach one half of its steady value. 3
c) State and explain the law of intermediate temperatures and law of intermediate metals, in thermoelectricity. 3
8. a) Distinguish among the diamagnetic, paramagnetic and ferromagnetic materials. 3
b) What do you mean by hysteresis loss in a ferromagnetic substance? 2
c) The core of a transformer is made of soft iron of total mass 10 kg and density 7500 kg/m^3 . If the area of B-H loop of soft iron corresponds to a hysteresis loss of $250\text{ J.m}^{-3}\text{.cycle}^{-1}$, calculate the hourly loss of energy when the transformer is used for operation in A.C. of frequency 50Hz. 5

9. a) An electromotive force $E_p \sin \omega t$ is applied to a circuit containing a resistance R, a self-inductance L and capacitor C in series. Derive an expression for the resulting current in the circuit. Deduce the condition under which electrical resonance occurs. Find the power in this circuit. What is meant by power factor of this circuit? 6
- b) The impedance of a series LCR circuit is 80Ω when its frequency is 6 KHz at resonance and 100Ω at 7 KHz. Calculate the value of L and C. 4

