Shivaji University, Kolhapur

B. Sc.Part II (CBCS) Semester IV

PHYSICS Paper VIII

DSC- D2 - WAVES AND OPTICS-II

Question Bank

Unit I: 1. Cardinal points

- **Choose correct alternative (Correct answer is given in RED color)**

1) The Concept of cardinal points is defined by scientist -------

a) Gauss b) Newton c) Faraday d) Brewster

2) In an optical system , the distance between principal points and nodal points are -------

a) equal b) unequal c) zero d) none of these.

3) For an optical system number of Cardinal points are ------

a) 1 b) 2 c) 4 **d) 6**

4) If medium on both the sides of an optical is same, the relation between lateral magnification 'm' and longitudinal magnification 'm_x'is ------

a) $m.m_x=1$ b) $m.m_x = -1$ **c) $m_x = m^2$** d) $m^2_x = m$.

5) For lens system in air ----------

a) $\alpha=m.m_L$ **b) $m_{L=} m\alpha$** c) $m = m_L\alpha$ d) $m^2 = m_L\alpha$

6) For principal planes the lateral magnification is -------

a) 1 b) 2 c) -1 d) -2

7) Angular magnification is one for ---------- point.

a) cardinal **b) principal** c) nodal d) focal

8) If H_1,H_2 are principal points and N_1,N_2 are nodal points of an optical system then ----

a) $H_1H_2= N_1N_2$ b) $H_1H_2>N_1N_2$

c) $H_1H_2< N_1N_2$ d) $H_1N_2= N_1H_2$

9) If $x_1$and x_2 are the object and image distance from respective focal points f_1 and f_2 then the Newton's formula is ----------

a) $x_1x_2 = f_1.f_2$ a) $x_1x_2 = 2.f_1.f_2$

c) $x_1f_2= -f_1.x_2$ d) $\frac{x_1}{x_2} = \frac{f_1}{f_2}$

10) In an optical system , if the medium on the both the sides are same

principle points coincides with -------

a) focal points **b) Nodal points**

c) Principal points itself. d) none of the above.

11) Nodal planes are the cardinal planes of -------

a) unit positive lateral magnification **b) unit positive angular magnification**

c) unit positive longitudinal magnification d) unit negative lateral magnification

12) For an optical system , the relation between focal lengths 'f' and refractive

Index 'n' is -------

$a)\frac{f_1}{f_2}=-\frac{n_1}{n_2}$ $b)\frac{f_1}{f_2}=+\frac{n_1}{n_2}$ $c)\ f_1.f_2=n_1.n_2$ $d)\ f_1.f_2=-n_1.n_2$

13) A ray in object space parallel to principle axis always passes through the ------in image space.

a) focal point b)nodal point c)principle point d)cardinal points

14) A ray through --------- in object space always becomes parallel to principle axis in image space.

a) focal point b)nodal point c)principle point d)cardinal points

15) Angular magnification for optical system is --------.

a) θ_2/θ_1 b) $\theta_2.\theta_1$ c) θ_1/θ_2 d) $\theta_2-\theta_1$

16)The ratio of the height of image to height of object is called ----------

a) angular magnification **b) lateral magnification**

c) axial magnification d) optical magnification

- **Long Answer questions - 10 Marks**

1. Obtain relation between focal lengths and refractive indices for any optical system.
2. Define lateral, axial and angular magnification and hence obtain relation between them using neat diagram.

- **Short Answer questions – 5 Marks**

1. What are the nodal points and nodal planes (May 2018).
2. Show that for a lens system the distance between principal planes is equal to distance between nodal planes.
3. Explain graphical construction of image by using concept of cardinal points (May 2019) .

4. Explain with neat diagram define focal ,principal and nodal points(may 2019).
5. What are the cardinal points? How do you locate focal points and focal planes? (May 2019)
6. With graphical construction of image derive Newton's formula (May 2019)

Unit I : 2. Resolving power

1) Resolving power of a plane diffraction grating with total number of lines N in order number n is -----

a) n^2N **b) nN** c) n/N d) $\frac{1}{nN}$

2) In telescope and microscope, the image formation is due to -------

a) Refraction b) Diffraction

c) Refraction and diffraction d) reflection

3) The resolving power of prism is ----------

$a)\sqrt{t}\frac{d\mu}{d\lambda}$ $b)t.\frac{d\mu}{d\lambda}$ $c)\sqrt{t}.d\mu.d\lambda$ $d)\frac{1}{t}.\frac{d\mu}{d\lambda}$

