

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2015-2016 and thereafter)
SUBJECT CODE : 15PH/MC/EM54

B.Sc. DEGREE EXAMINATION NOVEMBER 2018
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. The electric potential is zero : _____
(a) Inside a conductor (b) midway between two charges of opposite sign
(c) midway between two charges of same sign (d) at any point equal distances from equal charges of opposite sign
2. According to Gauss's Law, the number of electric field lines crossing the closed surface is equal to _____
(a) enclosed charge (b) enclosed positive charge
(c) electric field inside the surface (d) charge density on the surface
3. In a region where there are no free charges, the Poisson's equation reduces to _____ equation
(a) Laplace (b) Maxwell's (c) Clausius-Mossotti (d) Colom'b's
4. A parallel plate capacitor is made by stacking n equally spaced plates connected alternately. If the capacitance between any two plates is C , the resultant capacitance is _____
(a) C^n (b) nC (c) $(n-1)C$ (d) $(n + 1)C$
5. The dielectric constant of a medium is 4. If the electric field in the dielectric is 10^6 V/m, the electric displacement will be _____
(a) $35.4 \times 10^{-6} \text{Cm}^{-2}$ (b) $3.54 \times 10^{-6} \text{Cm}^{-2}$
(c) $35.4 \times 10^6 \text{Cm}^{-2}$ (d) $35.4 \times 10^{-6} \text{Cm}^2$
6. Which of the following is not equal to the dielectric constant?
(a) V_0/V (b) C_0/C (c) E_0/E (d) E/E_0
7. _____ galvanometer is based on the principle of Biot-Savart law applied to a circular coil carrying current.
(a) Ballistic (b) dead-beat (c) Helmholtz tangent (d) tangent.
8. The normal component of \vec{B} inside a magnetic material is _____ the normal component of \vec{B} just outside the material.
(a) equal, but opposite sign (b) equal
(c) inverse (d) square
9. The magnetic force experienced by a conductor, moving across a magnetic field of flux density \vec{B} is given by $F_m =$ _____.
(a) ma (b) $\frac{1}{2}(mv^2)$ (c) Bev (d) eV

10. Which of the following is an example of magnetic dipole?
 (a) current loop (b) a bar magnet
 (c) a solenoid of finite length (d) all the above.
11. The MKS unit of magnetisation is _____
 (a) A/m (b) A/m² (c) Wb/m² (d) H/m
12. _____ is a measure of degree of penetration of magnetic field through a substance.
 (a) susceptibility (b) permeability
 (c) coercivity (d) retentivity.
13. One _____ is the inductance of a circuit in which an e.m.f. of 1 volt is induced when the current in it changes at the rate of 1A per second
 (a) Newton (b) Coulomb (c) Henry (d) Henry/m²
14. According to Fleming's right hand rule, the index finger points in the direction of _____.
 (a) induced e.m.f. (b) motion of conductor
 (c) magnetic flux (d) magnetic induction
15. Which of the following is the correct relation between mutual and self inductance?
 (a) $M_{12} = (L_1L_2)^{1/2}$ (b) $M_{12} = (L_1L_2)^2$ (c) $M_{12} = 1/(L_1L_2)^{1/2}$ (d) $M_{12} = 1/(L_1L_2)^2$

II. FILL IN THE BLANKS:

16. A closed surface drawn in an electric field is called a _____
17. In the expression for polarisation $P = Q'd/v$, the numerator represents the _____
18. The current density vector \mathbf{J} at any point is oriented in the _____ direction as that of a positive charge carrier moving at that point.
19. For paramagnetic and diamagnetic materials, it was found experimentally that \vec{B} is directly proportional to _____
20. The equation for Faraday's law of electromagnetic induction is _____

III. STATE TRUE OR FALSE:

21. In an electrostatic field, the line integral for a closed path is zero.
22. In isotropic materials, the value of polarisation vector is not a constant.
23. The expression for magnetic field strength by a current, as given by Biot-Savart law is always independent of the nature of the medium in which the field is produced.
24. In magnetism, there is no counterpart to the free charge q.
25. The tangential component of \vec{D} is continuous across a charge-free boundary between two dielectrics.

IV. ANSWER BRIEFLY:

26. Calculate the force between two charges of 2×10^{-9} Coulombs which are 3 cm apart.
27. State any one factor on which the capacitance of a capacitor depends upon.
28. State the condition for application of Ampere's law.
29. Classify magnetic materials as diamagnetic, paramagnetic and ferromagnetic based on their magnetic susceptibilities.
30. What is displacement current?

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

31. Let there exist a positive charge of value 2.23×10^{-10} Coulomb in air. Calculate the potential at the distance 10 cm (point A) and 40 cm (point B) from the point charge and the potential difference between the points A and B.
32. What are dielectrics? Discuss the mechanism by which a dielectric increases the capacitance of a capacitor when it is introduced between the plates of the capacitor.
33. The plates of a parallel plate capacitor 1 cm apart, each having an area of 2000 cm^2 , and the original potential difference between the plates is 3×10^3 volts. When a mica sheet is introduced, the voltage falls to 10^3 volts. Calculate (a) original capacitance (b) charge on each plate (c) capacitance after the introduction of mica sheet (d) dielectric constant of mica.
34. A long solenoid of length 1 metre and mean radius 10 cm consists of 1000 turns of wire. A current of 20 amperes flows through it. Calculate the magnetic field on its axis, at its centre.
35. A rod of magnetic material, 0.5 m in length has a coil of 200 turns wound over it uniformly. If a current of 2 amperes is sent through it, calculate, (a) the magnetising field H, (b) the intensity of magnetisation M and (c) the magnetic induction B of the material. (Given $\chi_m = 6 \times 10^{-3}$).
36. Derive the expression for energy stored in the magnetic field in a circuit containing an inductance L.
37. An electric line of force is going from one dielectric ($K = 5$) to another dielectric ($K = 4$). If it makes an angle of 60 degrees with the boundary in the first dielectric, what is its direction in the second dielectric?

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

38. Using Gauss's law find the expression for electric field due to a uniform infinite cylindrical charge.
39. Calculate the capacity of a parallel plate capacitor. Apply Gauss's law to a parallel plate capacitor filled with a dielectric and obtain the expression for Gauss's law in the presence of the dielectric.
40. State Ampere's circuital law. Apply it to find the value of \vec{B} (i) near a long wire carrying steady current and (ii) a solenoid
41. Derive the important relations between the three magnetic vectors \vec{B} , \vec{H} and \vec{M} .
42. Derive the expression for Maxwell's equations in an isotropic non-conducting medium.
