

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2008-09 & thereafter)

SUBJECT CODE : PH/MC/EM54

B.Sc. DEGREE EXAMINATION NOVEMBER 2012
BRANCH III - PHYSICS
FIFTH SEMESTER

REG. No. _____

COURSE : MAJOR – CORE
PAPER : ELECTROMAGNETISM
TIME : 30 MINS. MAX. MARKS : 30

SECTION – A

TO BE ANSWERED IN THE QUESTION PAPER ITSELF

ANSWER ALL QUESTIONS: (30 x 1 = 30)

I. CHOOSE THE CORRECT ANSWER:

- The value of $\frac{1}{4\pi\epsilon_0}$ in Coulomb's law is
a) $9 \times 10^9 \text{ Nm}^2/\text{C}^2$ b) $9 \times 10^{-9} \frac{\text{Nm}^2}{\text{C}^2}$ c) $9 \times 10^9 \frac{\text{C}^2}{\text{Nm}^2}$
- The force of attraction or repulsion between two charges follows
a) Square law b) Inverse Square law c) Lenz's law
- The potential difference between two points A and B is given by
a) $V_B - V_A = - \int_A^B E \cdot dl$ b) $V_A - V_B = - \int_A^B E \cdot dl$ c) $V_B - V_A = - \int_A^B E^2 \cdot dl$
- The differential form of Gauss law
a) $\nabla \cdot E = \frac{\rho}{\epsilon_0}$ b) $\nabla \times E = \frac{\rho}{\epsilon_0}$ c) $\nabla \cdot E = \rho - \epsilon_0$
- The Laplace equation is
a) $\nabla^2 V = 1$ b) $\nabla^2 V = \infty$ c) $\nabla^2 V = 0$
- The dielectric constant K is
a) $K = \frac{C}{C_0}$ b) $K = \frac{C_0}{C}$ c) $K = C_0 - C$
- The Gauss Law is the Presence of Dielectric media
a) $\oint_S \vec{D} \cdot d\vec{s} = 0$ b) $\oint \vec{D} \cdot d\vec{s} = \varphi$ c) $\oint \vec{D} \cdot d\vec{s} = 1$
- The Lorentz force is given by
a) $q_0[\vec{E} - (\vec{v} \times \vec{B})]$ b) $q_0[\vec{E} + (\vec{v} \cdot \vec{B})]$ c) $q_0[\vec{E} + (\vec{v} \times \vec{B})]$
- In magnetic materials the relation between magnetizing field H and magnetization M is
a) $M \propto H$ b) $M \propto \frac{1}{H}$ c) $M \propto H^2$
- The law of electromagnetic induction was given by
a) Faraday b) Lenz c) Neumann

11. The direction of induced emf in a circuit is given by
 a) Lenz b) Lorentz c) Flemings' left hand rule
12. Which of the following is correct
 a) $B = \nabla \times A$ b) $B = \nabla \cdot A$ c) $B = \nabla + A$
13. The susceptibility χ_m varies
 a) Inversely with absolute temperature
 b) directly with absolute temperature
 c) none of these
14. In paramagnetic material the susceptibility χ_m is
 a) negative b) positive c) none of these
15. Velocity of plane electromagnetic wave is given by
 a) $c = \sqrt{\frac{\mu_0}{\epsilon_0}}$ b) $c = \sqrt{\mu_0 \epsilon_0}$ c) $c = \sqrt{\frac{\epsilon_0}{\mu_0}}$

II. FILL IN THE BLANKS:

16. The space around the electric charge is called _____.
17. The work done on a unit +ve charge is in bringing it from infinity to any point is called _____
18. $\nabla^2 V = \frac{-\rho}{\epsilon_0}$ is known as _____
19. The magnetic susceptibility for diamagnetic substance _____
20. Coefficient of coupling emphasis _____

III. STATE WHETHER TRUE OR FALSE:

21. Poynting vector is rate at which energy is transmitted through unit area perpendicular to the direction of propagation of energy.
22. The unit of polarization \vec{P} is same as that of \vec{D} .
23. The inductance of a coil depends upon number of turns, type of core and space between the turns.
24. The relative permeability of ferromagnetics would be extremely large.
25. Magnetic susceptibility is the ratio of the magnetization (\vec{M}) and magnetizing field (\vec{H})

IV. ANSWER THE FOLLOWING :

26. Define electric potential.

27. Define Equi Potential Surface.

28. Define a Capacitor.

29. Define Polarization.

30. State Lenz's law.

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TIME : 2 ½ HOURS **MAX. MARKS : 70**

SECTION – B

ANSWER ANY FIVE OF THE FOLLOWING **(5 x 5 = 25)**

1. Two spheres charged with equal but opposite charges experience a force of 100 newtons when they are placed 10cms apart in a medium of relative permittivity 5. Determine the charge on each sphere.
2. The radii of the inner and outer sphere of a spherical capacitor are $4 \times 10^{-2} \text{m}$ and $6 \times 10^{-2} \text{m}$. If the dielectric medium between the plates is air, calculate the capacitance of the spherical capacitor if the outer is earthed and the inner sphere is positively charged.
3. Derive Gauss's law in dielectrics.
4. A solenoid 16cms in length has 1000 turns and cross sectional area of 10sq cms. Another coil of 100 turns is wound on the central part of the solenoid. Find mutual inductance between the two coils.
5. A circular coil has a radius of 0.1m and a number of turns 50. Calculate the magnetic induction at a point on the axis of the coil and distance 0.2m from the centre when a current of 0.1A flows in it.
6. A coil has a self inductance of 1.5H when a current of 3amp in the coil is cut off in 0.1 sec. Calculate the voltage induced in the coil.
7. Use Maxwell's equation to show that electromagnetic waves travel with velocity of light in free space.

SECTION-C

ANSWER ANY THREE OF THE FOLLOWING **(3x 15=45)**

- 8.a. State and prove Gauss law in electrostatics.
b. Apply Gauss law to deduce Coulombs law.
- 9.a. Calculate the capacity of a parallel plate capacitor.
b. What will be the capacity if the sphere between the plates is partially filled with a dielectric slab of thickness 't' and dielectric constant 'k'.

- 10.a. State the Biot-Savart law.
b. Deduce an expression for the intensity of the magnetic field inside a long solenoid.
- 11.a. Define the coefficient of self inductance of a coil hence derive an expression for the self inductance of a solenoid.
b. Derive an expression for the coefficient of coupling between two coils.
12. Establish the relations
a) $B = \mu_0(H + M)$
b) $\mu = \mu_0(1 + \kappa_m)$
c) $\mu_r = (1 + \kappa_m)$