4) The resolving power of a prism or a grating is expressed by the relation --------

a) $\frac{\lambda}{d\lambda}$ b) $\frac{d\lambda}{\lambda}$ c) $\lambda..d\lambda$ d) $\frac{\lambda+d\lambda}{\lambda}$

5) The resolving power is greater for ------wavelength.

a) longer b) shorter c) same d) red colors

6) Spectral resolving power of a prism varies with the length of base (t) as ---

a) R. P. α t b) R. P. α t^2 c) R. P.α $t^{1/2}$ d) R. P. α t^3

7) The resolving power of a plane diffraction grating is --------

a) directly proportional to the order of spectrum

b) inversely proportional to the order of spectrum

c) dependent on the grating element

d) independent of the order of spectrum

8) The resolving power of a prism or a grating is expressed by the relation --------

a) $\frac{\lambda}{d\lambda}$ b) $\frac{d\lambda}{\lambda}$ c) $\lambda..d\lambda$ d) $\frac{\lambda+d\lambda}{\lambda}$

9) The ability of an instrument to give details of an image is called ------

a) resolving power b) magnifying power

c) dispersive power d) magnification

10) "Any two close objects can be resolved by increasing magnification ' .
The statement is ------

a) true **b) false** c) sometimes true d) partially true.

11)According to Rayleigh criterion for just resolution of two nearly equal wavelengths ,the central maximum of one should fall at ------

a) central maximum of other **b) first minimum of other**

c) second minimum of other d) first secondary minimum of other

12) According to Rayleigh modified criterion for just resolution of two nearly equal wavelengths ,the intensity at the dip should be ------ times intensity at either maximum.

a)$8/\pi^2$ b) $\pi^2/8$ c)$4/\pi^2$ d) $\pi^2/4$

- **Long Answer questions- 10 Marks**

1. Define resolving power of an optical instrument? Obtain an expression for R.P.of prism.(May 2018,May 2019)
2. Define resolving power of an optical instrument? Obtain an expression for R.P.of grating.

- **Short Answer questions – 5 Marks**

1. State and explain Rayleigh's criterion for spectral resolution.
2. Distinguish between geometrical resolution and optical resolution.
3. Distinguish between resolution and magnification.
4. Examples based on R.P.

Unit-I 3. Polarization

1) For determining specific rotation of solution,, the length of light in the solution is measured in -------

a) decimeter b) centimeter c) decameter d) millimeter

2) In double refraction, ray having same velocity in all direction in the crystal is --------

a) Ordinary ray b) Extra ordinary ray
c) both ordinary and Extra ordinary ray d) none of these

3) Plane of vibration and plane of polarization are mutually ---

a) Perpendicular b) parallel

c) Co- planer d) Inclined at 45^0.

4) The wave front for extraordinary ray is --------

a) plane b) spherical c) parabolic **d) elliptical**

5) The device used to measure optical rotation of an optical active substance is ----

a) Calorimeter b) spectrometer

c) Photometer **d) Polarimeter.**

6) Dextro-rotatory substance are those which rotate the plane of polarization in ---------- direction when seen in the source.

a) Clockwise b) Anti – clockwise

c) left d) Random

7) In double refraction, doubly refracted rays are -------

a) Both plane polarized b) Both are un- polarized

c) Only ordinary ray is plane polarized

d) Only extra- ordinary ray is plane polarized

8) In a Q- plate the path difference between E- ray and O- ray is ----

a) $\frac{\lambda}{4}$ b) $\frac{4}{\lambda}$ c) $\frac{\lambda}{2}$ d) $\frac{2}{\lambda}$

9) In a half wave plate the path difference between E- ray and O- ray is ----

a) $\frac{\lambda}{4}$ b) $\frac{4}{\lambda}$ **c)** $\frac{\lambda}{2}$ d) $\frac{2}{\lambda}$

10) In a double refracting crystal , ordinary and extraordinary rays have plane of vibration -----

a) Mutually Perpendicular b) Mutually parallel

c) Co- planer d) Inclined to each other at 45^0.

11) A Nicol prism is used as ----

a) a polarizer **b) analyser& a polarizer**

c) analyser d) none of the above.

