

D 50210

(Pages : 3)

Name.....

Reg. No.....

**FIFTH SEMESTER (CUCBCSS-UG) DEGREE EXAMINATION
NOVEMBER 2023**

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

(2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A*Answer in a word or a phrase.**Answer all questions.**Each question carries 1 mark.*

1. The system matrix for a thin lens is given by _____.
2. Optical fibers can carry optical frequencies of about _____.
3. The basic technique in holography is _____.
4. For non reflecting films, the refractive index of the film should be _____ than that of glass on which it is coated.
5. The principal focal length of a zone plate is _____.

True or False :

6. The light ray incident at an angle of incidence greater than acceptance angle on a step index fiber will be totally internally reflected through the core.
7. In order to observe good interference pattern, the distance of the screen from the sources must be large.
8. Colours appear on thin film and on soap bubble due to interference.
9. In negative uniaxial crystals, velocity of O-ray is greater than velocity of E-ray.
10. The diffraction pattern due to circular aperture for a plane wave are concentric circular rings.

(10 × 1 = 10 marks)

Section B*Answer all questions.**Each question carries 2 marks.*

11. Explain Fermat's principle of least time.
12. What are the advantages of using matrix method in paraxial optics ?

Turn over

13. What are coherent sources ? Give two examples.
14. State Cosine law.
15. Explain the difference between interference and diffraction.
16. Explain pulse dispersion in step index fiber.
17. What are the advantages of a hologram over ordinary photograph ?

(7 × 2 = 14 marks)

Section C

*Answer any **five** questions
in a paragraph of about a half page to one page.
Each question carries 4 marks.*

18. Obtain system matrix for thin film hence obtain thick lens formula.
19. Describe Fresnel's biprism. Explain how the wavelength of light can be determined with the help of it.
20. What are Newton's rings ? Describe an experiment to determine the radius of curvature of a plano convex lens.
21. Draw the intensity distribution curve of Fresnel's diffraction at a straight edge and explain it.
22. State and explain Rayleigh's criterion for the resolution of two spectral line.
23. Show that when a ray is incident at polarizing angle, the reflected and refracted rays are perpendicular.
24. Give the necessity of cladding in the optical fiber. Mention any four applications of optical fiber.

(5 × 4 = 20 marks)

Section D

*Answer any **four** questions.
Each question carries 4 marks.*

25. Obtain a system matrix for a lens placed in air made of glass of refractive index 1.6 and radii of curvature 60 cm each. Find the focal length of the lens.
26. Two coherent sources are 0.2 mm apart and the fringes are observed on a screen 100 cm away. It is found that with a monochromatic source of light, the fourth bright fringe is situated at a distance of 10.8 mm from the central fringe. Calculate the wavelength of light.
27. A parallel beam of sodium light ($\lambda = 589 \text{ nm}$) strikes a film of oil floating in water when viewed at an angle of 30° from the normal, the 8th dark band is seen. Determine the thickness of the film, refractive index of oil = 1.5.

28. The diameter of m^{th} Newton's ring changes from 1.2 cm to 1 cm when the air space between the lens and the plate is replaced by transparent liquid. Find the refractive index of the liquid.
29. A plane transmission diffraction grating has 40,000 lines in all with grating element 12.5×10^{-5} cm. Calculate the maximum resolving power for which it can be used in the range of wavelength 5000 Å.
30. Find the thickness of (a) Quarter wave plate ; (b) Half wave plate, when light of wavelength 559 nm is used. Given $\mu_o = 1.55, \mu_E = 1.54$.
31. Calculate the numerical aperture and acceptance angle of a fiber having core refractive index 1.5 and cladding refractive index 1.45.

(4 × 4 = 16 marks)

Section E

*Answer in about two pages.
Answer any two questions.
Each question carries 10 marks.*

32. Explain the theory of Young's slit experiment for determining band width of interference pattern due to two coherent sources. Also draw the intensity distribution for the same.
33. Give the construction and theory of plane transmission grating. Obtain the condition for absent spectra.
34. Describe how to produce circularly and elliptically polarized light. How will you analyze the type of polarization ?
35. What is the principle of holography ? Describe the recording and reconstruction process in holography with the help of suitable diagrams.

(2 × 10 = 20 marks)

D 30197

(Pages : 3)

Name.....

Reg. No.....

**FIFTH SEMESTER (CUCBCSS-UG) DEGREE EXAMINATION
NOVEMBER 2022**

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

(2017–2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

Section A*Answer in a word or a phrase.**Answer all questions.**Each question carries 1 mark.*

1. In paraxial approximation, we confine to rays which pass _____ the axis.
2. Light rays are propagated through an optical fiber by the mechanism of _____.
3. The principle of holography was discovered by _____.
4. Lenses are coated with non-reflecting films to minimise _____.
5. The resolving power of grating is given by the equation _____.

True or False :

6. The light ray incident at an angle of incidence greater than acceptance angle on a step index fiber will be refracted through cladding.
7. In order to observe good interface pattern, the distance of the screen from the sources must be small.
8. Colours appear on a thin film and on a soap bubble due to dispersion.
9. In a negative uniaxial crystal, velocity of O-ray is less than velocity of E-ray.
10. In N-slit Fraunhofer diffraction pattern, the principal maximum becomes sharper as N increases.

