GOVERNMENT ZIRTIRI RESIDENTIAL SCIENCE COLLEGE

Subject : **PHYSICS**
Paper Name : **Electromagnetic Theory**
Paper No. : **PHY/VI/CC/17**
Semester : **VI**

A. Multiple Choice Questions:

1. The integral form of Maxwell's equation originated from Faraday's law of electromagnetic induction is

a) $\int \vec{D}.\overrightarrow{ds} = \int \rho.dV$

b) $\oint_c \vec{E}.\,\mathrm{d}l = \int \frac{d\vec{B}}{dt}.\overrightarrow{ds}$

c) $\int \vec{B}.\overrightarrow{ds} = 0$

d) $\oint_c \vec{H}.\,\mathrm{d}l = \int \overrightarrow{I_c}.\overrightarrow{ds} + \int \frac{d\vec{D}}{dt}.\overrightarrow{ds}$

2. Faradays law in differential form is

a) $\nabla \times \vec{B} = \mu_o \vec{J}$

b) $\nabla \times \vec{E} = -\frac{d\vec{B}}{dt}$

c) $\nabla.\vec{B} = 0$

d) $\nabla.\vec{E} = \frac{\rho}{\varepsilon_o}$

3. Energy Density in a magnetic field $\vec{B}$ is given by

a) $\frac{B^2}{2\mu_o}$

b) $\frac{B^2}{2\varepsilon_o}$

c) $2\mu_o B$

d) $\frac{2\mu_o}{B}$

4. Amperes law is given by

a) $\nabla \times \vec{B} = \mu_o \vec{J}$

b) $\vec{B} = \mu_o \vec{H}$

c) $\nabla \times \vec{B} = \mu_o \vec{J} + \mu_o \varepsilon_o \frac{d\vec{E}}{dt}$

d) $\nabla.\vec{B} = 0$

5. Maxwell's First electromagnetic equation is originated from

a) Amperes law.

b) Gauss law.

c) Faradays law.

d) None of these.

6. Wave equation satisfied by Electric Field in free space is

a) $\nabla^2\vec{E}=\mu_o\varepsilon_o\frac{d^2\vec{E}}{dt^2}$

b) $\nabla^2\vec{E}=\frac{1}{\mu_o\varepsilon_o}\frac{d^2\vec{E}}{dt^2}$

c) $\nabla^2\vec{H}=\mu_o\varepsilon_o\frac{d^2\vec{H}}{dt^2}$

d) $\nabla^2\vec{E}=\sqrt{\mu_o\varepsilon_o}\frac{d^2\vec{E}}{dt^2}$

7. The velocity of light in free space is

a) $\mu_o\varepsilon_o$

b) $\sqrt{\mu_o\varepsilon_o}$

c) $\frac{1}{\sqrt{\mu_o\varepsilon_o}}$

d) $\sqrt{\frac{\mu_o}{\varepsilon_o}}$

8. The intrinsic impedence of an electromagnetic wave is

a) $\frac{\mu_o\omega}{k}$

b) $\frac{\mu_o k}{\omega}$

c) $\frac{k}{\varepsilon_o\omega}$

d) $\frac{\varepsilon_o k}{\omega}$

9. When a plane electromagnetic wave enters from one medium into another, which of the following quantities remains unchanged

a) Frequency

b) Electic Field Amplitude

c) Wavelength

d) Velocity

10. The energy per unit time, per unit area transported by the fields is called Poynting Vector (S). Its mathematical expression is

a) $\vec{S}\equiv\frac{1}{\mu_o}(\vec{E}\times\vec{B})$

b) $\vec{S}\equiv\frac{1}{\varepsilon_o}(\vec{E}\times\vec{B})$

c) $\vec{S}\equiv\mu_o(\vec{E}\times\vec{B})$

d) None of the above.

