



10. For the function $f(x, y) = x \cos y + ye^x$ find $\frac{\partial^2 f}{\partial x^2}$.
11. Using chain rule to find the derivative of $w = x^2y - y^2$ with respect to t along the path $x = \sin t$ and $y = e^t$.
12. Find the volume of region between the cylinder $z = y^2$ in the xy plane and bounded by the plane $x = 0$, $x = 1$, $y = -1$, $y = 1$.
13. Evaluate $\iint_R f(x, y) dA$ for $f(x, y) = 1 - 6x^2y$ and R is the region bounded by $0 \leq x \leq 2$ and $-1 \leq y \leq 1$.
14. Evaluate $\int_0^1 \int_0^2 \int_0^{1-z} dy dx dz$.

PART – B

(8×5=40)

Unit – I

15. If p is a prime number and a is an integer such that $p \nmid a$ then prove that $a^{p-1} \equiv 1 \pmod{p}$.
16. If p is a prime number then prove that $(p-1)! \equiv -1 \pmod{p}$.
17. Prove that $\phi(n) = n \left(1 - \frac{1}{p_1}\right) \left(1 - \frac{1}{p_2}\right) \dots \left(1 - \frac{1}{p_r}\right)$ when $n = p_1^{k_1} p_2^{k_2} \dots p_r^{k_r}$.
18. Express $\frac{19}{51}$ as a simple continued fraction.

Unit – II

19. Prove that a nonempty subset H of a group G is a subgroup, if and only if whenever $a \in H$, $b \in H$, ab^{-1} also belongs to H .
20. Let H and K be subgroups of a group G . Then prove that if HK is a subgroup of G then $HK = KH$.
21. Prove that any subgroup of an infinite cyclic group is also an infinite cyclic group.
22. Prove that an infinite cyclic group has exactly two generators.



Unit – III

23. Show that $\lim_{(x,y) \rightarrow (0,0)} \frac{x^4 - y^2}{x^4 + y^2}$ does not exist.
24. Show that the function $f(x, y, z) = (x^2 + y^2 + z^2)^{-\frac{1}{2}}$ satisfies Laplace equation.
25. Find the local extreme values of the function $f(x, y) = xy - x^2 - y^2 - 2x - 2y + 4$.
26. If $u = \log \left(\frac{x^2 + y^2}{x + y} \right)$ then prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 1$.

Unit – IV

27. Evaluate $\int_C (x + y) ds$ where C is the straight line segment.
 $x = t, y = 1 - t, z = 0$ from $(0, 1, 0)$ to $(1, 0, 0)$
28. Find the volume of the region bounded by the paraboloid $z = x^2 + y^2$ and below by the triangle enclosed by the lines $y = x, x = 0$ and $x + y = 2$ in the xy – plane.
29. Find the area enclosed by the cardioid $r = a(1 + \cos\theta)$.
30. Evaluate $\int_0^1 \int_0^{2-x} \int_0^{2-x-y} dz dy dx$.
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BSCPHCN 201

**Second Semester B.Sc. Degree Examination, July/August 2023
(NEP 2020) (2021 – 2022 Batch Onwards)
PHYSICS (DSCC)
Electricity and Magnetism**

Time : 2 Hours

Max. Marks : 60

- Instructions :** 1) Answer questions from **all** Parts.
2) Scientific calculators are **allowed**.

PART – A

Answer **any four** questions. **Each** question carries **2** marks. **(4×2=8)**

1. Mention any two properties of charges.
2. State and explain Gauss' law in electrostatics.
3. What is a conductor ? Give an example.
4. Write the formula for force on a moving charge in magnetic field. Explain the symbols.
5. State Faraday's laws of electromagnetic induction.
6. Define curl of a vector. What is its significance ?

PART – B

Answer **all** questions.

(4×10=40)

Unit – I

7. a) Mention any four properties of electric field lines. **4**
b) Derive an expression for the electric potential due to a charged spherical conductor at a point **6**
 - i) Outside the sphere
 - ii) On the sphere and
 - iii) Inside the sphere.

OR

P.T.O.



8. a) Define electric field intensity and electric potential. Obtain the relation connecting them. 4
- b) Obtain an expression for electric potential due to a point charge. 6

Unit – II

9. a) Derive an expression for energy stored in a capacitor. 4
- b) Obtain an expression for the growth of current in a series LR circuit with a steady emf. Define time constant of the circuit. 6

OR

10. a) What is an electric current ? Mention its SI Unit. State and explain Ohm's law. 4
- b) Obtain an expression for the decay of charge in a CR circuit. Define time constant of the circuit. 6

Unit – III

11. a) Obtain an expression for current in a series LCR circuit. 4
- b) Discuss about RC Low Pass Filter and derive an expression for the cut off frequency. 6

OR

12. a) Distinguish between inductive reactance and capacitive reactance. 4
- b) Discuss about RC High Pass Filter and derive an expression for the cut off frequency. 6

Unit – IV

13. a) Derive equation of continuity. 4
- b) Explain the properties of Dia, Para and Ferro magnetic substances. 6

OR

14. a) Derive $\vec{\nabla} \times \vec{E} = -\frac{\delta \vec{B}}{\delta t}$ with usual symbols. 4
- b) Derive the wave equation for the field vectors \vec{E} and \vec{B} hence arrive at the equation for the velocity of electromagnetic wave in a medium. 6



PART – C

15. Answer **any three** questions. **Each** question carries 4 marks. **(3×4=12)**
- a) Two point charges $1.5 \mu\text{C}$ and $2.5 \mu\text{C}$ are placed 30 cm apart. Find the electric field intensity and electric potential at the mid-point of the line joining the two charges.
 - b) A proton is moving with velocity $2 \times 10^5 \text{ m/s}$ in a magnetic field of 3 Tesla. Calculate maximum force and minimum force acting on it. What is the force if inclination is 30° ?
 - c) An inductor of 200 mH and a resistor of 100Ω are connected in series to an ac source of 230 V, 50 Hz. Calculate the impedance, current and phase angle.
 - d) Find Div grad ϕ if $\phi = 2x^3y^2z^4$.
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