B.Sc. PHYSICS
THIRD SEMESTER
WAVE OPTICS & ELECTROMAGNETIC THEORY

SET A

BSP – 931 IDMJ

[USE OMR FOR OBJECTIVE PART]

Duration: 3 hrs.

Full Marks: 70

(Objective)

Time: 30 min.

Marks: 20

Choose the correct answer from the following: *1×20=20*

1. When light passes from one medium to another, Huygens' Principle helps explain which of the following effects?
   a. Total internal reflection
   b. The bending of light (refraction)
   c. Polarization
   d. Dispersion

2. Which of the following statements is true regarding secondary wavelets?
   a. They can only propagate in a straight line.
   b. They only exist in electromagnetic waves.
   c. They can interfere with other wavelets to create complex wavefronts.
   d. They are always in phase with the original wavefront.

3. What is spherical aberration?
   a. An effect where light rays parallel to the optical axis focus at differentpoints.
   b. A distortion caused by the misalignment of optical elements.
   c. An increase in intensity at certain points in an image.
   d. A color distortion seen in images.

4. Which type of coherence describes waves that have a constant phase relationship over time?
   a. Temporal coherence
   b. Spatial coherence
   c. Longitudinal coherence
   d. Geometric coherence

5. The variation in the magnification produced by a lens for different axial distances results in the aberration called
   a. Coma
   b. Astigmatism
   c. Distortion
   d. The curvature of the field in the image

6. A laser beam is coherent because it contains
   a. waves of several wavelengths.
   b. incoherent waves of a single wavelength.
   c. coherent waves of several wavelengths
   d. coherent waves of a single wavelength

7. In Newton's ring, if the radius of curvature of the lens is R and the wavelength of light used is λ, the distance between two successive dark rings is proportional to:
   a. λ/R
   b. R/λ
   c. R^2/λ
   d. λ^2/R

8. Which part of the lens system primarily contributes to chromatic aberration?
   - a. The front element
   - b. The lens shape
   - c. The refractive index of the lens material
   - d. The coating on the lens

9. The phenomenon where light bends around obstacles is known as:
   - a. Reflection
   - b. Diffraction
   - c. Refraction
   - d. Dispersion

10. What type of interference occurs when two waves are in phase?
    - a. Destructive interference
    - b. Diffraction
    - c. Polarization
    - d. Constructive interference

11. Flux through any closed surface is a measure of total charge inside
    - a. Gauss Law
    - b. Stefan Boltzmann law
    - c. Faraday's Law
    - d. Maxwell's law

12. Gaussian surface of coaxial cylinder
    - a. Spherical symmetry
    - b. Cylindrical symmetry
    - c. Plane symmetry
    - d. None of the above

13. _____ forces do no work
    - a. Electric
    - b. Magnetic
    - c. Both
    - d. None

14. A changing _____ induces a _____.
    - a. Electric, Electric
    - b. Magnetic, Magnetic
    - c. Electric, Magnetic
    - d. Magnetic, Electric

15. Stationary sources for _____ field exist but not for _____ field.
    - a. Electric, Magnetic
    - b. Magnetic, Electric
    - c. Electric, Graviational
    - d. Gravitational, Magnetic

16. Analogous accumulation of charges is due to
    - a. Polarization
    - b. Magnetization
    - c. Both
    - d. None

17. Velocity of an electro-magnetic wave is given by
    - a. $(\varepsilon_0\mu_0)^1$
    - b. $(\varepsilon_0\mu_0)^{1/2}$
    - c. $(\varepsilon_0\mu_0)^{-1/2}$
    - d. $(\varepsilon_0\mu_0)^{/2}$

18. Charges produce _____, fields affect _____.
    - a. charges, fields
    - b. charges, charges
    - c. field, charges
    - d. fields, fields

19. Work done on charges by the electromagnetic force is _____ in energy stored in the field
    - a. Decrease
    - b. Increase
    - c. Equal
    - d. Constant

20. Divergence of curl is
    a. zero
    b. infinite
    c. negative
    d. imaginary

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(Descriptive)

Time: 2 hrs. 30 min.

Marks: 50

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

1. a. Explain Huygens' principle of wave propagation and deduce   5+5=10
      from it the law of reflection.

   b. Elaborate Poynting's theorem.

2. Discuss the different type monochromatic aberrations in the image   10
   formed by a single lens.

3. a. Derive the expression for longitudinal chromatic aberration for   5+5=10
      an object at infinity.

   b. Deduce the condition of achromatism of two lenses of same
      material.

4. a. State the conditions of sustained interference.   3+7=10

   b. What are coherent sources? Two coherent sources form
      interference fringes. Derive the theory of interference and state
      the condition of constructive and destructive interference.

   a. Describe mutual inductance.   3+4+3
                                            =10
5. b. Describe how divergence of magnetic field can be obtained
      using Maxwell's equations.

   c. Nature abhors a change in flux. Elaborate.

3

6. **a.** Write the expression for continuity equation relating to conservation of electric charges.   1+4+2+3 =10

   b. Discuss Ampere's law in light of conservation of charges.

   c. Define spatial and temporal coherence.

   d. State the differences between interference and diffraction of light waves.

7. Discuss Maxwell's equations in matter and general boundary conditions.   6+4=10

8. Discuss in detail the electromagnetic waves in matter.   10

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