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B.Sc. (Semester - 3)

Subject: Physics

Course: US03CPHY01

Optics

Question Bank

UNIT: I

Multiple choice questions:

(1) There are _____ points known as cardinal points of an optical system
(a) two (b) four
(b) **six** (d) eight

(2) In 1841, _____ showed that any number of coaxial lenses could be treated as a single unit
(a) Newton (b) Rayleigh
(c) Galileo (d) **Gauss**

(3) The nodal points are a pair of conjugate points on the axis having unit _____ angular magnification
(a) negative (b) **positive**
(c) unequal (d) zero

(4) The distance between two nodal points is always _____ to the distance between two principal points
(a) **equal** (b) unequal
(c) higher (d) lower

(5) The distance between principal point and focal points in the lens combination is known as _____
(a) First length (b) simple length
(c) **equivalent focal length** (d) principal length

(6) The distance of principal plane from the first lens is _____
(a) $\beta = -\frac{f\,d}{f_1}$ (b) $\boldsymbol{\alpha = \frac{f\,d}{f_2}}$
(c) $\beta = -\frac{f_1\,d}{f}$ (d) $\alpha = -\frac{f_2\,d}{f}$

(7) The distance of principal plane from the second lens is _____
(a) $\boldsymbol{\beta = -\frac{f\,d}{f_1}}$ (b) $\alpha = \frac{f\,d}{f_2}$
(c) $\beta = -\frac{f_1\,d}{f}$ (d) $\alpha = -\frac{f_2\,d}{f}$

(8) The aberration that occurs due to dispersion of light are called _____ aberration
(a) monochromatic (b) coma
(c) distortion (d) **chromatic**

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(9) The peripheral light rays passing through a lens come to focus_____ the lens after refraction

(a) away from (b) **close to**

(c) on (d) at infinity

(10) The paraxial rays passing through the lens close to the axis are refracted less and come to focus _____ from the lens

(a) **farther** (b) close to

(c) at infinity (d) on

(11) The spherical aberration produced by convex lens is _____

(a) negative (b) **positive**

(c) equal (d) zero

(12) For a cross lens _____

(a) $\frac{R_1}{R_2} = \frac{1}{4}$ (b) $\frac{R_1}{R_2} = -\frac{1}{4}$

(c) $\boldsymbol{\frac{R_1}{R_2} = -\frac{1}{6}}$ (d) $\frac{R_1}{R_2} = \frac{1}{6}$

(13) Spherical aberration can also be made minimum by using two_____ lenses

(a) convex (b) concave

(c) plano-concave (d) **plano-convex**

(14) The coma can be eliminated if a lens satisfied _____ condition

(a) Snell's (b) **Abbe's sine**

(c) Gauss (d) Newton's

(15) The axial chromatic aberration for a thin lens for an object at infinity is equal to the _____ of the dispersive power of the material of the lens and the mean focal length

(a) sum (b) **product**

(c) square (d) cube

(16) The lens near the object is called _____

(a) ocular (b) eyepiece

(c) **objective** (d) field of view

(17) An extra lens used between the objective and eye lens is called _____

(a) telephoto lens (b) bipolar lens

(c) **field lens** (d) achromatic lens

(18) The field of view of Huygens' eyepiece is _____ than that of Ramsden's eyepiece

(a) **smaller** (b) greater

(c) equal (d) unequal

(19) The Ramsden eyepiece is sometimes referred to as _____ eyepiece

(a) negative (b) large

(c) small (d) **positive**

(20) The power of Huygens' eyepiece is _____

(a)negative (b) **positive**

(c) small (d) zero

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Short Questions:

1. Define cardinal points and cardinal planes
2. Define first principal point and second principal point
3. Define first focal point and second focal point
4. Write the properties of nodal points
5. Show that the distance between two nodal points is always equal to the distance between two principal points
6. Show that the nodal points are a pair of conjugate points on the axis having unit positive angular magnification
7. Show that the nodal points are coincide with the principal points when the refractive indices on either side of the lens are same
8. Derive the Newton's formula for lens
9. Define equivalent focal length
10. What is aberration?
11. What are the types of aberration?
12. Define monochromatic and chromatic aberrations
13. Write the types of monochromatic aberration
14. What you meant by longitudinal and lateral spherical aberration?
15. What is the circle of least confusion?
16. Write the formula of shape factor
17. What is the condition for minimum spherical aberration?
18. Define coma
19. What is the positive and negative coma?
20. Write the Abbe's sine condition
21. What is an anastigmat?
22. What you meant by the curvature of the field?
23. Define distortion
24. Define longitudinal and lateral chromatic aberration
25. Write the expression for measure of axial chromatic aberration
26. What is an eyepiece?
27. State the merits and demerits of Huygens' eyepiece
28. State the merits and demerits of Ramsden eyepiece
29. Write the conditions for minimized spherical and chromatic aberration
30. Why the Huygens' eyepiece is known as negative eyepiece?