12) Natural light from any source is ----

a) Un- polarized b) Plane polarized

c) Circularly polarized d) elliptically polarized

13) For negative crystals ----------

a) $V_E > Ve > Vo$ **b) $V_E < Ve < Vo$**

c) $V_E = Ve = Vo$ d) $V_E > Vo > Ve$

14)The phenomenon of polarization of light helped to explain ----- nature of light.

a) transverse b) longitudinal c) stationary d) electromagnetic

15) A Nicol prism is made up of ----

a) natural calcite crystal **b) properly cut natural calcite crystal**

c) natural quartz crystal d) properly cut natural quartz crystal

16) In Nicol prism ordinary ray is removed from the emergent beam by--------

a)reflection b)refraction **c)total internal refelction** d)polarization

17)The plane of polarization of plane polarized light Passing through ----- material gets rotated through certain angle θ.

a)transparent b)crystalline c)all **d)optically active**

18) For negative crystals ----------

a) $\mu_e > \mu o$ **b) $\mu_e < \mu o$**

c) $\mu_e = \mu o$ d) μ_e is positive

19) For positive crystals ----------

a) $\mu_e > \mu o$ **b)** $\mu_e < \mu o$

c) $\mu_e = \mu o$ d) μ_e is positive

20) Specific rotation of optically active substance is ----------

a)$\rho = \theta/l.C$ a)$\rho = \lambda/\theta\ C$ c) $\theta = \rho\ .l.C$ d))$\rho = \theta.l.C$

21) ------- instrument is used to measure specific rotation of sugar solution.

a)polarimter b)voltmeter c) polarizer d) specctrometer

22) In polarimeter ------- source is used

a) mercury **b)sodium** c)ordinary d)hydrogen

- **Long Answer questions - 10 Marks**

1. What is polarization? Explain construction and working of polarimeter.(May 2019)
2. Explain how circularly and elliptically polarized light is produced.
3. What is polarimeter? Explain how it is used to measure the optical activity of optically active solution.

- **Short Answer type – 5 Marks**

1. Explain what do you mean by double refraction?
2. Explain construction and working of Nicol prism.
3. Explain positive and negative crystals using Huygens theory of wave fonts.
4. What is optical activity? State the laws of rotation of plane of polarization.
5. Explain construction and working of quarter wave plate.

Unit-II 1. Interference

1. Two sources are said to be coherent if they have-------

(A) same wavelength (B) constant path difference

(C) constant phase difference (D) all the above

2. For better contrast of the interference fringes, the amplitudes of two waves must be .....

(A) equal (B) unequal (C) zero (D) maximum

3.To obtain two coherent sources --------

(A) they must have same wavelength (B) they must have same path difference

(C) they must have same phase difference (D) they must be derived from the same original source

4. In Lloyd's single mirror experiment, the central fringe is observed to be .....

(A) bright (B) dark (C) faint (D) diffuse

5. In a wave getting reflected from a denser medium, the additional phase difference introduced is .....

(A) 0 (B)$\pi/2$ (C) π (D)2π

6. In case of light reflected from thin parallel film ,the condition for dark fringe is -------

(A) $2\mu t \cos(r) = \lambda/2$ (B) $2\mu t \cos(r) = (2n+1)\lambda/2$

(C) $2\mu t \cos(r) = n\lambda$ (D) $2\mu t \cos(r) = (2n-1)\lambda/2$

7.The fringe width is wedge shaped thin film with wedge angle α is given by .....

(A) $\alpha/2\lambda$ (B) $\lambda/2\alpha$ (C) $2\alpha/\lambda$ (D) $2\lambda/\alpha$

8. The fringes obtained in wedge shaped thin film are of ----------

(A) increasing thickness (B) decreasing thickness

(C) varying thickness (D) equal thickness

9. The center of Newton's rings due to reflected light is ----------

(A) dark (B) bright (C) white (D) coloured

10. In parallel faced thin film the path difference between successive bands is .....

(A) 2mt sin(r) (B) $2\mu t \cos(r)$ (C) $\mu t \sin(r)$ (D) $\mu t \cos(r)$

11. The radius of n^{th} Newton's ring is proportional to ------

(A) n (b) 2n (C) √n (D) n/2

12. Newton's rings are .....

(A) localised fringes (B) non-localised fringes

(C) fringes formed at infinity (D) fringes formed at small distance from the film

13. In Newton's rings experiment, the plano-convex lens is kept with its ..... face on the horizontal glass surface.

(A) any one (B) plane (C) convex (D) concave

14. A path difference of $\lambda/2$ is equivalent to a phase difference of .....

(A) $\pi/4$ (B) $\pi/2$ (C) π (D) 2π

- **Long Answer type- 10 Marks**

1. Describe an exper if the radius of planoconvex lens is 100 cm. Find the wavelength of light used.iment set up to produce Newton's rings. Show that the radius of nth dark ring is proportional to square root o natural numbers.(Nov.2018)
2. Obtain expression for path difference in case of interference due to reflected rays from wedge shaped thin film.

