D 111983   (Pages : 2)   Name.............................

Reg. No...............................

THIRD SEMESTER (CBCSS–UG) DEGREE EXAMINATION, NOVEMBER 2024

Physics/Applied Physics

PHY 3B 03/APH 3B 03—ELECTRODYNAMICS

(2019—2023 Admissions)

Time : Two Hours   Maximum Marks : 60

The Symbols used in this questions paper have their usual meanings

Section A (Short Answer Type)

Answer **all** *questions in* **two** *or* **three** *sentences.*
Each question carries 2 marks.
(Ceiling 20 marks)

1. What is law of cosines ?

2. What is the force on a test charge Q due to a single point charge q. Write down the expression.

3. Discuss the fundamental theorem for curl.

4. Express surface charge and volume charge in terms of polarization.

5. What do you mean by curl less field ?

6. Define electric field.

7. Define atomic polarizability.

8. Write the unit vectors in spherical co-ordinate system in terms of Cartesian system.

9. State and explain Gauss's law.

10. What is the physical interpretation of bound charge ?

11. Distinguish paramagnets and ferromagnets.

12. Define magnetic vector potential.

Section B (Paragraph/Problem Type)

Answe **all** *questions in* **a paragraph** *of about* **half a page to one page**.
Each question carries 5 marks.
(Ceiling 30 marks)

13. Discuss the magnetostatic boundary conditions in detail.

14. Find the gradient of $r = \sqrt{x^2 + y^2 + z^2}$.

Turn over

15. Obtain the expression for electrostatic pressure on surface charge.

16. Show that the potential of a polarized object is the same as that produced by a volume charge density plus a surface charge density.

17. Check the divergence theorem using the function $v = y^2\hat{x} + \left(2xy + z^2\right)\hat{y} + (2yz)\hat{z}$ and a unit cube at the origin.

18. Deduce the Ampere's law in magnetized materials.

19. A long straight wire, carrying uniform line charge λ, is surrounded by rubber insulation out to a radius a. Find the electric displacement.

Section C (Essay Type)

Answer any **one** *question in* **two** *pages.*
The question carries 10 *marks.*

20. (a) Discuss the magnetic vector potential in terms of volume current density, surface current density and linear current density.

    (b) Find the vector potential of an infinite solenoid with n turns per unit lenght, radius R, and current I.

21. Explain the linear curent density, surface current density and volume current density. Derive the continuity equation.

$(1 \times 10 = 10$ marks$)$

D 51771 (Pages : 2) Name..

Reg. No.....................................

THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2023

Physics/Applied Physics

PHY 3B 03/APH 3B 03—ELECTRODYNAMICS—I

(2019—2022 Admissions)

Time : Two Hours Maximum : 60 Marks

The Symbols used in this question paper have their usual meanings.

Section A (Short Answer Type)

Answer **all** *questions in two* **or** *three sentences.*
Each correct answer carries a maximum of 2 *marks.*

1. What is law of cosines ?

2. State Coulomb's law.

3. Express surface charge and volume charge in terms of polarization.

4. What do you mean by divergence less field ?

5. Define electric field.

6. Comment on "the magnetic forces do no work".

7. State and explain Gauss's law.

8. Write the two product rules for curls.

9. Distinguish paramagnets and ferromagnets.

10. What is the physical interpretation of bound current.

11. Discuss about the magnetic field inside and outside the solenoid.

12. Discuss the fundamental theorem for curl.

(Ceiling - 20)

Turn over

Section B (Paragraph / Problem type)

Answer **all** *questions in* **a paragraph** *of about* **half a page to one page**.
Each correct answer carries a maximum of 5 *marks.*

13. Find the angle between the face diagonals of a cube.

14. Obtain the expression for electrostatic pressure on surface charge

15. Calculate the surface integral of $v = 2xz\hat{x} + (x+2)\hat{y} + y(z^2 - 3)\hat{z}$ over five sides (excluding the bottom) of the cubical box (side 2) in figure
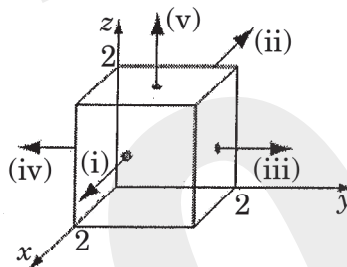
16. Find the magnetic field a distance s from a long straight wire carrying a steady current I.