Long Questions:

1. Explain the term cardinal points with reference to a coaxial system
2. What are the principal points and principal planes? Show that the principal planes are the planes of unit linear magnification
3. What are nodal points? Give their properties. Show that the nodal planes are planes of unit angular magnification
4. Derive Newton's formula for a convergent system of lenses forming a real image

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5. Two thin convex lenses of focal length f_1 and f_2 are coaxial and separated by distance'd'. Show that the equivalent focal length f of the combination is given by the relation $f = \frac{f_1 f_2}{f_1 + f_2 - d}$
6. Derive expressions for the equivalent focal length and the positions of principal points and focal points of a coaxial system of two lenses separated by a finite distance
7. What is spherical aberration of a lens? Explain how it caused by a lens. Also explain the methods of removing them.
8. Find the condition for minimum spherical aberration.
9. Explain the defect coma with neat diagram. Explain how it can be minimized.
10. Discuss the astigmatism with neat diagram. How it is removed?
11. Explain the defects curvature of the field and distortion with the methods of removal.
12. Discuss the chromatic aberration of a lens and derive an expression for longitudinal chromatic aberration for an object at infinity.
13. What is the difference between pincushion distortion and barrel-shaped distortion? How can these defects be removed?
14. What is an eyepiece and what is its advantage over a single lens?
15. Give the construction and working of a Ramsden eyepiece? How are chromatic and spherical aberrations minimized in this eyepiece?
16. Explain the construction of Huygens eyepiece. Why cannot a cross-wire be used with it?
17. Give the name and construction of the eyepiece, which satisfied the condition for achromatism.
18. Describe and point out the respective merits of Ramsden and Huygens eyepieces.
19. Explain with the help of a neat diagram the construction and working of a Huygens eyepiece and clearly indicate the positions of its cardinal points.
20. Give the comparison of Ramsden and Huygens eyepiece?

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B.Sc. (Semester - 3)
Subject: Physics
Course: US03CPHY01
Optics
UNIT: II Interference and Diffraction
Question Bank

Q-1 Multiple Choice Questions

(1) Fresnel's biprism is based on splitting of _____

(a) Amplitude (b) **wave front**

(c) Inclination (d) thickness

(2) The two parts of the same wave front travel through different paths and reunite on a screen to produce fringe pattern. This is known as interference due to division of _____

(a) **wave front** (b) amplitude

(c) Thickness (d) inclination

(3) Newton's ring is based on the splitting of _____
(a) wave front (b) **amplitude**
(c) Thickness (d) inclination

(4) In biprism when fringes are obtained by using white light, the central white fringe is known as_____ fringe.
(a) first order (b) nearest order
(c) **zero- order** (d) Second order

(5) Newton's rings are an example of fringes of equal _____
(a) Inclination (b) **thickness**
(c) phase-shift (d) amplitude

(6) In Fresnel diffraction , the source of light and the screen are effectively at_____ distances from the obstacle
(a) Infinite (b) equal
(c) **Finite** (d) greater

(7) In Fraunhoffer diffraction the source of light and screen are effectively at _____ distances from the obstacle
(a) Equal (b) **infinite**
(c) Greater (d) finite

(8) The division of amplitude method requires _____ source
(a) **Extended** (b) narrow
(c) Finite (d) infinite

(9) The division of wave front is useful only with _____ sources
(a) extended (b) **narrow**
(c) Finite (d) infinite

(10) Fabry perot interferometer is a high resolving power instrument, which make use of the fringes of equal _____
(a) **Inclination** (b) amplitude
(c) Thickness (d) phase-shift

(11) The Fabry perot interferometer is a _____instrument, which make use for the fringes of equal inclination
(a) high pressure power (b) high magnifying power
(c) **high resolving power** (d) high visual power

