Roll No. ..... Total Printed Pages - 8

# F- 303

## M.Sc. (FIRST SEMESTER)
## EXAMINATION, Dec. - Jan., 2021-22
## (PHYSICS)
### PAPER THIRD
### (ELECTRODYNAMICS AND PLASMA PHYSICS)

***Time : Three Hours]*** ***[Maximum Marks : 80***

**Note : Attempt all sections as directed**

**Section - A**

**(1 Mark each)**

**(Objective/Multiple Choice Questions)**

**Note- Attempt all questions.**

**Choose the correct answer:**

1. The power radiated by the dipole is

(A) $\frac{p^2\omega^4}{3\pi\varepsilon_0 c^3}$ (B) $\frac{p^2\omega^4}{6\pi\varepsilon_0 c^3}$

(C) $\frac{p^2\omega^4}{8\pi\varepsilon_0 c^3}$ (D) $\frac{p^2\omega^4}{12\pi\varepsilon_0 c^3}$





2. The instantaneous rate of radiation from the charge is -

(A) $\frac{1}{4\pi\varepsilon_0}\frac{2q^2a^2}{3c^3}$ (B) $\frac{1}{4\pi\varepsilon_0}\frac{q\,a}{c}$

(C) Zero (D) None of these

3. The field equation in coulomb gauge i.e. with div $\vec{A}=0$ reduce to.

(A) $\Box^2\vec{A}=-\mu\vec{J}_T$ and $\nabla^2\phi=\frac{\rho}{\in}$

(B) $\Box^2 A=\mu J_T$ and $\nabla^2\phi=+\frac{\rho}{\in}$

(C) $\Box^2 A=-\mu J_T$ and $\nabla^2\phi=-\frac{\rho}{\in}$

(D) $\Box^2 A=\mu J_T$ and $\nabla^2\phi=-\frac{\rho}{\in}$

4. The field equation in Lorentz guage with div $A+\mu\varepsilon\frac{d\phi}{dt}=0$ reduce to.

(A) $\Box^2 A=-\mu j$ and $\Box^2\phi=-\frac{\rho}{\in}$

(B) $\Box^2 A=\mu j$ and $\Box^2\phi=-\frac{\rho}{\in}$

(C) $\Box^2 A=-\mu j$ and $\Box^2\phi=\frac{\rho}{\in}$

(D) $\Box^2 A=\mu j$ and $\Box^2\phi=\frac{\rho}{\in}$

5. In an EM field which one of the following remains invariants under Lorentz transformation.

   (A) $\vec{E} \times \vec{B}$

   (B) $E^2 - C^2B^2$

   (C) $B^2$

   (D) $E^2$

6. Which one is incorrect relation?

   (A) $\vec{B} = \nabla \times A$ and $E = -\nabla\phi - \frac{\delta A}{\delta t}$

   (B) $\nabla . E = \frac{\rho}{\in_0}$ and $\vec{\nabla} \times E = 0$

   (C) $\nabla . B = 0$ and $\nabla \times B = \mu_0 j$

   (D) $\vec{B} = \nabla \times A$ and $E = -\nabla\phi + \frac{\delta A}{\delta t}$

7. What is criteria for plasma

   (A) $N_D << L$

   (B) $\lambda_D << L$

   (C) $\lambda_D >> L$

   (D) $N_D = 0$

8. What is the relation between K and B in alfven wave?

   (A) K is perpendicualr to B

   (B) K is parallel to B

   (C) The direction of K and B are different

   (D) Option (A) and (B)





9. Radiation due to the acceleration of a charge in coulomb field of another charge is called

   (A) Thermal Bremsstralung emission.

   (B) Thermal Bremasstralung absorption

   (C) Free emission

   (D) None of these

10. What is the unit of magnetic induction.

    (A) Coulmb/$m^3$

    (B) Weber/$m^3$

    (C) Weber/$m^2$

    (D) Volt/$m^3$

11. The electromagnetic radiation emitted when the charged particle are accelerated radially (v/a) is called.

    (A) Cyclotron Radiation

    (B) Synchrotron Radiation

    (C) Cherenkav Radiation

    (D) None of these

12. Total power radiated by an accelerated charge is equal to.

    (A) $\frac{2}{3}\frac{e^2}{c^3}|\dot{v}|^2$ (B) $\frac{2}{5}\frac{e^2}{c^3}|\dot{v}|$