17. Deduce the Ampere's law in magnetized materials

18. Discuss the magnetostatic boundary conditions in detail.

19. Find the potential of a uniformly charged spherical shell of radius R.

(Ceiling - 30)

Section C(Essay Type)

Answer in about **two pages,** *any* **one** *question.*
Answer carries 10 *marks.*

20. a) Discuss the magnetic vector potential in terms of volume current density, surface current density and linear current density.

    b) Find the vector potential of an infinite solenoid with *n* turns per unit length, radius R, and current I.

21. Discuss the energies of a point charge distribution, continuous charge distribution. Also comments on electrostatic energy.

(1 × 10 = 10 marks)

D 31828 (Pages : 2) Name..

Reg. No...................................

THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION NOVEMBER 2022

Physics/Applied Physics

PHY 3B 03/APH 3B 03—ELECTRODYNAMICS—I

(2019 Admission onwards)

Time : Two Hours　　　　　　　　　　　　　　　　　　　　Maximum : 60 Marks

The symbols used in question paper have their usual meanings.

Section A (Short Answer Type)

*Answer **all** questions in two or three sentences.*
Each correct answer carries a maximum of 2 marks.

1. What do you mean by the Laplacian of a scalar ? Is it a scalar or a vector ?

2. Write down an expression for the electric field due to a volume charge. Discuss the terms involved.

3. Give Poisson's equation and explain the terms involved.

4. How is the work and energy related in electrostatics ? Is the electrostatic force conservative ?

5. Write down the expression for the torque experienced by a dipole in uniform electric field. What is the effect of the torque ?

6. Write down the relation connecting permittivity and susceptibility in linear dielectrics. Explain the terms involved. What is the susceptibility of vacuum ?

7. Check whether the following statements are true or false : (i) Magnetic forces can alter the direction in which a charged particle moves ; and (ii) Magnetic forces can speed up a charged particle.

8. Write and explain the expressions for the divergence and curl of B in magnetostatics.

9. Explain the equation of continuity.

10. What is the relation connecting magnetic flux density B and magnetic vector potential A ? What is the divergence of A ?

11. When will you say that a medium is magnetically polarized ? Discuss the magnetic polarization in diamagnets.

12. Explain the temperature-driven phase transitions in ferromagnetic materials.

(Ceiling 20)

Turn over

Section B (Paragraph/Problem Type)

Answer **all** *questions in a paragraph of about* **half a page** *to* **one page**.
Each question answer carries a maximum of 5 *marks.*

13. Prove that the curl of the gradient of a function is zero.

14. Find the electric field (magnitude and direction) at a distance z above the midpoint between two equal charges q, a distance d apart.

15. Suppose the electric field in some region is found to be $E = kr^3\hat{r}$, in spherical polar coordinates, where k is some constant. Determine the charge density.

16. Explain why the electric field and charge density vanishes inside a conductor.

17. Compare the curl of E and D in electrostatics.

18. Give an expression for the field of a magnetized object. Explain the physical meaning of the expression.

19. Explain the hysteresis loop of ferromagnets.

(Ceiling 30)

Section C (Essay type)

Answer in about **two pages**, *any one question.*
Answer carries 10 *marks.*

20. What do you mean by the curl of a vector function ? Explain its geometrical interpretation. Explain Stokes' theorem and give its geometrical interpretation.

21. Using suitable figures, discuss the magnetostatic boundary conditions.

$(1 \times 10 = 10$ marks$)$

D 12039
(Pages : 2)

Name...

Reg. No....................................

THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION NOVEMBER 2021

Physics/Applied Physics

PHY 3B 03/APH 3B 03—ELECTRODYNAMICS—I

(2019—2020 Admissions)

Time : Two Hours

Maximum : 60 Marks

The symbols used in question paper have their usual meanings.

Section A (Short Answer Type)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. Explain Coulomb's law in electrostatics.

2. Give an expression for the electric field due to a surface charge. Explain the terms involved.

3. How is electric field and potential related in electrostatics ? What is Laplace's equation in electrostatics ?

4. Write down the relation connecting polarization and electric field in linear dielectrics. What do you mean by a polar dielectric ?

5. Write down Gauss's law in presence of a dielectric.

6. Give the relation connecting permittivity and susceptibility in linear dielectrics. Explain the terms involved. How is relative permittivity connected to susceptibility ?

7. Check whether the following statements are true or false : (i) stationary charges create constant magnetic field ; and (ii) a moving point charge cannot constitute a steady current.