(10 × 1 = 10 marks)

Section B*Answer all questions in two or three sentences.**Each question carries 1 mark.*

11. Explain Fermat's principle of extremum path.
12. What do you mean by optical direction cosine ?
13. Describe the conditions to obtain sustained interference pattern.

Turn over

14. What is the idea behind colour of thin films ?
15. What is meant by overlapping spectra in the spectra of a grating ?
16. Explain any two applications of holography.
17. Briefly explain acceptance angle and critical angle.

(7 × 2 = 14 marks)

Section C

*Answer any five questions in paragraph of about half a page to one page.
Each question carries 4 marks.*

18. Obtain system matrix for thin film, hence obtain thin lens formula.
19. Considering the super position of two sinusoidal waves, obtain the conditions for constructive and destructive interference.
20. With neat diagram, explain Michelson interferometer. Describe how it can be used to determine the difference in wavelength of two waves.
21. Explain the principle and construction of a zone plate.
22. Discuss Fraunhofer diffraction at a circular aperture. Also explain the intensity distribution of the diffraction pattern.
23. Write brief note on : (a) Quarter wave plate ; Half wave plate.
24. Explain how hologram is constructed. What are the advantages ?

(5 × 4 = 20 marks)

Section D

*Answer any four questions.
Each question carries 4 marks.*

25. Two thin converging lenses of focal lengths 40 cm and 60 cm are placed co-axially 20 cm apart. Find the focal length of the combination.
26. In an interference experiment, the slit source is at a distance of 2 mm from the plane of the mirror. If the wavelength of the light used is 589 nm and the screen is kept at a distance of 1.5 m from the source. Calculate the fringe width.
27. Light of wavelength 5839 \AA is reflected at near normal incidence from a soap bubble of refractive index 1.42. What is the least thickness of the film that will appear bright by reflection ?
28. Newton's ring are formed with red light of $\lambda = 670 \text{ nm}$. The radius of the 20th dark ring is found to be $1.1 \times 10^{-2} \text{ m}$. Find the radius of curvature of the lens and the radius of 30th ring.

29. A diffraction grating has 0.15 m of surface ruled with 6×10^5 lines per meter. What is its resolving power in the first order.
30. Calculate the thickness of double refracting plate capable of producing a path difference of $\frac{\lambda}{4}$ between ordinary and extra ordinary waves. Given $\lambda = 5500\text{ \AA}$, $\mu_E = 1.54$, $\mu_O = 1.53$.
31. A step index fiber has a core diameter of $200\text{ }\mu\text{m}$, its numerical aperture is 0.29 . Calculate the number of propagating modes of the fiber with an operating wavelength of 859 nm .

(4 × 4 = 16 marks)

Section E

Answer any two questions.

Answer in about two pages.

Each question carries 10 marks.

32. Explain with necessary theory, the formation of Newton's rings in reflected light. How can we use this arrangement to determine the wavelength of light ?
33. Discuss Fraunhofer diffraction due to a single slit. Find the positions of maximum and minimum intensity.
34. Explain the rectilinear propagation of light on the basis of Fresnel's half period zones.
35. Briefly explain an optical fiber. Using ray theory, discuss the mechanism of transmission of light with an optical fiber. Deduce an expression for numerical aperture of an optical fiber.

(2 × 10 = 20 marks)

D 10245

(Pages : 3)

Name.....

Reg. No.....

**FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION
NOVEMBER 2021**

(CUCBCSS-UG)

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

Time : Three Hours

Maximum : 80 Marks

Section A*Answer in a word or a phrase.**Answer all questions.**Each question carries 1 mark.*

- The system matrix of a lens system is given by $\begin{bmatrix} 9/5 & 1/100 \\ 8 & 3/5 \end{bmatrix}$. The focal length of the combination is _____ units.
- The inner part of optical fiber is called _____.
- The construction of hologram made use of the principle of _____.
- Two or more waves of the same frequency can maintain the same phase or constant phase difference over a distance and time are called _____.
- The principal focal length of a zone plate is given by the equation _____.

True or False :

- In N-slit Fraunhofer diffraction pattern the principal maximum becomes sharper as N decreases.
- The light ray incident at an angle of incidence greater than acceptance angle on a step index fiber will be refracted through cladding.
- In order to observe good interference pattern, the distance of the screen from the sources must be large.
- Colour appear on a thin film and on a soap bubble due to dispersion.
- In a negative uniaxial crystal, velocity of O-ray is less than velocity of E-ray.

(10 × 1 = 10 marks)

Section B*Answer any seven questions.**Each question carries 2 marks.*

- Explain Fermat's principle of least time.
- What are the advantages of using matrix method in paraxial optics?

Turn over

13. Describe the conditions to obtain sustained interference pattern.
14. What is the idea behind colour of thin films?
15. What is meant by overlapping spectra in the spectra of a grating?
16. Explain pulse dispersion in step index fiber.
17. Explain any two applications of holography.

(7 × 2 = 14 marks)

Section C

Answer any **five** questions in paragraph of about **half-a-page to one page**.

Each question carries 4 marks.