(12) In Newton's ring experiment the _____ lens is used
(a) Convex (b) concave
(c) **plano-convex** (d) plano-concave

Q-2 Short Questions

(1) Explain the techniques for obtaining interference.
(2) Give the comparison between the fringes produced by biprism and Lloyd's mirror
(3) What is the difference between Fabry Perot Interferometer and Fabry Perot Etalon?
(4) What is diffraction? Explain with neat diagram Fraunhoffer diffraction

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(5) What is diffraction? Explain with neat diagram Fresnel diffraction
(6) What do you mean by wave front splitting? What type of source is required for such technique narrow or extended?
(7) Explain interference fringes with white light in biprism. What is zero order fringe?
(8) Why it is not possible to locate zero –order fringe in case of biprism when monochromatic source is used?
(9) What do you mean by division of amplitude? What type of source is required for such technique, narrow or extended?
(10) Explain multiple reflections from a plane parallel film. Define amplitude coefficient of reflection.
(11) In Newton's ring, why the fringes are circular?
(12) Explain how the fringe width β is determined in the case of biprism?

Q-3 Long Questions

(1) Describe Fresnel's biprism. Explain how the wave length of light can be determined with its help.
(2) With neat diagram explain Lloyd's single mirror. Give the comparison between the fringes produced by biprism and Lloyd's mirror
(3) Describe Fresnel's biprism. How the fringe width β is determined? Also discuss interference fringes with white light.
(4) Explain the theory of Newton's ring. Discuss how the Newton's ring experiment is helpful to determine the wavelength of given light.
(5) Explain the theory of Newton's ring. Discuss the condition for bright and dark fringes.
(6) How is the wavelength of the sodium light determined by Newton's rings method? Derive the formula used. Why the fringes are circular?
(7) Discuss multiple beam interference. Discuss in brief intensity distribution.
(8) Explain with neat diagram Febry Perot Interferometer. Discuss measurement of difference in wave length using Febry Perot Interferometer
(9) What is diffraction? Discuss Fresnel and Fraunhoffer diffraction.
(10) Write a note on "Diffraction due to a narrow wire". Draw the geometric shadow for narrow wire and a thick wire.
(11) Discuss Cornu's spiral. Draw the necessary figures.
(12) With necessary diagram explain the Fraunhoffer diffraction at double slits.

Q-4 Solved problems:

(i) In the biprism experiment the eyepiece is placed at a distance of 1.2m from the source. The distance between the virtual sources was found to be $7.5 \times$

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10^{-4} m. Find the wavelength of light, if the eyepiece is to be moved transversely through a distance of 1.888cm for 20 fringes.

Given : D= 1.2m,

d= 7.5×10^{-4} m,

l= 1.888 cm= 0.01888m but $\beta = \frac{l}{n} = \frac{0.01888}{20}$

The fringe width is $\beta = \frac{\lambda D}{d}$ = $\lambda = \frac{\beta d}{D} = \frac{0.01888m \times 7.5 \times 10^{-4} m}{20 \times 1.2m}$

$\lambda = 5900 \times 10^{-10} m = 5900 A^0$

(ii) In Newton's ring experiment the diameter of 15th ring was found to be 5.9×10^{-3}m. and that of 5th ring was 3.36×10^{-3}m . If the radius of the plano-convex lens is 100cm. calculate the wave length of light used.

$D_{m+p}^2 = D_{15}^2 = 5.9 \times 10^{-3} m$

Given: $D_m^2 = D_5^2 = 3.36 \times 10^{-3} m$ and R=100cm =1m

$$\lambda = \frac{D_{m+p}^2 - D_m^2}{4pR}$$

$$= \frac{(5.9 - 3.36) \times 10^{-6} m^2}{4 \times 10 \times 1m} = 5880 A^0$$

(iii) In Lloyd's single mirror interference experiment, the slit source is at a distance of 2mm from the plane of the mirror. The screen is kept at a distance of 1.5 m from the source. Calculate the fringe width. The wave length of the light is 5890 A^0

Given: d/2 = 2mm ∴ d= 4×10^{-3} m ,

D = 1.5m

λ= 5890 A^0= 5890× 10^{-10} m

The fringe width is $\beta = \frac{\lambda D}{d}$ = = $\frac{5890 \times 10^{-10} \text{ m} \times 1.5m}{4 \times 10^{-3} m} = 22mm$

