CHAPTER 8

Electromagnetic Waves

Displacement Current, Ampere Maxwell's Law

1. A 100 Ω resistance and a capacitor of 100 Ω reactance are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is: *(2016 - II)*

a. 4.4 A
b. $11\sqrt{2}$ A
c. 2.2 A
d. 11 A

Properties and Applications (i.e. Velocity, Amplitude, Energy Density) of Electromagnetic Waves

2. When light propagates through a material medium of relative permittivity ϵ_r and relative permeability μ_r, the velocity of light, v is given by : (c - velocity of light in vacuum) *(2022)*

a. $v = \frac{c}{\sqrt{\epsilon_r \mu_r}}$
b. $v = c$
c. $v = \sqrt{\frac{\mu_r}{\epsilon_r}}$
d. $v = \sqrt{\frac{\epsilon_r}{\mu_r}}$

3. For a plane electromagnetic wave propagating in x-direction, which one of the following combination gives the correct possible directions for electric field (E) and magnetic field (B) respectively? *(2021)*

a. $-\hat{j}+\hat{k}, -\hat{j}-\hat{k}$
b. $\hat{j}+\hat{k}, -\hat{j}-\hat{k}$
c. $-\hat{j}+\hat{k}, -\hat{j}+\hat{k}$
d. $\hat{j}+\hat{k}, \hat{j}+\hat{k}$

4. Light with an average flux of 20 W/cm^2 falls on non-reflecting surface at normal incidence having surface area 20 cm^2. The energy received by the surface during time span of 1 minute is: *(2020)*

a. 12×10^3 J
b. 24×10^3 J
c. 48×10^3 J
d. 10×10^3 J

5. The ratio of contributions made by the electric field and magnetic field components to the intensity of an electromagnetic wave is : (c = speed of electromagnetic waves) *(2020)*

a. 1 : 1
b. 1 : c
c. 1 : c^2
d. c : 1

6. The magnetic field in an electromagnetic wave is given by, *(2020-Covid)*

$B_y = 2 \times 10^{-7} \sin(\pi \times 10^3 x + 3\pi \times 10^{11} t)T$

Calculate the wavelength.

a. 2×10^{-3} m
b. 2×10^3 m
c. $\pi \times 10^{-3}$ m
d. $\pi \times 10^3$ m

7. An em wave is propagating in a medium with a velocity $v = \hat{i}v$. The instantaneous oscillating electric field of this em wave is along +y axis. Then the direction of oscillating magnetic field of the em wave will be along. *(2018)*

a. –y direction
b. +z direction
c. –z direction
d. –x direction

8. In an electromagnetic wave in free space the root mean square value of the electric field is E_{rms} = 6 V/m. The peak value of the magnetic field is: *(2017-Delhi)*

a. 2.83×10^{-8} T
b. 0.70×10^{-8} T
c. 4.23×10^{-8} T
d. 1.41×10^{-8} T

9. Out of the following options which one can be used to produce a propagating electromagnetic wave? *(2016 - I)*

a. A charge moving at constant velocity
b. A stationary charge
c. A charge less particle
d. An accelerating charge

10. Radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (*C* = velocity of light): *(2015)*

a. $\frac{2E}{C}$
b. $\frac{2E}{C^2}$
c. —
d. $\frac{E}{C}$

11. Light with an energy flux of 25×10^4 W/m^2 falls on a perfectly reflecting surface at normal incidence. If the surface area is 15 cm^2, the average force exerted on the surface is: *(2014)*

a. 1.25×10^{-6} N
b. 2.50×10^{-6} N
c. 1.20×10^{-6} N
d. 3.0×10^{-6} N

Electromagnetic Spectrum

12. Match List-I with List-II *(2022)*

List-I (Electromagnetic waves)	List-II (Wavelength)
a. AM radio waves	(i) 10^{-10} m
b. Microwaves	(ii) 10^{2} m
c. Infraraed radiations	(iii) 10^{-2} m
d. X-rays	(iv) 10^{-4} m

Choose the correct answer from the options given below:

a. (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
b. (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
c. (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
d. (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

13. The E.M. wave with shortest wavelength among the following is, *(2020-Covid)*

a. X-rays
b. Gamma-rays
c. Microwaves
d. Ultraviolet rays

14. Which colour of the light has the longest wavelength? *(2019)*

a. Red
b. Blue
c. Green
d. Violet

15. The energy of the E.M. waves is of the order of 15 keV. To which part of the spectrum does it belong? *(2015 Pre)*

a. Gamma-rays
b. X-rays
c. Infra-red rays
d. Ultraviolet rays

16. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is: *(2013)*

a. Infra-red waves produce heating in a microwave oven
b. The frequency of the microwaves must match the resonant frequency of the water molecules
c. The frequency of the microwaves has no relation with natural frequency of water molecules
d. Microwaves are heat waves, so always produce heating

Effects of Dielectrics in Capacitors

17. When light propagates through a material medium of relative permittivity ϵ_r and relative permeability μ_r, the velocity of light, v is given by : (c - velocity of light in vacuum) *(2022)*

a. $v = \frac{c}{\sqrt{\epsilon_r \mu_r}}$
b. $v = c$
c. $v = \sqrt{\frac{\mu_r}{\epsilon_r}}$
d. $v = \sqrt{\frac{\epsilon_r}{\mu_r}}$

18. A parallel plate capacitor of capacitance 20 μF is being charged by a voltage source whose potential is changing at the rate of 3 V/s. The conduction current through the connecting wires, and the displacement current through the plates of the capacitor, would be, respectively. *(2019)*

a. Zero, 60 μA
b. 60 μA, 60 μA
c. 60 μA, zero
d. Zero, zero

Answer Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
c	a	a	b	a	a	b	a	d	a	b	a	b	a	b	b	a

18
b