18. Obtain system matrix for thin film and hence obtain thin lens formula.
19. Describe Fresnel's biprism. Explain how the wavelength of light can be determined with the help of it.
20. With neat diagram, explain Michelson's interferometer. Describe how it can be used to determine the difference in wavelength of two waves.
21. Explain the principle and construction of a zone plate.
22. Draw the intensity distribution curve of Fresnel's diffraction at a straight edge and explain it.
23. Write brief note on (a) Quarter wave plate ; (b) Half wave plate.
24. Give the necessity of cladding in the optical fiber. Also mention any four applications of optical fiber.

(5 × 4 = 20 marks)

Section D

Answer any **four** questions.

Each question carries 4 marks.

25. Obtain a system matrix for a lens placed in air made of glass of refractive index 1.6 and radii of curvature 60 cm each. Find the focal length of the lens?
26. Two coherent sources are 0.2 mm apart and the fringes are observed on a screen 100 cm away. It is found that with a monochromatic source of light, the fourth bright fringe is situated at a distance of 10.8 mm from the central fringe. Calculate the wavelength of light.
27. Light of wavelength 5839 \AA is reflected at near normal incidence from a soap bubble of refractive index 1.42. What is the least thickness of the film that will appear bright by reflection?
28. Newton's rings are formed with red light of $\lambda = 670 \text{ nm}$. The radius of the 20th dark ring is found to be $1.1 \times 10^{-2} \text{ m}$. Find the radius of curvature of the lens and the radius of 30th ring.

29. A plane transmission diffraction grating has 40,000 lines in all with grating element 12.5×10^{-5} cm. Calculate the maximum resolving power for which it can be used in the range of wavelength 5000 Å.
30. Find the thickness of (a) Quarter wave plate ; (b) Half wave plate, when light of wavelength 559 nm is used. Given $\mu_o = 1.55$, $\mu_E = 1.54$.
31. A step index fiber has a core diameter of 200 μm , its numerical aperture is 0.29. Calculate the number of propagating modes of an optical fiber with an operating wavelength of 859 nm.

(4 × 4 = 16 marks)

Section E

Answer in about two pages.

Answer any two questions.

Each question carries 10 marks.

32. Explain with necessary theory, the formation of Newton's rings in reflected light. How can we use this arrangement to determine the wavelength of light.
33. Give the construction and theory of plane transmission grating. Obtain the condition for absent spectra.
34. Explain the rectilinear propagation of light on the basis of Fresnel's half period zones.
35. What is the principle of holography? Describe the recording and reconstruction process in holography with the help of suitable diagrams.

(2 × 20 = 20 marks)

D 90245

(Pages : 3)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCBCSS—UG)

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

Time : Three Hours

Maximum : 80 Marks

Symbols used in this question paper have their usual meanings.

Section A

Answer all questions.

Each question carries 1 mark.

1. The dimensional formula of optical length is _____.
2. A slit width 'a' is illuminated by red light of wavelength 6500 Å, if the 1st minimum falls at $\theta = 30^\circ$, the value of 'a' is :
(a) 6.5×10^{-4} mm. (b) 1.3 micron.
(c) 0.26 mm. (d) 0.13 mm.
3. Which property of light is proved by means of polarization ?
4. Write down the equation for the resolving power of grating ?
5. An optical fibre works on the principle of _____.
6. Colours of thin films are explained using the phenomenon called _____.
7. A biprism produce N_1 fringes with light of wavelength λ_1 . The number of fringes with wavelength λ_2 is _____.
(a) $\lambda_1 N_1 / \lambda_2$. (b) $\lambda_2 N_1 / \lambda_1$.
(c) $\lambda_1 / \lambda_2 N_1$. (d) $[\lambda_1 / \lambda_2]^{1/2} N_1$.
8. When focal length of a lens decreases, the field of view of the lens _____.
9. The radius of the 6th zone plate of focal length 10cm for light of wavelength 6000Å is _____.
10. Which one is not used to produce interference pattern :
(a) Biprism. (b) Two mirror.
(c) Newton's rings. (d) Nicol prism.

(10 × 1 = 10 marks)

Turn over

Section B

Answer at least six questions.

Each question carries 2 marks.

All questions can be attended.

Overall ceiling 12.

11. State laws of refraction.
12. Differentiate between Constructive and Destructive interference.
13. What do you mean by double refraction ?
14. Define Translation matrix and refraction Matrix of an optical system.
15. Compare a zone plate and a convex lens ?
16. Distinguish between Holography and Conventional Photography.
17. What is the difference between Step index fibre and Graded index fibre.

(6 × 2 = 12 marks)

Section C

Answer at least four questions.

Each question carries 5 marks.

All questions can be attended.

Overall ceiling 20.

18. State and explain Fermat's principle of extremum path and use it to deduce the laws of reflection and refraction of light.
19. What is system matrix ? Obtain it in the case of a system of two thin lenses separated by a distance and hence derive the formula for its focal length.
20. What is meant by interference of light ? State the fundamental conditions for the production of interference fringes.
21. State the principle of superposition of light waves.
22. Define and explain polarization.
23. Distinguish between positive uniaxial and negative uniaxial crystals.
24. What is meant by critical angle of an optical fiber ? Obtain an expression for the critical angle.

(4 × 5 = 20 marks)

Section D

Answer at least three questions.

Each question carries 6 marks.

All questions can be attended.

Overall ceiling 18.

