STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2015-2016)

SUBJECT CODE :15PH/MC/EM54

B.Sc. DEGREE EXAMINATION NOVEMBER 2017
BRANCH III - PHYSICS
FIFTH SEMESTER

COURSE : MAJOR – CORE
PAPER : ELECTROMAGNETISM
TIME : 3HOURS MAX. MARKS 100

SECTION – A
ANSWER ALL QUESTIONS:
(30 x 1 = 30)

I. CHOOSE THE CORRECT ANSWER:

1. Gauss's law in differential form is given as_____
   (a) $\vec{\nabla}.\vec{D} = \rho$ (b) $\vec{\nabla}.\vec{E} = \rho$ (c) $\vec{\nabla}.\vec{D} = 0$ (d) $\vec{E}.\overrightarrow{dS} = \rho$
2. In a field which is free from charge, Poisson's equation is given as _____ .
   (a) $\nabla^2 V = \infty$ (b) $\nabla^2 V = \rho/\varepsilon_0$ (c) $\nabla^2 V = 0$ (d) $\nabla^2 V = q$
3. The electric field inside a perfectly conducting media is_____.
   (a) ∞ (b) 0 (c) q/r (d) q/r^2
4. Potential difference in a parallel plate capacitor decreases by a factor _____on introduction of a dielectric.
   (a) k (b) $1/k^2$ (c) 1/k (d) k^2
5. If the dielectric constant of a medium is 78, its electrical permittivity is given as _____
   690.3 x 10^{-12}F/m (b) 690.3 x 10^{-12}F/m^2 (c) 69.03 x 10^{-12} F/m (d) 690.3 x 10^{12} F/m
6. Five thousand electric lines of force enter a given volume and three thousand leave it. Then the total charge contained in it is given by_____.
   (a) $-2000\varepsilon_0$ Coulomb (b) $+ 2000\varepsilon_0$ Coulomb (c) $\varepsilon_0/2000$ Coulomb (d) $2000/\varepsilon_0$ Coulomb
7. In a circular coil of radius R, carrying a current I, the rate of change of magnetic field B becomes constant at a distance _____.
   (a) R (b) R/2 (c) 2R (d) R^2
8. Ratio of intensity of magnetic field at the centre of a very long solenoid to that at the extreme ends is_____.
   (a) 4 (b) 1/2 (c) 1 (d) 2
9. If two conductors carry current in opposite direction, they will _____.
   (a) Attract each other (b) repel each other (c) there is no force between them (d)rotate around each other.
10. The S.I unit of magnetisation is _____.
    (a) A/m^2 (b) A.m (c) A/m (d) V/m

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11. The magnetic susceptibility of a medium is 948 x 10^{-11}. Its relative permeability will be given by _____.
(a) 9480 x 10^{-11} (b) 94.8 x 10^{-11} (c) 949 x 10^{-11} (d) 94.8 x 10^{-11}
12. In the relation B = μ_0 (H + M), $\vec{H}$ is expressed in the same unit as _____.
(a) $\vec{M}$ (b) $\vec{B}$ (c)$\vec{\mu}$ (d) $\vec{J}$
13. _____ is regarded as magnetic counterpart of capacitor.
(a) Inductor (b) resistor (c) transformer (d) transistor
14. Mutual inductance of two circuits is numerically equal to the magnetic flux linked with one circuit, when unit _____ flows through the other.
(a) voltage (b) current (c) charge (d) heat.
15. The continuous path for the charges across a capacitor is provided by _____ current.
(a) True (b) conduction (c) displacement (d) magnetisation.

II. FILL IN THE BLANKS:

16. Coulomb's law of electrostatics is analogous to the inverse law of _____.
17. The Gauss's law in the presence of a dielectric is given as _____.
18. The magnetic induction $\vec{B}$is related to vector potential $\vec{A}$ as _____.
19. A magnetic dipole experiences a torque τ, given by _____ when placed in a magnetic field $\vec{B}$
20. The e.m.f. induced in a coil due to self - inductance is also called as _____.

III. STATE TRUE OR FALSE:

21. Electric field at any point is the negative of the curl of potential at that point.
22. A dielectric is a material in which all the electrons are tightly bound to the nuclei of the atoms.
23. Just as in a solenoid, $\vec{B}$ is a constant over the cross-section of a toroid.
24. Electric and magnetic dipoles give rise to similar fields.
25. Component of $\vec{E}$ parallel to the interface between two media are continuous across the boundary.

IV. ANSWER BRIEFLY:

26. A spherical drop of water carrying a charge of 3 x 10^{-6} C has a potential of 500 V at its surface. What is the radius of the drop?
27. Define electric polarisation vector 'p'.
28. What are the conditions under which Ampere's law can be usefully applied?
29. How are magnetic materials classified based on the values of their magnetic susceptibility?
30. State the Lenz's laws of electromagnetic induction.

SECTION – B

(5 x 5 = 25)

ANSWER ANY FIVE QUESTIONS

31. Two charges +q and –3q are separated by a distance of 1m. At what points on its axis is the potential zero?

32. Discuss how the electric field changes at the boundary between two different media.

33. For a parallel plate capacitor following data are given: area of each plate = 100 cm^2, separation of plates = 1.00 cm. A potential difference of 100 V is applied with no dielectric present. A dielectric slab of dielectric constant 7.00 and of thickness 0.50cm is introduced. Calculate (a) the free charge (b) electric field strength in the gap (c) electric field strength in the dielectric (d) potential difference between the plates, (e) capacitance with dielectric.

34. A long straight wire carries a current of 20 amperes. An electron is travelling at 10^7m/sec, is 2.0 cm from the wire, what force acts on the electron if its motion is directed (a) towards the wire (b) parallel to the wire (c) at right angles to the direction given in (a) and (b).

35. A magnetic induction of 2 x 10^{-4} Wbm^{-2} in vacuum produces a magnetic flux of 2.4 x 10^{-8}Wb in a bar of area of cross-section 2 x 10^{-5} m^2. Calculate the intensity of magnetisation.

36. A long coaxial cable carries a current I. The current flows down the surface of the inner cylinder of radius ‘a’ and back along the outer cylinder of radius ‘b’. Find the magnetic energy stored in a section of length l. Hence calculate the self - inductance of the coil.

37. Derive the expression for Faraday’s law of electromagnetic induction in vector form.

SECTION C (3 x 15 = 45)

ANSWER ANY THREE QUESTIONS

38. There is an uniform distribution of electric charge within an infinite cylinder of radius R. Using Gauss’s law, calculate the electric field strength at a point lying at a distance ‘r’ from the axis, (i) inside (ii) on the surface (iii) outside the cylindrical charge distribution.

39. Derive the expression for capacity of a parallel plate capacitor. How does the expression change when the capacitor is partially filled with dielectric.

40. Show that the expression for magnetic field $\vec{B}$ near a straight current carrying conductor is the same whether Biot-Savart law or Ampere’s law is applied.

41. Define the terms $\vec{B}$, $\vec{H}$ and $\vec{M}$. Obtain the following relation between them.
(a) $B = \mu_0 (H + M)$ (b) $\mu = \mu_0 (1 + \chi_m)$

42. Using the basic laws of electromagnetism, derive the Maxwell’s equations.

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