STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2011-12 & thereafter)

SUBJECT CODE : 11PH/MC/EM54

B.Sc. DEGREE EXAMINATION NOVEMBER 2014
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:

1. Electric field lines of a point charge is
   a) radially outward and never intersects b) radially inward and never intersects
   c) radially outward and intersects d) radially inward and intersects

2. Gauss's law gives the
   a) net charge enclosed within a closed surface
   b) net surface charge density enclosed within a closed surface
   c) net volume charge density enclosed within a closed surface
   d) net point charges enclosed within a closed surface

3. The normal component of E is
   a) discontinuous by an amount σ/ε_0 at any boundary
   b) continuous by an amount σ/ε_0 at any boundary
   c) discontinuous by an amount $\boldsymbol{\rho}/\varepsilon_0$ at any boundary
   d) continuous by an amount $\boldsymbol{\rho}/\varepsilon_0$ at any boundary

4. Two principal mechanisms by which electric fields can distort the charge distribution of a dielectric atom are
   a) stretching and vibrating b) stretching and rotating
   c) rotating and vibrating d) rotating and oscillating

5. The volume bound charge in a homogeneous linear dielectric is proportional to
   a) density of free charge b) mass of free charge
   c) polarity of free charge d) volume of free charge.

6. Permittivity of free space ε_0 has the value
   a) $8.85\text{x}10^{-12}\ C^2/Nm^2$ b) $8.85\text{x}10^{-12}$ C/Nm
   c) $8.85\text{x}10^{12}\ C^2/Nm^2$ d) $8.85\text{x}10^{12}$ C/Nm

7. The magnetic field at a distance r from a long straight wire carrying a steady current I is given by
   a) $B=\mu_0 I/2\pi r^2$ b) $B = \mu_0 I/2\pi r$ c) $B=\mu_0 I/4\pi r$ d) $B=\mu_0 I/4\pi r^2$

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8. Continuity equation is given by
   a) $\nabla . J = \partial\sigma/\partial t$ b) $\nabla . J = \partial p/\partial t$ c) $\nabla . J = -\partial\sigma/\partial t$ d) $\nabla . J = -\partial p/\partial t$

9. Steady currents produce magnetic fields that are
   a) varying independent of time b) varying in time
   c) constant independent of time d) constant in time

10. When the magnetization of the materials is parallel to the applied magnetic field they are referred to as
    a) ferromagnets b) diamagnets c) paramagnets d) ferrimagnets

11. A material which obeys $M = \chi_m H$ is a
    a) non linear medium b) linear medium
    c) homogeneous medium d) heterogeneous medium

12. Internal currents cancel each other only when the magnetization is
    a) linearly decreases b) uniform c) linearly increases d) non uniform

13. Displacement current is given by the term
    a) $\varepsilon_0 \partial E/\partial t$ b) $\mu_0 \partial E/\partial t$ c) $\varepsilon_0\mu_0 \partial E/\partial t$ d) $\varepsilon\mu \partial E/\partial t$

14. Greater the value of inductance, the
    a) easier it is to change the current
    b) harder it is to change the current
    c) not at all possible to change the current
    d) possible to change current with the application of an external field.

15. For steady currents,
    a) $\nabla . J = -\infty$ b) $\nabla . J = 1$ c) $\nabla . J = 0$ d) $\nabla . J = +\infty$

II. FILL IN THE BLANKS:

16. Coulomb's law gives the _____ acting between point charges.
17. Polarizability tensor for a molecule has a set of _____ components.
18. Magnetic forces do no work is a direct consequence of _____ law.
19. Bound currents are those where every charge is _____ to a particular atom.
20. If a current flows it will be in such a direction that the magnetic field it produces tends to _____ the change in flux that induced the emf.

III. STATE WHETHER TRUE OR FALSE:

21. Capacitance is purely geometrical quantity determined by sizes, shapes and separation of two conductors.
22. The dipole **p** in a uniform field **E** experiences a torque **N** = **p** x **E**
23. Currents flowing in opposite directions repel each other.

24. When a magnetic field is applied, a net alignment of dipoles occur and the medium becomes magnetically polarized.
25. A changing magnetic field induces an electric field.

IV. ANSWER THE FOLLOWING :

26. State the principle of superposition of charges.

27. Define polarization.

28. Why magnetic forces do no work?

29. What are ferromagnetic materials?

30. Write Maxwell's equations.

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COURSE : MAJOR – CORE
PAPER : ELECTROMAGNETISM
TIME : 2 ½ HOURS **MAX. MARKS : 70**

SECTION – B **(5 x 5 = 25)**
ANSWER ANY FIVE QUESTIONS

1. Find the capacitance of two concentric spherical metal shells with radii a and b.

2. A charge of 5c is at the centre of a sphere of radius 2m.
   a) How many electric flux lines originate on the charge?
   b) What is electric field at the surface of the sphere?
   c) How many electric field lines emerge through an area of ½ m^2 of the surface of the sphere?

3. Find the magnetic field of a very long solenoid consisting of 200 closely wound turns per unit length on a cylinder of radius 5cm and carrying a steady current 3 amperes.

4. Derive Ampere's law in terms of vector potential.

5. Suppose a cyclotron is operated at an oscillator frequency of 12 Mhz and has a 'dee' radius $R = 53\ cm$.
   a) What is the magnitude of the magnetic field needed for deuteron to be accelerated in the cyclotron? The deuteron mass $m = 3.34 \times 10^{-27}\ kg$.
   b) What is the resulting kinetic energy of the deuterons?

6. A uniform magnetic field $B_0(t)$ pointing straight up fills the entire circular region of space. If it is changing with time, what is the induced electric field?

7. Derive Neumann's formula which highlights the significance of mutual inductance.

SECTION C **(3 x 15 = 45)**
ANSWER ANY THREE QUESTIONS

8. Obtain an expression for the energy stored in the configuration of point charges.

9. Derive an expression for field of a polarized object.

10. Discuss the motion of a particle moving along a path when the electric and magnetic fields are acting in mutually perpendicular directions.

11. Obtain an expression for the field produced by a magnetized object.

12. Derive an expression for energy in a magnetic field.

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