25. A soap film 5×10^{-5} cm thick is viewed at an angle of 35° to the normal. Find the wavelength of light in the visible spectrum which will be absent from the reflected light. Given $\mu = 1.33$?
26. What is the radius of the 1st half period zone in a zone plate behavior like a convex lens of focal length 60 cm for light of wavelength 6000\AA ?
27. Calculate the thickness of (i) quarter wave plate ; and (ii) a half wave plate. Given that $\mu_0 = 1.973$, $\mu_e = 2.656$ and $\lambda = 590$ nm.
28. Show that areas of half period zones are equal.
29. Calculate the angle of acceptance of a given optical fiber, if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively.
30. The critical angle of incidence for total reflection in case of water is 48° . What is its polarization angle ? What is the angle of refraction corresponding to the polarization angle ?
31. In Fraunhofer diffraction pattern due to a narrow slit a screen is placed 2 m away from the lens to obtain the pattern. If the slit width is 0.2 mm and the first minimum lie 5 mm on either sides of the central maximum, find the wavelength of light.

(3 × 6 = 18 marks)

Section E (Essays)

Answer any two questions.

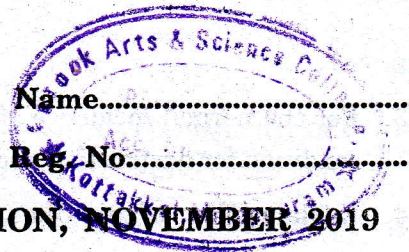
Each question carries 10 marks.

32. Write principle of holography ? Describe the recording and re-recording process in holography with the help of suitable diagrams.
33. Discuss the Fraunhofer diffraction pattern due to a single slit. Draw the intensity distribution?
34. What are Newtons ring ? derive an expression for the radius of the n^{th} dark ring formed by the reflection also by transmitted light.
35. With a diagram explain diffraction at a single slit Using the theory of grating, explain how wavelength of light is determined in normal incidence mode.

(2 × 10 = 20 marks)

D 70335

(Pages : 3)



FIFTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, NOVEMBER 2019

(CUCBCSS—UG)

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

Time : Three Hours

Maximum : 80 Marks

The symbols used in the question paper have their usual meanings.

Section A

Answer in a word or a phrase.

Answer all questions.

Each question carries 1 mark.

1. The determinant of translation matrix is _____.
2. The light gathering power in an optical fibre is given by _____.
3. In Newton's rings central spot is _____.
4. Several images can be recorded in a _____.
5. The optical path traversed by light wave when reflected from the lower surface of a thin film _____ with increase of refractive index of the film

Write True or False :

6. In N slit Fraunhofer diffraction pattern the principal maximum becomes sharper as N decreases.
7. The diffraction pattern due to circular aperture for a plane wave are concentric circular rings.
8. Both Ordinary ray and Extra ordinary rays are plane polarized.
9. Larger the grating element larger will be the angular dispersion.
10. A hologram records both intensity and phase of light wave.

(10 × 1 = 10 marks)

Section B

Answer all questions in two or three sentences.

Each question carries 2 marks.

11. State Fermats principle of stationary time. Explain with respect to elliptical reflector.
12. To get more directionality for sound waves how will you select the diameter of the loud speaker ?

Turn over

13. For the normal incidence of a parallel light beam on a thin film of refractive index n , state the condition for destructive and constructive interference. Explain.
14. Explain colour of thin films.
15. State and explain the principle of superposition of light waves.
16. Describe any one application of Holography.
17. Interference colours are not observed in thick plates or glass slabs. Why?

(7 × 2 = 14 marks)

Section C

Answer any five questions in paragraph of about a half a page to one page.

Each question carries 4 marks.

18. Derive the condition for image plane with respect to a refracting surface.
19. Discuss on the resolving power of a microscope. Why oil immersion objectives are preferred in microscopes?
20. Explain the construction of Fresnel's half period zones on a plane wave front. Find the area of each zone.
21. Describe Michelson interferometer with neat diagram and explain how it can be used to measure wavelength of light.
22. Discuss the application of the thin film interference phenomenon in reducing the reflectivity of lens surfaces.
23. Represent the effect of translation of a ray through a distance D in a homogenous medium of refractive index μ by the translation matrix.
24. Give the theory of Holography.

(5 × 4 = 20 marks)

Section D

Answer any four questions.

Each question carries 4 marks.

25. Find the system matrix for a thin lens placed in air and made of refractive index 1.6 and radii of curvature 40cm each.
26. In a biprism experiment, interference fringes are observed at a distance of 1 m away from it. The refractive index of the material of the biprism is 1.5. If the distance between the source and the biprism is 10cm, calculate the fringe width when wave length of light used is 5000\AA . Given that the biprism has refracting angle 1° .

27. Newton's rings are observed in reflected light of wavelength $6 \times 10^{-7} \text{m}$. The diameter of the 10th dark ring is 0.3cm. Find the thickness of the air film and the radius curvature of the lens.
28. If the diameter of the pupil of the eye is 2mm, find the minimum separation between two points to be resolved by eye. Given that the distance of the points from the eye is 30m and the points are red in colour with wavelength $6 \times 10^{-7} \text{m}$.
29. A zone plate has radii $r_n = 0.001 \sqrt{nm}$ for $\lambda = 4.5 \times 10^{-7} \text{m}$, find the positions of foci.
30. Calculate the thickness of double refracting plate capable of producing a path difference of $\lambda/4$ between extraordinary and ordinary waves. Given $\lambda = 5500 \text{Å}$, refractive index of e-ray = 1.54, refractive index of o-ray = 1.53.
31. For a step index fibre the refractive index of core is 1.50, and refractive index of cladding is 1.48. Calculate the temporal broadening after 1 km. The core radius is such that the ray optics is valid.