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B.Sc. (Semester - 3)
Subject: Physics
Course: US03CPHY01
Title: Optics

Polarization

Question Bank
UNIT: 3

Multiple choice questions:

(1) The polarization is possible in _____ wave
(a) **transverse** (b) longitudinal
(c) water (d) mechanical

(2) A _____ light is a wave in which the electric vector is everywhere confined to a single plane
(a) unpolarized (b) **plane polarized**
(c) circularly polarized (d) elliptically polarized

(3) The _____ component of wave is called s-component
(a) equal (b) unequal
(c) parallel (d) **perpendicular**

(4) The _____ component of wave is called p-component
(a) equal (b) unequal
(c) **parallel** (d) perpendicular

(5) The _____ of the angle of polarization is numerically equal to the refractive index of the medium
(a) sine (b) cosine
(c) cosec (d) **tangent**

(6) _____ has discovered that certain crystal absorbs light selectively
(a) Maxwell's (b) Brewster's
(c) **Biot's** (d) Nicol's

(7) The crystal that exhibit selective absorption are called _____
(a)Isotropic (b) non-isotropic
(c) **anisotropic** (d) non-anisotropic

(8) The ray which obeys Snell's law of refraction is known as _____ ray
(a) **ordinary** (b) extraordinary
(c) simple (d) electric

(9) _____ is a device which is used to find whether the light is polarized or not polarized
(a) polarizer (b) **analyzer**
(c) glass (d) polaroid

(10) A Nicol prism is made from _____ crystal
(a) tourmaline (b) quartz
(c) topaz (d) **calcite**

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(11) In Nocol prism two parts of the crystal are cemented together with _____ layer
(a) oil (b) silica
(c) **Canada balsam** (d) glycerin

(12) The intensity of transmitted light through the polarizer is _____ the intensity of incident light
(a) double (b) **half**
(c) equal (d) zero

(13) In _____ materials, atoms are arranged in a regular manner
(a) **Isotropic** (b) non-isotropic
(c) anisotropic (d) non-anisotropic

(14) In _____ crystal both the refracted rays are extra ordinary rays
(a) **biaxial** (b) uniaxial
(c) triaxial (d) single axial

(15) In _____ crystal one of the refracted ray is ordinary and the other is an extra ordinary rays
(a) biaxial (b) **uniaxial**
(c) triaxial (d) single axial

(16) In positive crystal the refractive index for extraordinary ray is _____then that of ordinary ray
(a) less (b) **greater**
(c) equal (d) zero

(17) In negative crystal the refractive index for extraordinary ray is _____then that of ordinary ray
(a) **less** (b) greater
(c) equal (d) zero

(18) When two waves are in same phase then the resultant wave is _____polarized wave
(a) circularly (b) elliptically
(c) **plane** (d) non

(19) When $\delta = \frac{\pi}{2}$ between the two waves and amplitudes are unequal then the resultant wave is _____polarized wave
(a) circularly (b) **elliptically**
(c) plane (d) non

(20) When $\delta = \frac{\pi}{2}$ between the two waves and amplitudes are equal then the resultant wave is _____polarized wave
(a) **circularly** (b) elliptically
(c) plane (d) non

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Short Questions:

1. List the method for producing the linearly polarized light
2. Define unpolarized and plane polarized light
3. Define circularly polarized and elliptically polarized light
4. What are s and p- components of wave?
5. Define polarizing angle
6. State the Brewster's law
7. State the applications of Brewster's law
8. What is the pile of plates?
9. What is meant by selective absorption?
10. What is double refraction?
11. Define polarizer and analyzer
12. What are ordinary and extra-ordinary rays?
13. What is the working of Canada balsam layer?
14. State the Malus law
15. What are the isotropic and anisotropic materials?
16. What are uniaxial and biaxial crystals?
17. What are positive and negative crystals?
18. Give the three names of uniaxial crystal
19. Give the three names of biaxial crystal
20. Give the name of positive and negative crystal

Long Questions:

1. Discuss the polarization by reflection and prove the Brewster law
2. State and prove Brewster's law and show that reflected and refracted rays are at right angles to each other
3. Discuss the polarization by refraction and scattering
4. Explain the phenomena of polarization by selective absorption
5. Describe the Nicol prism and explain how it can work as analyzer and polarizer?
6. How to construct the polaroid sheet? Explain its working as polarizer and analyzer
7. Show that the intensity of transmitted light through the polarizer is half the intensity of incident light
8. State and explain the law of Malus
9. What is double refraction? Give the Huygens theory of double refraction in uniaxial crystal
10. Distinguish between positive and negative crystal
11. Describe the superposition of linearly polarized light and derive the general equation of ellipse
12. Find the resultant wave when the phase angle $\delta = 0, \pi, and \frac{\pi}{2}$
13. Give the construction and working of LCD.

