

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. THIRD SEMESTER EXAMINATION, DECEMBER 2011

SECOND YEAR

PHYSICS (General)

Date : 20/12/2011

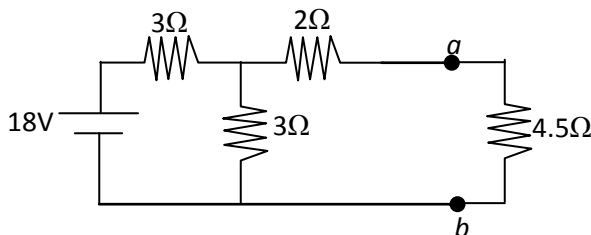
Time : 11am – 1pm

Paper : III

Full Marks : 50

Answer any five questions

1. a) State and prove Gauss's law in electrostatics. 1+3
b) Apply Gauss's law to calculate the electric field at a point inside the uniformly charged solid sphere. 4
c) What is electric polarization? 2
2. a) In Balance oil-drop method a oil drop of radius 10^{-6}m , density 10^3kg-m^{-3} is charged with one electron. Calculate the electric field required to keep it stationary. 4
b) An electric dipole of amount \vec{p} is placed in a uniform electric field \vec{E} . Show that its potential energy is $-\vec{p} \cdot \vec{E}$. 4
c) A capacitor of capacity 500 pF is discharged through a resistance of 1000M Ω . Find the time taken by half the charge on the capacitor to escape. 2
3. a) State Thevenin's theorem for any electrical network. 2
b) A battery of emf E and internal resistance r is connected to an external variable load R . Find the condition for maximum power transfer from the battery to the load. 3
c) Consider the circuit as shown in the figure below. Find the Thevenin equivalent of the circuit to the left of the points (a, b). Hence find the power delivered to the resistance of 4.5 Ω . 5



4. a) Applying Biot-Savart law find the magnetic field at an axial point due to a circular current carrying loop. 6
b) An electron of charge $1.6 \times 10^{-19}\text{C}$ is rotating 6.8×10^{15} times per sec around the nucleus in a circular orbit of radius $5.1 \times 10^{-11}\text{m}$. Find the magnetic field \vec{B} at the position of the nucleus. 4
5. a) Define the vectors \vec{B} , \vec{H} and \vec{M} . 3

b)	Show that the magnetic force acting on a moving charged particle is a no-work force.	3
c)	What is hysteresis loop?	2
d)	What property of a magnetic material would you particularly enquire into for using it as the core of an electromagnet and why?	2
6. a)	What is self-induction? Find an expression for self-induction due to a plane circular coil of radius a and carrying current i .	1+3
b)	Show that current in a d.c. circuit containing a resistance and inductance grows exponentially. What do you mean by time constant of the circuit?	4+2
7. a)	Write Ampere's circuital law.	1
b)	Using Ampere's circuital law find the magnetic field at a point on the axis of a long solenoid carrying current i .	4
c)	When a charged particle is placed in a magnetic field making an angle with the magnetic field. What will be the trajectory of the charged particle? Explain your answer.	3
d)	In what way Peltier heating is different from Joule heating?	2
8. a)	What is non-inductive coil?	2
b)	A rectangular current carrying loop of length ' a ' and breadth ' b ' is placed in a magnetic field such that the normal of the rectangular surface makes an angle θ with the magnetic field. Find the expression for torque on this loop.	4
c)	Thermo-emf in a thermocouple with cold junction at 0°C and hot junction at $t^\circ\text{C}$ is given by $E = 16t - 0.04t^2 \mu\text{V}$. Find the neutral temperature and the thermoelectric power at inversion temperature.	4
9. a)	A voltage $V_0 \sin \omega t$ is applied to a series LCR circuit. Find an expression for the current passing through R . How do the magnitude of a voltage drop V_R across R and the phase of V_R vary with ω ?	3+2
b)	Give the theory of an alternating voltage transformer.	3
c)	What do you mean by "wattless" current?	2