(4 × 4 = 16 marks)

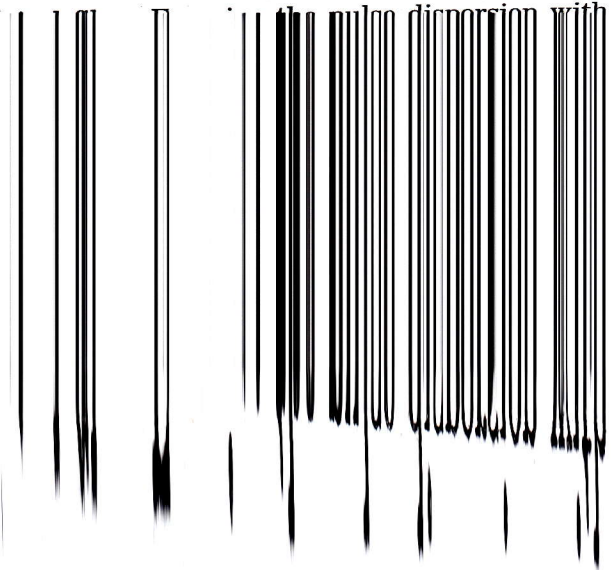
Section E (Essays)

Answer in about two pages.

Answer any two questions.

Each question carries 10 marks.

32. What are coherent sources? Derive an expression for the resultant intensity when two coherent beams of light are superposed. What will be the intensity when two sources are incoherent?
33. Discuss Fraunhofer diffraction pattern produced by a long single slit. Find positions of maximum and minimum intensity.
34. Describe how you produce circularly and elliptically polarized lights? How will you analyse the type of polarization?



D 50608

(Pages : 3)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2018

(CUCBCSS—UG)

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

Time : Three Hours

Maximum : 80 Marks

Section A

Answer in a word or phrase.

Answer all questions. Each question carries 1 mark.

1. To determine optical rotation of solutions _____ is used.
 - (a) Interferometer.
 - (b) Spectrometer.
 - (c) Magnetometer.
 - (d) Polarimeter.
2. Wide separation of spectral lines indicates :
 - (a) High resolving power.
 - (b) High magnifying power.
 - (c) High dispersive power.
 - (d) None of these.
3. A biprism produce N_1 fringes with light of wavelength λ_1 . The number of fringes with wavelength λ_2 is _____.
 - (a) $\lambda_1 N_1 / \lambda_2$.
 - (b) $\lambda_2 N_1 / \lambda_1$.
 - (c) $\lambda_1 / \lambda_2 N_1$.
 - (d) $[\lambda_1 / \lambda_2]^{1/2} N_1$.
4. To invert a circularly polarized light, we use:
 - (a) Quarter wave plate.
 - (b) Halfwave plate.
 - (c) Half shade device .
 - (d) Biquartz device.
5. When focal length of a lens decreases, the field of view of the lens _____.
6. Colours of thin films are explained using the phenomenon called _____.
7. Which one is not used to produce interference pattern
 - (a) Biprism .
 - (b) Two mirror.
 - (c) Newton's rings.
 - (d) Nicol prism.

Turn over

8. Compact disc shows colours in white light due to _____.
9. The radius of the 6th zone plate of focal length 10cm for light of wavelength 6000Å is _____.
10. The basic principle of optic fiber is _____.

(10 × 1 = 10 marks)

Section B

(Answer in a short paragraph- three or four sentences.

Answer all questions. Each question carries 2 marks.

11. Draw Frenel's two mirror arrangement ?
12. What is polarizing angle. How is it related to refractive index of the medium ?
13. What do you meant by double refraction ?
14. Define Translation matrix and refraction Matrix of an optical system.
15. Compare a zone plate and a convex lens ?
16. What are Newton's rings ? What are its uses ?
17. How are the hologram classified ? Explain.

(7 × 2 = 14 marks)

Section C

Answer in a paragraph of about half a page to one page.

Answer any five questions. Each question carries 4 marks.

18. State and explain Fermat's principle of extremum path and use it to deduce the laws of reflection and refraction of light.
19. What is system matrix ? Obtain it in the case of a system of two thin lenses separated by a distance and hence derive the formula for its focal length.
20. What is meant by interference of light ? State the fundamental conditions for the production of interference fringes.
21. State the principle of superposition of light waves.
22. Define and explain polarization.
23. Distinguish between positive uniaxial and negative uniaxial crystals.
24. What is meant by critical angle of an optical fiber ? Obtain an expression for the critical angle.

(5 × 4 = 20 marks)

Section D

(Problems- write all relevant formulas. All important steps carry separate marks.

Answer any four questions. Each question carries 4 marks.