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B. Sc. (Semester-3)
Course: US03CPHY01
Optics
Question Bank
UNIT: 4

Q1: Multiple Choice Questions: Choose most appropriate one and fill in the blanks:

1. An optical fiber is made up of ……transparent dielectric.

1. **Glass or Clear plastic**	2. Ribosome	3. Poly vinyl Alcohol	4. None of abov

2. Optical Fibers relies heavily on two concepts ……

a. Polarization	b. defraction	**c. Total Internal reflection**	d. absorption

3. The thin strand of dielectric materials is called ……..

a. hair	**b. fiber**	**c.** straw	d. wire

4. The thin strand of a metal is called ……..

a. fiber	b. ray	c. beam	**d. wire**

5. The inner member of the optical fiber is known as ……..

a. cladding	**b. core**	**c.** shield	d. cloths

6. The outer most member of the optical fiber is known as ……..

a. cladding	b. core	**c. shield**	d. cloths

7. The optical fiber requires a…….. to receive light at its output end.

a. light source	**b. photo detector**	c. speaker	d. cable

8. A multiple cable consists of number of fibers in a ……

a. individual fiber	**b. single jacket**	c. both of above	d. none of above

9. A medium having lower refractive index is said to be an optically……medium while a medium having higher refractive index is said to be an optically ……medium.

a. denser, rare	**b. rare, dense**	c. rare, rare	d. denser, denser

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10 In step index optical fiber the end at which light enters the fiber is called……
.

a. carrying | b. received | **c. launching** | d. none of above

11 In optical fiber the refractive index of the core is always ……than the refractive index of the cladding.

a. greater | b. lesser | c. equal | d. All of above

12 The Numerical Aperture (N.A.) is dependent only on……of the core and cladding materials.

a. the angle of refraction | **b. the refractive indices** | c. Snell's law | d. multiple reflection

13 The light ray paths along which the waves are in phase inside the fiber are known as…….

a. reflectivity | b. coherency | **c. modes** | d. permeability

14 GRIN fiber stands for ……

a. Graded Index fiber | b. Groove Relative index fiber | c. Government Region Innovative fiber | d. Great Refractive Index fiber

15 Multimode step index fiber allows……of guided modes.

a. infinite number | **b. finite number** | c. equal number | d. not a single

16 A Flurocarbon polymer is used as a……material

a. core | **b. cladding** | c. buffer | d. wire

17 The step index single mode fiber is used as ……

a. ground to ground communication | b. ground to sky communication | **c. under water cables** | d. gas pipe line

18 The step index multi mode fiber is used in……

a. wave generator | **b. data links** | c. under water cables | d. ghost fiber

19 The Graded index multi mode fiber is used in ……

a. data links | **b. telephone links** | c. under water cables | d. earthlings fiber

20 PCS fiber means ……..

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	a. Plastic Clad Silica	b. Popular Cable Service	c. Plastic Core Silica	d. Poly Cable Start

21 1 mm optical fiber can transmits ……..telephone calls.

a. 10000	b. 30000	**c. 50000**	d. 70000

Q2: **Answer in short**

1. Define Optical fiber.
2. Give the important functions of the cladding.
3. Explain fractional relative index change.
4. Explain all glass fibers.
5. Explain all plastic fibers.
6. Explain PCS fibers.
7. Give the disadvantages of the optical fibers.
8. Give the characteristics of Step index multimode fiber.
9. Give the characteristics of Step index single mode fiber.
10. Give the characteristics of Graded index multimode fiber.

Q3: **Answer with full detail**

1. Explain Optical Fiber in detail.
2. Explain the total internal reflection providing the appropriate derivations.
3. Define the angle of acceptance and derive formula $\theta_0 = sin^{-1}\sqrt{n_1^2 - n_2^2}$
4. Explain modes of propagation.
5. Narrate the classification of Optical fibers.
6. Give the characteristics of optical fibers.
7. Give the merits and demerits of optical fibers.

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