

Fill in the blanks. The symbols, unless mentioned otherwise, have their usual meanings.

11. The self- inductance per unit length of a long solenoid of radius R , carrying n turns per unit length is given by _____
12. In Meissner effect, the magnetic susceptibility of superconducting specimen is equal to _____
13. A primitive model for an atom consists of a point nuclei ($+q$) surrounded by a uniformly charged spherical cloud ($-q$) of radius a . The atomic polarizability (α) of such an atom is _____
14. A charged particle of mass m and charge Q moves along a circular path of radius r that is perpendicular to a magnetic field B . The time taken by the particle to complete one revolution is _____
15. The Laplacian of the function $T = x^3 + 5x^2y + 6z^2 + 10$ is equal to _____

KATHMANDU UNIVERSITY
End Semester Examination
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Level : B.E./B.Sc.
Year : I
Time : 2 hrs. 30 mins.

Course : PHYS 102
Semester : II
F. M. : 40

01 SEP 2024

SECTION "B"
[5Q × 3 = 15 marks]

Attempt ALL questions.

1. Distinguish between nuclear fusion and nuclear fission with suitable examples.
2. Define the divergence of a vector function. Show that the divergence of curl is always zero.

OR

Find the electric field (magnitude and direction) a distance z above the midpoint between two charges $+q$ and $-q$, a distance d apart. Check that your result consistent with what you would expect when $z \gg d$.

3. Prove that the volume bound current density is equal to the curl of magnetization.
4. What is electric potential? Show that electric field is the negative gradient of electric potential.

OR

Show that curl of electric field is zero in electrostatics conditions. What does this imply about the nature of the electric field in electrostatics?

5. Derive the expression for the magnetic vector potential in terms of the volume current density.

OR

State and prove the reciprocity theorem for the mutual inductance of two loops.

SECTION "C"
[5Q × 5 = 25 marks]

Attempt ALL questions.

6. What is threshold energy of a nuclear reaction? Derive the expression for the threshold energy of nuclear reaction.

OR

Explain the Raman effect with well labeled diagram. Describe the quantum mechanical explanation of Raman spectra with energy level diagram.

P.T.O.

7. Derive the expressions for the energy stored per unit volume in the magnetic field of a coil.
8. Find the electric field a distance z above the center of a flat circular disc of radius R which carries a uniform surface charge σ , what does your formula give in the limit $R \rightarrow \infty$? Also check the case $z \gg R$.

OR

- a. Find the energy stored in a uniformly charged solid sphere of radius R and total charge q .
 - b. Find the electric field inside and outside of a sphere which carries a charge density proportional to the distance from the origin, $\rho = kr$, for some constant k .
9. State and prove the Poynting's theorem for the flow of energy in an electromagnetic field.

OR

How did Maxwell modify Ampere's law? Derive the Maxwell's equations in matter in terms of free charges and currents.

10. Derive an expression for the electric field at the center of a spherical cavity inside a polarized dielectric due to the charges on the wall of the cavity and hence establish the Clausius-Mossotti formula.