25. A soap film 5×10^{-5} cm thick is viewed at an angle of 35° to the normal. Find the wavelength of light in the visible spectrum which will be absent from the reflected light. Given $\mu = 1.33$?
26. What is the radius of the 1st half period zone in a zone plate behavior like a convex lens of focal length 60cm for light of wavelength 6000Å ?
27. Calculate the thickness of (i) quarter wave plate(ii) a half wave plate. Given that $\mu_o = 1.973$, $\mu_e = 2.656$ and $\lambda = 590\text{nm}$.
28. Show that areas of half period zones are equal.
29. Calculate the angle of acceptance of a given optical fiber, if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively.
30. The critical angle of incidence for total reflection in case of water is 48° . What is its polarization angle ? What is the angle of refraction corresponding to the polarization angle ?
31. In Fraunhofer diffraction pattern due to a narrow slit a screen is placed 2m away from the lens to obtain the pattern. If the slit width is 0.2 mm and the first minimum lie 5mm on either sides of the central maximum, find the wavelength of light.

(4 × 4 = 16 marks)

Section E

Essays. Answer in about two pages.

Answer any two questions. Each question carries 10 marks.

32. Discuss the Fraunhofer diffraction pattern due to a single slit. Draw the intensity distribution ?
33. Write principle of holography ? Describe the recording and rerecording process in holography with the help of suitable diagrams.
34. What are Newtons ring ? derive an expression for the radius of the n^{th} dark ring formed by the reflection also by transmitted light.
35. Explain the rectangular propagation of light on the basis of Fresnels half period zone.

(2 × 10 = 20 marks)

C 30815

(Pages : 4)

Name.....

Reg. No.....

**FIFTH SEMESTER B.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION
NOVEMBER 2017**

(UG—CCSS)

PH 5B 11—PHYSICAL OPTICS AND MODERN OPTICS

(2013 Admissions)

Time : Three Hours

Maximum : 30 Weightage

Section A

Answer all questions.

Each bunch carries weightage of 1.

- I. 1. The determinant of the translation matrix =
- (a) 1. (b) 0.
(c) ∞ . (d) None of the above.
2. The distance between the pair of sources (virtual images) in Fresnel's biprism is
- (a) $d = 2\alpha(\mu - 1)a$. (b) $d = 2a(\mu - 1)\alpha$.
(c) $d = 2\mu(a - 1)\alpha$. (d) $d = 2a(\alpha - 1)\mu$.
3. In Fresnel's two mirror arrangement, the two virtual images of the source are produced by :
- (a) Refraction. (b) Reflection.
(c) Diffraction. (d) Polarization.
4. The colour of thin film is due to :
- (a) Interference. (b) Dichorism.
(c) Birefringence. (d) Optical Activity.
- II. 5. If a white light source is used in Newton's rings, the central fringe will be :
- (a) White. (b) Dark.
(c) Violet. (d) Red.
6. In Fraunhofer diffraction the diffracted wavefront is :
- (a) Plane. (b) Spherical.
(c) Cylindrical. (d) None of these.

Turn over

7. In a diffraction grating with white light, red is :
- (a) Most deviated. (b) Least deviated.
(c) Not deviated. (d) None of these.
8. In a zone plate, the radii of the circles and natural numbers are related as :
- (a) $r_n \propto \sqrt{n}$. (b) $r_n \propto n$.
(c) $r_n \propto n^2$. (d) $r_n \propto \frac{1}{n}$.
- III. 9. In a quarter wave plate, the phase difference introduced between the o-ray and e-ray is
- (a) 2π . (b) π .
(c) $\frac{\pi}{2}$. (d) $\frac{\pi}{4}$.
10. Polarization can be explained with the help of
- (a) Corpuscular theory. (b) Wave theory.
(c) Quantum theory. (d) None of these.
11. If the input and output pulse widths are t_{p1} and t_{p2} respectively, the dispersion in the optical fiber $\Delta t =$ _____.
- (a) $t_{p2}^2 - t_{p1}^2$. (b) $t_{p2}^2 + t_{p1}^2$.
(c) $\sqrt{t_{p2}^2 + t_{p1}^2}$. (d) $\sqrt{t_{p2}^2 - t_{p1}^2}$.
12. The shape of the ordinary wave front in a doubly refracting crystal is :
- (a) Plane. (b) Cylindrical.
(c) Ellipsoid. (d) Spherical.

(12 × ¼ = 3 weightage)

Section B

Answer all nine questions.

Each question carries a weightage of 1.

- 13 State Fermat's principle of extremum path.
- 14 Define power of a refracting surface.
- 15 What are coherent sources ?
- 16 What are non-reflecting films ? Give one application.

- 17 How do you explain the formation of shadows of small objects on the basis of wave theory.
- 18 Draw the intensity distribution curve for the Fraunhofer diffraction at a single slit.
- 19 What is the role of Canada balsam in a Nicol prism ?
- 20 What is the basic principle of fiber optic communication ?
- 21 Explain the term phase matching in non-linear optics.

(9 × 1 = 9 weightage)

Section C

Answer any five questions.

Each question carries a weightage of 2.