    (C) $\frac{2}{3}\frac{e^2}{c^3}|\dot{v}|$ (D) $\frac{2}{3}\frac{e}{c^3}|\dot{v}|^2$

13. The electric field $\vec{E}$ is

(A) Normal

(B) Tangential

(C) Opposite

(D) Unrelated to the electric lines equipotential

14. The field of magnetic vector $\vec{B}$ is always -

(A) Irrotational

(B) Solenoidal

(C) Non-solenoidal

(D) Both (A) and (C)

15. If $\vec{E}$ is an electric field and $\vec{B}$ is magnetic induction then the energy per unit area per unit time in electromagetic field is given by -

(A) $\vec{E} \times \vec{B}$

(B) $\vec{E} \,.\vec{B}$

(C) $E^2 + B^2$

(D) $\frac{E}{B}$







16. What is retarted vector Potential

(A) $\vec{A}(r,t) = \frac{1}{4\pi \in_0} \int \frac{\mathrm{J}(r^1 t^1)dv}{|\vec{r} - \vec{r}\,'|}$

(B) $\vec{A}(r,t) = \frac{\mu_0}{4\pi} \int \frac{\mathrm{J}(r't')dv}{|\vec{r} - \vec{r}\,'|}$

(C) $\phi(r,t) = \frac{1}{4\pi \in_0} \int \frac{\rho(r',t')dv}{|\vec{r} - \vec{r}\,'|}$

(D) $\phi(r,t) = \frac{\mu_0}{4\pi} \int \frac{\rho(r',t')dv}{|\vec{r} - \vec{r}\,'|}$

17. The direction of propogation of electromagnetic wave is given by

(A) Vector $\vec{E}$ (B) Vector $\vec{H}$

(C) Vector $\vec{E} \times \vec{H}$ (D) $\vec{E} \times \vec{H}$

18. The potential (A and $\phi$) at the position defined by the vector $\vec{r}$ in uniform electric and magnetric field by

(A) $\phi = -\vec{E}.\vec{r}$ and $\vec{A} = \frac{1}{2}(\vec{B} \times \vec{r})$

(B) $\phi = \vec{E}.\vec{r}$ and $\vec{A} = \frac{1}{2}(\vec{B} \times \vec{r})$

(C) $\phi = \vec{E}.\vec{r}$ and $\vec{A} = (\vec{B} \times \vec{r})$

(D) $\phi = -E.\vec{r}$ and $\vec{A} = (\vec{B} \times \vec{r})$

19. What is the correct formula for magnetic viscosity.

(A) $\eta_m = \frac{1}{\mu_0 \sigma_0}$ (B) $\eta_m = \frac{c^2}{\in_0}$

(C) $\mu_0 \in_0 = \frac{1}{c^2}$ (D) None of the these

20. What is cyclotron frequency for a simple harmonic osullater

(A) $\omega_c = \frac{q\beta}{2m}$ (B) $\omega_c \frac{q\beta}{m^2}$

(C) $\frac{q|\beta|}{m}$ (D) None of these

## Section - B

**(Very Short Answer Type Questions)**

**(2 marks each)**

**Note : Attempt all questions.**

1. What is four-vectors?
2. Define the thermal Bremsstralung.
3. What is magnetic viscosty.
4. What do you understand by plasma oscillations?
5. What is electric field drift?
6. Write the formula for total power radiated by an accelerated charge.
7. What is Gauge transformation?
8. Define synchroton radiation.





## Section - C

**(3 Marks each)**

**(Short Answer Type Questions)**

**Note- Attempt all questions.**

1. Derive the matrix representation of Lorentz transformation.
2. Explain Emission from single speed electron.
3. What is the fundamental equation of magnetohydrodynamics?
4. What is the criteria for plasma?
5. Explain spectrum of synchrotron radiation.
6. Expalin Scalar and vector potential.
7. Explain Radiation by moving charge.
8. Explain of distribntion in frequency by accelerated charge?

## Section - D

**(Long Answer Type Questions)**

**(5 Marks each)**

**Note- Answer any 4 questions.**

1. Explain covariance of electron dynamics.
2. Derive the Lienard- Wiechart potential and field for a point charge.
3. Explain "Debye shielding".
4. Explain Magneto-sonic and Alfen waves?
5. Explain Cherenkor radiation.