11.Brewster law relates the refractive index μ and polarising angle ρ as

a) μ=sinρ

b) $\mu=\frac{1}{\tan\rho}$

c) $\mu=\sin^{-1}\rho$

d. μ = tan ρ

12. For normal incidence of *e.m. wave* from media *1* to *2*, the ratio of reflected intensity to the incidence intensity is (*n1* and *n2* are refractive indices at the two media)

a) $\left(\frac{2n_1}{n_1+n_2}\right)^2$

b) $\left(\frac{n_1-n_2}{n_1+n_2}\right)^2$

c) $\left(\frac{n_1+n_2}{n_1-n_2}\right)^2$

d) $\left(\frac{2n_2}{n_1+n_2}\right)^2$

13. The relation between reflection coefficient *R* and transmission coefficient *T* for electromagnetic wave at normal incidence at the boundary between two linear media is obtained as

a) R-T=1

b) R/T=1

c) T-R=1

d) R+T=1

14. The boundary condition for perpendicular component of electric field at a conducting surface is

a) $E_1^{\perp} = E_2^{\perp}$

b) $\epsilon_2 E_1^{\perp} = \epsilon_1 E_2^{\perp}$

c) $\epsilon_1 E_1^{\perp} - \epsilon_2 E_2^{\perp} = \sigma_f$

d) $\epsilon_1 E_1^{\perp} + \epsilon_2 E_2^{\perp} = \sigma_f$

15. For monochromatic plane waves, $\vec{E}$ and $\vec{B}$ are in phase and mutually perpendicular, their (real) amplitudes are related by

a) $B_o = E_o c$

b) $B_o = \frac{1}{c} E_o$.

c) $E_o = \frac{1}{c} B_o$.

d) None of these.

16. Coulomb gauge condition is

a) $\nabla.\vec{A}$=0

b) $\nabla.\vec{A} = -\mu_o \varepsilon_o \frac{dV}{dt}$

c) $\nabla.\vec{A} = \mu_o \varepsilon_o \frac{dV}{dt}$

d) $\nabla.\vec{A} = \frac{1}{\mu_o \varepsilon_o} \frac{dV}{dt}$

17. If a vector and scalar potentials in a region of space are respectively ***A*** and *V*, then magnetic field ***B*** there exists is

a) $\nabla \times \vec{A}$

b) -∇V

c) $\nabla \times \vec{A}$ -∇V

d) $\nabla \times \vec{A}$ + ∇V

18. Lorenz gauge condition is obtained when $\nabla.\vec{A}$ is replaced by

a) -$\mu_o \varepsilon_o \frac{dV}{dt}$

b) 1

c) 0

d) $\frac{\rho}{\varepsilon_0}$

19.An electric field ***E*** in terms of scalar *V* and vector potential $\vec{A}$ is

a) $\nabla V - \frac{d\vec{A}}{dt}$

b) $-\nabla V - \frac{d\vec{A}}{dt}$

c) $\nabla.\vec{A} - \frac{dV}{dt}$

d) $-\nabla.\vec{A} - \frac{dV}{dt}$

20. On applying Coulomb gauge condition in the equation $\nabla^2.V + \nabla.\vec{A} = -\frac{1}{\varepsilon_0}\rho$, the Poisson's equation thus obtained is

a) $\nabla.V = \frac{\rho}{\varepsilon_0}$

b) $\nabla.V = -\frac{\rho}{\varepsilon_0}$

c) $\nabla^2.V = -\frac{\rho}{\varepsilon_0}$

d) $\nabla^2.V = \frac{\rho}{\varepsilon_0}$

21. Which of the following statement is incorrect. Planck's radiation formula

a) Agrees with experimental curves.

b) Disagrees with experimental result.

c) Obtained by applying Bose-Einstein distribution to photons.

d) None of the above.

22. Stefan-Boltzmann law gives the relation between total radiant heat power *P* emitted from a surface and the absolute temperature *T* as

a) $p \propto 1/T^4$

b) $p \propto T^3$

c) $p \propto 1/T^3$

d) $p \propto T^4$

23. According to Wien's displacement law of blackbody radiation, (λ_{max}= *peak wavelength, T = absolute temperature, a = proportionality constant)*
a) $\lambda_{max} = \frac{a}{T}$
b) $\lambda_{max} = \frac{a}{T^2}$
c) $\lambda_{max} = aT$
d) $\lambda_{max} = aT^2$

24. Identify the correct statement
a) Rayleight-Jeans law agrees with experimental results at short wavelength.
b) Inconsistency in Rayleigh-Jeans law occur at large wavelength.
c) Plancks law is an approximation of Rayleigh-Jeans law.
d) Rayleigh-Jeans law agrees experimental results at lowfrequency but strongly disagrees at high frequency.

