One Two Academy | Electromagnetic Waves

Maximum Marks : 25 **PHYSICS** **Time: 50 Minutes**

Choose the correct answer :- **3x1=3**

1. Which of the following electromagnetic radiations is used for viewing objects through fog
(a) microwave (b) gamma rays (c) X- rays (d) infrared

2. Fraunhofer lines are an example of _____ spectrum.
(a) line emission (b) line absorption (c) band emission (d) band absorption

3.Which of the following is not an E.M waves

(a) X – Rays (b) UV Rays (c) γ – Rays (d) α – Rays

Answer the following :- **3x2=6**

4. Write down the integral form of modified Ampere's circuital law.
5. What is displacement current?
6. Compute the speed of the electromagnetic wave in a medium if the amplitude of electric and magnetic fields are 3×10^{4} N C^{-1} and 2×10^{-4} T, respectively.

Answer any two of the following:- **2x3=6**

7. Discuss the source of electromagnetic waves.
8. Give two uses each of (i) IR radiation, (ii) Microwaves.
9. A magnetron in a microwave oven emits electromagnetic waves (em waves) with frequency f = 2450 MHz. What magnetic field strength is required for electrons to move in circular paths with this frequency?.

Answer the following :- **2x5=10**

10. (a) Write down Maxwell equations in integral form.

(OR)

(b) (b) Explain the types of emission spectrum.

11. i) What are electromagnetic waves?
ii) A transmitter consists of LC circuit with an inductance of 1 μH and a capacitance of 1 μF. What is the wavelength of the electromagnetic waves it emits?

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Answer key attached in next page!!!

This page is to prevent seeing answer key

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ANSWER KEY

Q NO	ANSWERS	MARKS
1.	(D) infrared	**1**
2.	(B) line absorption	**1**
3.	(D) α - rays	**1**
4.	This law relates the magnetic field around any closed path to the conduction current and displacement current through that path. $\oint_l \vec{B} \cdot \overrightarrow{dl} = \mu_0 i_c + \mu_0 \varepsilon_o \frac{d}{dt} \oint_s \vec{E} \cdot \overrightarrow{dA}$	**2**
5.	The displacement current can be defined as the current which comes into play in the region in which the electric field (or the electric flux) is changing with time. $\oint_l \vec{B} \cdot \overrightarrow{dl} = \mu_0 i_c + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$	**2**
6.	$v = \frac{E_o}{B_o} = 1.5 \times 10^8 ms^{-1}$	**2**
7.	Any stationary charge produces only electric field . When the charge moves with uniform velocity, it produces steady current which gives rise to magnetic field (not time dependent, only space dependent) around the conductor in which charge flows. If the charged particle accelerates, it produces magnetic field in addition to electric field. Both electric and magnetic fields are time varying fields. Since the electromagnetic waves are transverse waves, the direction of propagation of electromagnetic waves is perpendicular to the planes containing electric and magnetic field vectors. Any oscillatory motion is also an accelerated motion. So, when the charge oscillates (oscillating molecular dipole) about their mean position, it produces electromagnetic waves. Suppose the electromagnetic field in free space propagates along *z*-direction and if the electric field vector points along *x*-axis, then the magnetic field vector will be mutually perpendicular to both electric field and the direction of wave propagation. Thus $E_x = E_0 \sin(kz - \omega t)$ $B_y = B_0 \sin(kz - \omega t)$	**3**
8.	a) Infrared rays • It is used in TV as a signal carrier. • Used to look through haze fog or mist. b) Microwaves • It is used in radar system for aircraft navigation. • Used in very long distance wireless communication through satellites.	**3**
9.	$\omega = 2\pi f$ = 15,386 x 10^6 Hz = 1.54 x 10^{10} s^{-1}	**3**

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	$^{B} = \frac{m_e \omega}{\lvert q \rvert} = 0.08768$ T	
10. a	**First equation** $$\oint_S \vec{E} \cdot \overrightarrow{dA} = \frac{Q_{enclosed}}{\epsilon_o}$$ **Second equation** $$\oint_S \vec{B} \cdot \overrightarrow{dA} = 0$$ **Third equation** $$\oint_l \vec{E} \cdot \overrightarrow{dl} = -\frac{d\phi_B}{dt}$$ **Fourth equation** $$\oint_l \vec{B} \cdot \overrightarrow{dl} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d}{dt} \oint_S \vec{E} \cdot \overrightarrow{dA}$$	**5**
10. b	**(i) Continuous emission spectrum** If the light from incandescent lamp is allowed to pass through prism, it splits up into seven colours. Thus, it consists of wavelengths containing all the visible colours ranging from violet to red . Examples: spectrum obtained from carbon arc and incandescent solids. **(ii) Line emission spectrum** Suppose light from hot gas is allowed to pass through prism, line spectrum is observed. Line spectra are also known as discontinuous spectra. The line spectra consists of sharp lines of definite wavelengths or frequencies. Such spectra arise due to excited atoms of elements. These lines are the characteristics of the element and are different for different elements. Examples: spectra of atomic hydrogen, helium, etc. **(iii) Band emission spectrum** Band spectrum consists of several number of very closely spaced spectral lines which overlap together forming specific bands which are separated by dark spaces.This spectrum has a sharp edge at one end and fades out at the other end. Such spectra arise when the molecules are excited. Band spectrum is the characteristic of the molecule and hence the structure of the molecules can be studied using their band spectra. Example: spectra of ammonia gas in the discharge tube etc.	**5**
11	i) Electromagnetic waves are nonmechanical waves which move with speed equals to the speed of light (in vacuum). ii) $f = \frac{1}{2\pi\sqrt{LC}}$ Hz , $\lambda = \frac{c}{f}$ 18.84 x 10^2 m	**5**

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