- 22 Derive the refraction matrix for refraction at a spherical surface.
- 23 The refracting angle of a biprism is 1° and its refractive index is 1.5. It is illuminated with monochromatic light through a slit kept at a distance 20 cm from the biprism. If the wavelength of the light used is 6943 \AA , calculate the fringe width on a screen kept at distance of 80 cm from the biprism.
- 24 In a Newton's ring experiment the diameters of the 5th and 15th rings were found to be 0.4 cm and 0.6 cm respectively when light of wavelength 600 nm is used. Calculate the radius of curvature of the lens used.
- 25 Find the radius of the first half period zone on a zone plate, behaving like a convex lens of focal length 50 cm for $\lambda = 500 \text{ nm}$.
- 26 What is the highest order spectrum which may be seen with monochromatic light of wavelength 4800 \AA by means of diffraction grating with 25000/inch.
- 27 A beam of polarized light of wavelength 6000 \AA when passed through a thin plate, it gets converted into circularly polarized light. If $n_o = 1.46$ and $n_e = 1.455$, calculate the thickness of the plate.
- 28 If $n_1 = 1.55$ and $n_2 = 1.5$, calculate the numerical aperture and angle of acceptance of the optic fiber.

(5 × 2 = 10 weightage)

Turn over

Section D

Answer any two questions.

Each question carries a weightage of 4.

- 29 (a) Describe with necessary theory, the formation of Newton's rings.
- (b) How can you use Newton's rings to determine the wavelength of light from a monochromatic source ?
- 30 Describe in detail the Fresnel diffraction of a cylindrical wavefront at a straight edge.
- 31 (a) What is meant by optical activity ? Distinguish between dextrorotatory and laevorotatory substances with examples.
- (b) Describe the construction the construction of Laurent's half shade polarimeter. How do you use it to determine the specific rotation of an optically active liquid ?

(2 × 4 = 8 weightage)

C 30314

(Pages : 3)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2017

(CUCBCSS—UG)

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

Time : Three Hours

Maximum : 80 Marks

Section A (Answer in a Word or Phrase)

*Answer all questions.
Each question carries 1 mark.*

1. To determine optical rotation of solutions _____ is used.
(a) Interferometer. (b) Spectrometer.
(c) Magnetometer. (d) Polarimeter.
2. Wide separation of spectral lines indicates :
(a) High resolving power. (b) High magnifying power.
(c) High dispersive power. (d) None of these.
3. A biprism produce N_1 fringes with light of wavelength λ_1 . The number of fringes with wavelength λ_2 is _____
(a) $\lambda_1 N_1 / \lambda_2$. (b) $\lambda_2 N_1 / \lambda_1$.
(c) $\lambda_1 / \lambda_2 N_1$. (d) $[\lambda_1 / \lambda_2]^{1/2} N_1$.
4. The inability of a spherical lens to produce point image of point object is called _____.
5. Phase difference/path difference = _____.
(a) λ . (b) 2π .
(c) $\lambda / 2\pi$. (d) $2\pi / \lambda$.
6. The basic principle of optic fiber is _____.
7. The sine of acceptance angle is called _____.
8. Transverse nature of light was established by the phenomenon _____.
9. In a the case of grating $\lambda / d \lambda$ is called _____.
10. _____ eye piece is achromatic for all colours.

(10 × 1 = 10 marks)

Turn over

Section B

(Answer in a short paragraph-three or four sentences).

Answer any all questions.

Each question carries 2 marks.

11. What is meant by optical path ?
12. State principle of super position.
13. What are fiber optic sensors ?
14. Define Translation matrix and refraction Matrix of an optical system.
15. Compare a zone plate and a convex lens.
16. When Newton's rings are formed with white light which colour will be on the outer edge. Why ?
17. How are the hologram classified ? Explain.

(7 × 2 = 14 marks)

Section C

(Answer in a paragraph of about half a page to one page)

Answer any five questions.

Each question carries 4 marks.

18. State and explain Fermat's principle of extremum path and use it to deduce the laws of reflection and refraction of light.
19. Explain advantages of optical communication.
20. Show that for a thin air film enclosed between a convex lens and glass plate radii of dark rings of interference pattern are directly proportional to square root of natural numbers.
21. Distinguish between step index fiber and graded index fiber.
22. What are coherent sources ? Explain conditions for interference.
23. Explain working of Michelson interferometer.
24. Explain colour of thin film in white light.

(5 × 4 = 20 marks)

Section D

(Problems- write all relevant formulas. All important steps carry separate marks).

Answer any four questions.

Each question carries 4 marks.

25. A soap film 5×10^{-5} cm. thick is viewed at an angle of 35° to the normal. Find the wavelength of light in the visible spectrum which will be absent from the reflected light. Given $\mu = 1.33$?

26. What is the radius of the 1st half period zone in a zone plate behavior like a convex lens of focal length 60 cm. for light of wavelength 6000 Å ?
27. Calculate the thickness of (a) Quarter wave plate ; and (ii) A half wave plate. Given that $\mu_o = 1.973$, $\mu_e = 2.656$ and $\lambda = 590$ nm.
28. Show that areas of half period zones are equal.
29. Calculate the angle of acceptance of a given optical fiber, if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively.
30. The critical angle of incidence for total reflection in case of water is 48°. What is its polarization angle ? What is the angle of refraction corresponding to the polarization angle ?
31. In Fraunhofer diffraction pattern due to a narrow slit a screen is placed 2 m. away from the lens to obtain the pattern. If the slit width is 0.2 mm and the first minimum lie 5 mm. on either sides of the central maximum, find the wavelength of light.