8. Give Biot-Savart law. Explain the terms involved.

9. Give the differential and integral forms of Ampere's law in magnetostatics.

10. Write down the relation connecting magnetic flux density B and magnetic vector potential A. What is the divergence of A ?

Turn over

2

11. Explain the physical meaning of the equation of continuity.

12. What is the basic difference between electric and magnetic polarizations ?

$(8 \times 3 = 24 \text{ marks})$

Section B (Paragraph/Problem Type)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. Prove that the divergence of the curl of a vector is always zero.

14. Check whether $E = k\left[xy\hat{x} + 2yz\hat{y} + 3xz\hat{z}\right]$, is a possible electrostatic field ? Here, k is a constant with appropriate units.

15. Show that the energy of an ideal dipole p in an electric field E is given by $U = - p.E$.

16. Compare electrostatics and magnetostatics in terms of the Maxwell's equations applicable. Compare the nature of the fields with respect to their source.

17. Define the term surface current density. A current I flows down a wire of radius a. If the current is uniformly distributed over the surface, what is the surface current density ?

18. Write an expression for the field of a magnetized object. Explain the terms involved.

19. Explain the domain model of ferromagnets.

$(5 \times 5 = 25 \text{ marks})$

Section C (Essay Type)

Answer any **one** *question.*
The question carries 11 *marks.*

20. Discuss the divergence of a vector function and give its geometrical interpretation. Explain Green's theorem and illustrate it geometrically.

21. Explain the term electric potential. Obtain an expression for the electric potential of a localized charge distribution.

$(1 \times 11 = 11 \text{ marks})$

D 92965

Name..................................

Reg. No...............................

THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2020

Physics/Applied Physics

PHY 3B 03/APH 3B 03—ELECTRODYNAMICS—I

Time : Two Hours

Maximum : 60 Marks

Section A (Short Answer Type)

*Answer atleast **eight** questions.*
Each question carries 3 marks.
All questions can be attended.
Overall Ceiling 24.

1. What do you mean by the cross product of two vectors ? Mention two properties of cross product.

2. Give the geometrical interpretation of the gradient of a quantity.

3. Give the basic features of a one dimensional Dirac delta function.

4. Write down the relation connecting electric field and electric potential. Write its differential form.

5. Prove that the potential difference between two points a and b is equal to the work done per unit charge required to carry the particle from a to b.

6. List the basic electrostatic properties of ideal conductors.

7. What happens when a dielectric made of non-polar molecules is placed in an electric field ? What do you mean by the term polarization ?

8. Write down the relation connecting electric field, polarization and electric displacement. Can we express electric displacement as the gradient of a scalar potential ?

9. What happens when a dielectric is placed near the plates of a parallel plate capacitor ? Explain the term fringing field.

10. Write down Lorentz force law. Why magnetic forces do no work ?

11. Write down Maxwell's equations for magnetostatics.

12. Compare the behavior of paramagnetic and diamagnetic materials in a non-uniform magnetic field.

$(8 \times 3 = 24 \text{ marks})$

Turn over

Section B (Paragraph/Problem Type)

*Answer atleast **five** questions.*
Each question carries 5 marks.
All questions can be attended.
Overall Ceiling 25.

13. Using the expression for an infinitesimal volume element in spherical polar co-ordinates, determine the volume of a sphere.

14. Explain the Gauss's divergence theorem. Discuss its geometrical interpretation.

15. Obtain Poisson's and Laplace's equations in electrostatics.

16. A metal sphere of radius a carries a charge Q. It is surrounded, out to radius b, by a linear dielectric material of permittivity ε. Determine the potential at the centre (relative to infinity).

17. Find the magnetic field at a distance z above the centre of a circular loop of radius R, which carries a steady current I.

18. An infinitely long cylinder carries a uniform magnetization M parallel to its axis. Determine the magnetic field due to M inside and outside the cylinder.

19. Draw and explain a typical ferromagnetic hysteresis curve.

$(5 \times 5 = 25$ marks)

Section C (Essay Type)

*Answer any **one** question.*
The question carries 11 marks.

20. Explain Gauss's law. Obtain the differential form of Gauss's law. Using Gauss's law, determine the field outside a uniformly charged solid sphere of radius R and total charge q.

21. Obtain the equation of continuity in magnetostatics. Explain the Bio-Savart Law.

$(1 \times 11 = 11$ marks)