REV-01
BSP/04/09

2023/12

SET A

B.Sc. PHYSICS
THIRD SEMESTER
WAVE OPTICS & ELECTROMAGNETIC THEORY
BSP - 301 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. If a parallel beam of light is incident on a concave lens, all the rays after refraction through the lens will
   a. Approach one another and converge at a point
   b. Move away from one another
   c. Move parallel to the principal axis
   d. None of these

2. The lens formula is
   a. $1/f = 1/v - 1/u$
   b. $1/f = 1/v + 1/u$
   c. $f = v + u$
   d. $f = v - u$

3. The point of intersection of the principal plane with the axis of the lens is called
   a. The optical center of the lens
   b. Pole of the lens
   c. Focus
   d. Radius of curvature

4. If the power of the lens is -1 diopter, then .....
   a. The lens is converging having a focal length of 1 m
   b. The lens is diverging having a focal length of 1 m
   c. The lens is converging having a focal length of 2 m
   d. The lens is converging having a focal length of 2 m

5. Two thin lenses of focal lengths 15 cm and 10 cm are placed co-axially at a certain distance apart. The combination of lenses produces minimum spherical aberration if the distance between two lenses is
   a. 5 cm
   b. 25 cm
   c. -5 cm
   d. 10 cm

6. In the context of interference, what is a 'phase difference'?
   a. The difference in brightness between two light waves
   b. The difference in speed between two light waves
   c. The difference in direction of two light waves
   d. The difference in the position of corresponding points on two light waves

7. The wavefront due to a source situated at infinity is
   a. Spherical
   b. Cylindrical
   c. Planar
   d. Circular

8. Consider interference between two waves from two sources of intensities I and 4I. What is the ratio of intensities at the point where the phase difference is π?
   a. I
   b. 9 I
   c. 5 I
   d. 6 I

9. The main principle used in Interference is
   a. Heisenberg's Uncertainty Principle
   b. Superposition Principle.
   c. Huygens principle
   d. Fermi Principle

10. What happens if the monochromatic light used in Young's double-slit experiment is replaced by white light?
   a. No fringes are observed.
   b. All bright fringes become white.
   c. All bright fringes have colors between violet and red.
   d. Only the central fringe is white and all other fringes are colored.

11. Divergence of curl is equal to
   a. Its gradient
   b. Zero
   c. Infinity
   d. none of the above

12. A changing _____ field induces _____ field.
   a. Electric, Magnetic
   b. Magnetic, Electric
   c. one of the above
   d. More than the above

13. Ampere's law is not applicable for _____ current.
   a. Steady
   b. Non-steady
   c. Zero
   d. none of the above

14. Biot Savart Law holds applicable for _____ current only.
   a. Steady
   b. Non-steady
   c. Zero
   d. None of the above

15. Magnetic dipole moment per unit volume is
   a. Magnetization
   b. Polarization
   c. Both
   d. None

16. Bound current is dependent on
   a. Magnetization
   b. Polarization
   c. Both
   d. None

17. Displacement current is dependent upon
   a. Electric displacement
   b. Magnetic displacement
   c. Charge density
   d. None

18. Nature _____ change in flux
   a. Abhors
   b. Fluctuates
   c. is independent of
   d. None

19. Magnitute of bound currents is given by
   a. Gradient of Polarization
   b. Curl of Polarization
   c. Divergence of Polarization
   d. none

20. Current density has

a. 1 charge component
b. 2 charge component
c. 3 charge component
d. 4 charge component

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Descriptive

Time : 2 hrs. 30 mins. **Marks : 50**

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

1. a. Explain Huygens' principle. Verify the law of reflection for a spherical wavefront incident on a plane surface using Huygens' wave theory. **2+3=5**
   b. Write the physical significance of Poynting Vector. **5**
2. a. Discuss the spherical aberrations in the image formed by a single lens with respect to a certain position of an object. **6+4=10**
   b. Discuss at least two methods to minimize the spherical aberration.
3. a. Explain what is chromatic aberration in the lenses? **2**
   b. A lens of focal length 30 cm is made of a glass having refractive indices for C and F lines as $n_C = 1.5164$ and $n_F = 1.5249$. It is used to form an image of a point object placed 60 cm in front of the lens. Find the amount of axial chromatic aberration. **2**
   c. What is interference of light? Give the theory and mention the conditions required for constructive and destructive interference of light. **1+5=6**
4. a. State the conditions for the sustained interference. **4+3+3 =10**
   b. Explain, why two coherent sources are essential to observe interference.
   c. The distance between the two coherent sources of light is 0.16 mm. Interference fringes are obtained on a screen placed at a distance of 1.2 m from the sources. It is found that for a certain monochromatic source of light the second bright fringe is at a distance of 9.6 mm from the central fringe. What is the wavelength of the source?

5. a. What is a Gaussian Surface? Describe different types of Gaussian surfaces with suitable diagrams. 2+2=4
   b. Write the expression for magnetic field of steady currents. How does the expression change for surface current and volume current 2+2=4
   c. Provide a detailed physical significance of the expression $\nabla.B=0$ 2

6. Elaborate the statement in detail citing examples, "Nature abhors a change in flux". 10

7. a. What is polarization current? 2+4+4 =10
   b. How is polarization current related to density of bound currents and Magnetization.
   c. Write and elaborate the expression for current density in its three counterparts

8. Write and explain the Maxwell's equations in terms of free charges and currents. 10

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