| | |
|---|---|
| **1.** | The electric field intensity produced by the radiations coming from 100W bulbs at a 3m distance is E. The electric field intensity produced by the radiations coming from 50W bulb at the same distance is<br>(a) $\frac{E}{2}$ (b) 2E<br>(c) $\frac{E}{\sqrt{2}}$ (d) $\sqrt{2E}$ |
| **2.** | Which of the following electromagnetic waves is used in medicine of destroy cancer cells?<br>(a) Infrared rays (b) Gamma rays<br>(c) Visible rays (d) Ultraviolet rays |
| **3.** | A linearly polarised electromagnetic wave given as $E = E_0\hat{\imath}\cos(kz-\omega t)$ is incident normally on a perfectly reflecting wall at z = a. Assuming that the material of the optically inactive, the reflected wave will be given as<br>(a) $\overrightarrow{E_r} = -E_0\hat{\imath}\cos(kz-\omega t)$<br>(b) $\overrightarrow{E_r} = E_0\hat{\imath}\cos(kz+\omega t)$<br>(c) $\overrightarrow{E_r} = -E_0\hat{\imath}\sin(kz+\omega t)$<br>(d) $\overrightarrow{E_r} = E_0\hat{\imath}\sin(kz-\omega t)$ |
| **4.** | The conduction current is the same as displacement current when the source is<br>(a) AC only (b) DC only<br>(c) either AC or DC (d) neither DC nor AC |
| | **Short Answer Type Qs (2 & 3 Marks)** |
| **5.** | Electromagnetic waves with wavelength<br>(i) $\lambda_1$ is used in satellite communication.<br>(ii) $\lambda_2$ used to kill germs in water purifier.<br>(iii) $\lambda_3$ used to detect leakage of oil in underground pipelines.<br>(iv) $\lambda_4$ used to improve visibility in runways during fog and mist conditions. |

| | |
|---|---|
| | (a) Identify and name the part of electromagnetic spectrum to which these radiations belong.<br>(b) Arrange these wavelengths in ascending order of their magnitude.<br>(c) Write one more application of each. |
| **6.** | Show that the magnetic field B at a point in between the plates of a parallel-plate capacitor during charging is $\frac{\varepsilon_0 \mu_r}{2}\frac{dE}{dt}$ (symbols having usual meaning). |
| **7.** | poynting vectors $\vec{S}$ is defined as a vector whose magnitude is equal to the wave intensity and whose direction is along the direction of wave propogation. Mathematically, it is given by $\vec{S} = \frac{1}{\mu_0}\vec{E} \times \vec{B}$. Show the nature of $\vec{S}$ vs t. graph |
| **8.** | Show that average value of radiant flux density 'S' over a single period 'T' is given by $S = \frac{1}{2c\mu_0}E_0^2$. |
| | **Long Answer Type Qs (5 Marks)** |
| **9.** | (a) How is electromagnetic waves produced? What is the nature of electromagnetic waves?<br>(b) The magnetic field in a plane electromagnetic wave is given by<br>$B_y = 8 \times 10^{-6} \sin[2 \times 10^{11}t + 300\pi x]$ T<br>(i) What is the wavelength and frequency of the wave?<br>(ii) Write an expression for the electric field. |
| **10.** | A plane EM wave travelling along z direction is described by $\vec{E} = E_0 \sin(kz - \omega t)\,\hat{i}$ and<br>$\vec{B} = B_0 \sin(kz - \omega t)\,\hat{j}$ .show that<br>(a) The average energy density of the wave is given by<br>$u_{av} = \frac{1}{4}\varepsilon_0 E_0^2 + \frac{1}{4}\frac{B_0^2}{\mu_0}$.<br>(b) The time averaged intensity of the wave is given by<br>$I_{av} = \frac{1}{2}c\varepsilon_0 E_0^2$. |

# HINTS AND ANSWER

**1.** (c)

**2.** (b)

**3.** (b)

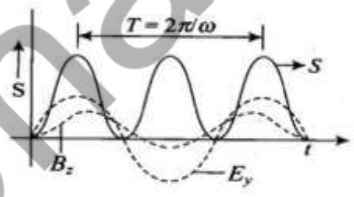
**4.** (c)

**5.** (i) Microwave is used in satellite communications. So $\lambda_1$ is the wavelength of microwave.
(ii) Ultraviolet rays are used to kill germs in water purifier So $\lambda_2$ is the wavelength of UV rays.
(iii) X-rays are used to detect leakage of oil in underground pipelines .So $\lambda_3$ is the wavelength of X-rays.
(iv) Infrared is used to improve visibility on runways during fog and mist condition. So, it is wavelength of infrared waves.
(b) Wavelength of X-rays < < wavelength of U V < wavelength of infrared < < wavelength of microwave. $\Rightarrow \lambda_3 < \lambda_2 < \lambda_4 < \lambda_1$
(c) Microwave is used in radar.
UV is used in LASIK eye surgery.
X-rays is used to detect a fracture in bones.
Infrared is used in optical communication.

**6.** $\frac{\mu_0 \varepsilon_0 r^2}{2} \frac{dE}{dt}$.

**7.** $\Rightarrow S = \frac{E_0 B_0}{\mu_0} \sin^2(\omega t - kx)\,\hat{i}$

Since $\sin^2(\omega t - kx)$ is never negative, $\vec{S}(x,t)$ always point in the positive X-direction, i.e, in the direction of wave propagation.
The variation of $|S|$ with time T will be as given in the figure below:




**8.** $S_{av} = \frac{E_0^2}{2\mu_0 C}$

**9.** (A) An electromagnetic wave is a waves radiated by an accelerated charge and propagates through space as coupled electric and magnetic field, oscillating perpendicular to each other and to the direction of propagation of the waves.

| | |
|---|---|
| | (B) (i)0.0067m<br>(ii) $E_0$ = 2400 V/m<br>$E_z$= 2400 sin (2 × $10^{11}$t + 300πx) V/m |
| **10.** | (A) **Expression type Question**<br>$u_{av} = u_E + u_B = \frac{1}{4}\epsilon_0 E_0^2 + \frac{1}{4}\frac{B_0^2}{\mu_0}$<br>(B) **Expression type Question**<br>$I_{av} = \frac{1}{2}c\epsilon_0 E_0^2$ |



You Tube Solutions
For JEE and NEET