REV-01 BSP/01/05

B.Sc. PHYSICS SIXTH SEMESTER ELECTROMAGNETIC THEORY BSP – 601 [SPECIAL REPEAT] [USE OMR SHEET FOR OBJECTIVE PART]

2024/07 **SET A**

Duration: 3 hrs.

(Object)

(Objective)

Time: 30 min.

Full Marks: 70

Marks: 20

Choose the correct answer from the following:

1X20=20

- 1. Out of the following options which one can be used to produce a propagating electromagnetic wave?
 - a. A chargeless particle
- b. An accelerating charge
- c. A charge moving at constant velocity
- d. A stationary charge
- 2. If the amplitude of the magnetic field is 0.1 mT, then amplitude of the electric field for a electromagnetic waves is
 - a. 3 V/m

b. 0.3 V/m

c. 30 KV/m

- d. 300 V/m
- 3. Which of the following is correct?

At a point on the interface of the two different media (symbols have their usual meaning)

- a. tangential component of \vec{E} is continuous
- **b.** tangential component of \vec{H} is continuous
- **c.** normal component of \vec{D} is continuous
- **d.** normal component of \vec{B} is discontinuous
- According to the Poynting theorem, the energy flow per unit time out of any closed surface is
 - a. Integral of \vec{S} over the length of the surface
- b. Integral of \vec{S} over the area of the surface
- C. Differential of \vec{S} over the length of the surface
- **d.** Differential of \vec{S} over the area of the surface
- 5. Which of the following is not an electromagnetic wave?
 - a. X-ray

b. Sound waves

c. Microwaves

- d. Radiowaves
- 6. For an EM wave in free space the Electric Field E and Magnetic Field H are
 - a Perpendicular to each other and along the direction of propagation
- b. Both are in the same phase
- c Perpendicular to each other and also perpendicular to the direction of propagation
- d.
- Both b and c

7.	In an electromagnetic wave the field vector a. only space coordinate c. both space and time coordinates	ors are functions of b. only time coordinate d. none		
8.	Electromagnetic waves propagate through a. $\sqrt{\mu_0 \epsilon_0}$ c. $\frac{1}{\mu_0 \epsilon_0}$	a linear homogeneous medium at b. $\frac{1}{\sqrt{\mu_0\epsilon_0}}$ d. $\mu_0\epsilon_0$	a speed of	
	A perfect dielectric acts as a a. Perfect transmitter c. Bad transmitter	b. Perfect reflectord. Bad reflector		
10.	If the phase difference between two rays II/4, the emergent light is a. Linearly Polarized c. Circularly Polarized	is π/2 and the angle of incidence ib. Elliptically Polarizedd. Non-Polarized	s equal to	
11.	When the angle of incidence is equal to the transmitted rays are: a. Parallel to each other c. Anti-parallel to each other	Brewster angle, the reflected andb. Perpendicular to each otherd. None of the above		
	Brewster's law in terms of refractive indeusual meaning] a. $\mu = \sin \theta_p$ c. $\mu = \tan \theta_p$	ex can be Expressed as [symbols b. $\mu = \cos \theta_p$ d. $\mu = \cot \theta_p$	have their	
13.	The skin depth is a phenomenon observed a. Insulators c. Conductors	d in b. Dielectrics d. Semiconductors		
	The working of Nicole prism is based on the a. Refraction c. Diffraction	b. Dispersiond. Double Refraction		
a	According to the law of Malus, the intensity analyzer varies as [symbols have their usua a. $I_0 \mathrm{Sin}^2 \theta$ c. $I_0 \mathrm{Cos} \theta$		igh the	
16.	A Nicol prism does not act as a polarizer w			
	a. The angle of incidence is less than the critical angle for the O-rayc. The angle of incidence is less than the critical angle for the E-ray	 b. The angle of incidence is greather critical angle for the O-ray d. The angle of incidence is greather critical angle for the E-ray 	' ater than	
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17. The operating frequency of a waveguide can be determined by

a. Size of the waveguide

b. Material of the waveguide

c. Mode of transmission of the waveguide

d. Both b and c

18. For an ideal waveguide, the energy loss is

a. zero

b. maximum

c. moderate

d. uncertain

19. A transverse electric mode or TE mode waveguide has

a. $E_z=0$ and $H_z\neq 0$

b. E,=0 and H,=0

c. E, \neq 0 and Hz=0

d. $E_z \neq 0$ and $H_z \neq 0$

20. A waveguide can transmit energy only if the frequency of the electromagnetic wave

a. is less than the cut off frequency.

b. is equal to the cut off frequency.

c. is greater than the cut off frequency.

d. None of these

Descriptive

Time: 2 hrs. 30 min.

Marks: 50

[Answer question no.1 & any four (4) from the rest]

- 1. a. Derive the wave equations for electric and magnetic field vectors, \vec{E} and \vec{B} respectively, for an isotropic homogeneous dielectric medium. With what velocity do these waves propagate through the medium?
 - **b.** Show that the tangential components of electric field are continuous across the boundary between two dielectric media.
- a. Write down the differential and integral forms of Maxwell's equations.
 - **b.** Derive the differential form of Maxwell's second and fourth equations.
- a. Write down the boundary conditions satisfied by the electric and magnetic fields when an electromagnetic wave propagates through a conductor.

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- b. Prove that electromagnetic waves are transverse in nature.
- **4.** Obtain the expression for reflection coefficient (R) and transmission coefficient (T) when the electromagnetic wave hits the interface between two linear media at normal incidence. Hence show that, R + T = 1.
- 5. **a.** Describe briefly the linear and circular polarization of electromagnetic waves.

 5+2+3
 =10
 - **b.** Define Brewster's angle θ_B ?
 - **c.** Deduce the value of Brewster angle for a glass slab placed in air, (n = 1.5 where n is the refractive index).
- 6. a. State and prove Poynting vector theorem. 8+2=10b. Explain the physical significance of Poynting vector?
- 7. a. Explain the phenomenon of double refraction.
 b. What is a Nicol prism?
 - c. Explain how a Nicol prism acts as a polarizer and an analyse.
- 8. a. What is waveguide? Give an example of it.
 b. What do you mean by TE, TM and TEM modes of a waveguide?

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c. Write down one difference between uniaxial and biaxial crystals? Give one example of each.

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