25. The state at which more electrons are in the higher energy state than the lower energy state to obtain laser action is called
a) Optical pumping.
b) Stimulated emission.
c) Population inversion.
d) none of the above.

B. Fill up the blanks:

1. The Divergence of a magnetic field is equal to __________
2. The quantity $\varepsilon_0 \frac{d\vec{E}}{dt}$ which arises in the fourth Maxwell equation is termed as __________
3. In vacuum, Maxwell's first equation $\nabla.\vec{E} = \frac{\rho}{\varepsilon_0}$ reduces to $\nabla.\vec{E} =$ __________
4. Electromagnetic waves are __________ in nature.
5.
6. The continuity equation is given by $\frac{\partial \rho}{\partial t} = -\nabla.$ __________
7. The average force exerted by em wave per unit area is called __________
8. Electromagnetic waves travels at the __________
9. When *em wave* is incident on the surface of the boundary of two media, the ratio of transmitted intensity to the incident intensity is called __________

10. The distance it takes to reduce the amplitudes of an em wave in a conductor by a factor of *1/e* (about a third) is called __________

11. __________ transforms a function without any change in its two sets of potentials producing the same fields.

12. According to Lorenz force law, the net force on a charge *q* moving with a velocity *v* in the presence of both Electric and magnetic field is given by __________

13. If $F_{mag} = Q(v \text{ x } B)$is the magnetic force, then the work done by magnetic force is dW = __________

14. According to Kirchoff's law of thermal radiation, for an arbitrary body emitting and absorbing thermal radiation in thermodynamic equilibrium, the emissivity is __________ to the absorptivity.

15. The Einstein coefficient A relates to the __________ emission of light.

16. Emission means that the number of particles(photons) in a state goes from *N-1* to *N*, according to principle of detailed balance, the reverse process when number of particles goes from *N* to *N-1* is called __________

Key Answers

A. Multiple Choice Questions:

1. b) $\oint_c \vec{E}.\,\mathrm{d}l = \int \frac{d\vec{B}}{dt}.\overrightarrow{ds}$
2. b) $\nabla \times \vec{E} = -\frac{d\vec{B}}{dt}$
3. a) $\frac{B^2}{2\mu_o}$
4. c) $\nabla \times \vec{B} = \mu_o \vec{J} + \mu_o \varepsilon_o \frac{d\vec{E}}{dt}$
5. b) Gauss law
6. a) $\nabla^2 \vec{E} = \mu_o \varepsilon_o \frac{d^2 \vec{E}}{dt^2}$
7. c) $\frac{1}{\sqrt{\mu_o \varepsilon_o}}$
8. c) $\frac{k}{\varepsilon_o \omega}$
9. a) Frequency
10. a) $\vec{S} \equiv \frac{1}{\mu_o}(\vec{E} \times \vec{B})$
11. d) μ = tan ρ
12. b) $\left(\frac{n_1 - n_2}{n_1 + n_2}\right)^2$
13. d) R+T=1
14. c) $\epsilon_1 E_1^{\perp} - \epsilon_2 E_2^{\perp} = \sigma_f$

15. b) $B_o = \frac{1}{c}E_o$
16. a) $\nabla.\vec{A}$=0
17. a) $\nabla \times \vec{A}$
18. a) $\mu_o \varepsilon_o \frac{dV}{dt}$
19. b) $-\nabla V - \frac{d\vec{A}}{dt}$
20. c) $\nabla^2 . V = -\frac{\rho}{\varepsilon_0}$
21. b) Disagrees with experimental result
22. d) $p \propto T^4$
23. a) $\lambda_{max} = \frac{a}{T}$
24. d) Rayleigh-Jeans law agrees experimental results at lowfrequency but strongly disagrees at high frequency
25. c) Population inversion

B. Fill up the blanks:

1. zero	2. displacement current	3. 0
4. transverse	5. **J**	6. radiation pressure
7. speed of light	8. transmission coefficient	9. skin depth
10. Gauge transformations	11. $q[\boldsymbol{E}(\boldsymbol{v} \text{ x } \boldsymbol{B})]$	12. zero
13. equal	14. spontaneous	15. absorption