- **Short Answer type – 5 Marks**

1. Expalin experiment to determine wavelength of monochromatic light using Newton's rings.
2. In Newton's rings experiment the diameter of the 15^{th} ring was found to be 0.59 cm and that of 5^{th} ring was 0.336 cm. if the radius of plano-convex lens is 100 cm then find the wavelength of light used.

Unit-II 2. Diffraction

(i) In Fraunhoffer diffraction with respect to the obstacle....

(a) both source and screen are at finite distance

(b)both source and screen are effectively at infinity

(c) source is at finite distance and screen is at infinity

(d) screen is at finite distance and source is at infinity

(ii) In Fresnel diffraction with respect to the obstacle centre of diffraction.....……

(a)both source and screen are at finite distance

(b) both source and screen are at infinite distance

(c) source and screen are very close to the obstacle

(d) source and screen are at very large distance from obstacle

(iii)In Fraunhoffer diffraction, the incident and diffracted wavefronts are

(a) plane (b) spherical

(c) cylindrical (d) circular

(iv) The bending of light around the edge of an obstacle is called

(a) interference (b) refraction

(c) diffraction (d) reflection

(v) In plane transmission grating with white light as source

(a) the central fringe is red (b) the central fringe is yellow

(c) the central fringe is violet (d) the central fringe is white

(vi) In plane transmission grating with white light as source, the first coloured fringe nearer the central fringe in each order of spectrum is

(a) red (b) yellow (c) violet (d) blue

(vii) In grating, to obtain sharp spectral lines

(a) total number of lines (N) on grating should be large

(b) the width (N.d) of the grating should be large

(c) angle of diffraction should be small

(d) all the above

(viii) In zone plate area of each zone with respect to a point at a perpendicular distance of b is-------

(a) $2\pi b\lambda$ (b) $\pi b\lambda$ (c)$\pi/2\ b\lambda$ (d)$\pi\ /b\lambda$

(ix) In zone plate radius of n^{th} zone is----------

(a) $\sqrt{(nb\lambda)}$ (b) $\sqrt{(2n+1)b\lambda}$ (c) $nb\lambda$ (d) $(2n+1)b\lambda$

(x) In zone plate, the amplitudes of waves from 1st, 2nd, 3rd etc. zones are m_1, m2, m3, ... respectively. Therefore, the resultant amplitude at any point due to whole wavefront is--------

(a) $m_1 + m_2 + m_3$+------ (b) m_1 (c)$m_1/2$ (d) $2m_1$

(xi) Corresponding to a wave length (λ), the focal length (f) of zone plate is a .....

(a)$f \alpha \lambda$ (b) $f \alpha 1/\lambda$ (c) $f = \lambda$ (d) $f = 5\lambda$

(xii) In straight edge diffraction pattern fringes are----------

(a) formed in illuminated region

(b) formed in geometrical shadow region

(c) equispaced

(d) of equal brightness

- **Long Answer type- 10 Marks**

1. What is Fresnel type of diffraction due to straight edge? State the features of diffraction pattern obtained? (May 2019)

2. What is Fresnel type of diffraction? Give Fresnel's theory of half period zones.
3. Give construction and working of zone plate. Show that zone plate acts as convex lens and has multiple focal lengths.
4. Explain Fresnel diffraction at straight edge and show how the intensity is distributed on the screen after diffraction at straight edge.
5. What is Fresnel class of diffraction ? Give Fresnel's theory of half period zones.
6. Explain how a plane diffraction grating is used to determine the wavelength of light.
7. Discuss elementary theory of plane diffraction grating and there by explain how it produces a spectrum of light incident on it.

- **Short Answer type – 5 Marks**

1. Distinguish between Fraunhoffer and Fresnel type of diffraction.(Nov.2016)
2. State characteristics of Fraunhoffer and Fresnel type of diffraction.(April 2016)
3. Give comparison between Zone plate and convex lens.
4. What is zone plate? Give its construction.

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