(4 × 4 = 16 marks)

Section E (Essays - Answer in about two pages)

Answer any two questions.

Each question carries 10 marks.

32. With a diagram explain diffraction by circular aperture. Using the theory of grating, explain how wavelength of light is determined in normal incidence mode.
33. Describe with theory Young's experiment for the determination of band width of interference pattern due to two coherent sources ? Also draw the intensity distribution for the same
34. Explain the rectangular propagation of light on the basis of Fresnel's half period zone.
35. Write principle of holography ? Describe the recording and rerecording process in holography with the help of suitable diagrams.

(2 × 10 = 20 marks)

D 11170

(Pages : 3)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2016

(CUCBCSS-UG)

Physics/Applied Physics

PHY 5B 08/APY 5B 09—PHYSICAL OPTICS AND MODERN OPTICS

Time : Three Hours

Maximum : 80 Marks

The symbols used in this question paper have their usual meanings.

Section A

Answer all questions in a word or a phrase.

Each question carries 1 mark.

1. How much is the phase change occurring for a light wave travelling from a rarer medium to a denser medium when it gets reflected at the boundary ?
2. In a Michelson interferometer, the interference occurs by division of Amplitude
3. In Fresnel class of diffraction, the source of light and the screen are at finite distance from the diffracting aperture.
4. For ordinary ray, what is the shape of the Huygens wave surface produced by a point source ? Circle
5. On a hologram, information is recorded in the form of interference pattern.

Write True or False :

6. The determinant of a system matrix is unity.
7. Superposition of incoherent waves produces a uniform illumination.
8. A Fresnel's zone plate acts as a concave lens. X
9. When a linearly polarized light is passed through a polarizer, it will be extinguished once in one full rotation of the polarizer.
10. The information holding capacity of a hologram is higher than a photographic film.

(10 × 1 = 10 marks)

Section B

Answer all questions in two or three sentences.

Each question carries 2 marks.

11. State the laws of reflection.
12. Using a suitable figure, express the term optical direction cosine of a ray.
13. Obtain a relation between optical path length and geometrical path length.

Turn over

14. What are the conditions for producing Haidinger fringes ?
15. Write down the expression for the intensity distribution in Fraunhofer diffraction due to a single slit and plot it.
16. What do you mean by a half wave plate ?
17. What are the basic steps in holography ?

(7 × 2 = 14 marks)

Section C

Answer any five questions in a paragraph of about half a page to one page.

Each question carries 4 marks.

18. Use Fermat's principle to prove that for minimum optical path length, the incident ray, the refracted ray and the normal to the interface lie in the same plane.
19. Discuss the effect of translation through a homogenous optical medium in terms of a translation matrix.
20. Explain the method of producing interference in a Fresnel's two-mirror arrangement.
21. Draw the experimental arrangement for observing Newton's rings and indicate the parts. Why the fringes are circular in shape ?
22. Can Fresnel's wave theory accounts for the rectilinear propagation of light ? Explain.
23. Explain a method to detect a circularly polarized light.
24. Discuss the applications of holography.

(5 × 4 = 20 marks)

Section D

Answer any four questions.

Each question carries 4 marks.

Problems-write all relevant formulas, all important steps carry separate marks.

25. Obtain the system matrix for a thick equi-convex lens made of a material of refractive index 1.5 with radii of curvature of the two surfaces 8 cm. The thickness of the lens is 1 cm. and the lens is placed in air.
26. Determine the separation between the coherent sources formed by a biprism whose inclined faces make angles of 2° with its base and the slit is 0.1 m. away from the biprism. Given, refractive index of the material of the prism is 1.5.
27. In Newton's rings experiment, the diameter of the m^{th} ring changes from 1.2 cm. to 1 cm. when the air space between the lens and the glass plate is replaced by a transparent liquid. Find the refractive index of the liquid.
28. A zone plate has the diameter of the first ring 1 mm. If a plane wave of wavelength 500 nm falls on the plate, where should the screen be placed so that the light is focused to a brightest spot ?
29. What is the highest order spectrum that may be seen with light of wavelength 550 nm by means of a grating with 3000 lines/cm. ?

30. A plane polarized light passes through a uniaxial crystal with its optic axis parallel to the faces. Determine the least thickness of the plate for which the emergent beam is plane-polarized. Given $\mu_e = 1.5533$, $\mu_o = 1.5442$, $\lambda = 500 \text{ nm}$.
31. Calculate the numerical aperture and hence the acceptance angle of an optical fiber having core and cladding refractive indices 1.45 and 1.40 respectively.

(4 × 4 = 16 marks)

Section E (Essays)*Answer any two questions in about two pages.**Each question carries 10 marks.*

32. Explain interference of light using the principle of superposition. Discuss the analytical treatment of interference.
33. Discuss the Fresnel diffraction at a straight edge. Obtain positions of maximum and minimum amplitude.
34. What do you mean by a polarized light? Discuss the production of linearly polarized light by (i) reflection; (ii) refraction; (iii) scattering; and (iv) selective absorption.
35. Illustrate the total internal reflection phenomenon. Explain the light propagation through an optical fiber. Distinguish between step index and graded index optical fibers.

(2 × 10 = 20 marks)

$$n = \frac{(D_n)_{\text{an}}}{(D_n)_{\text{e.g.}}}$$

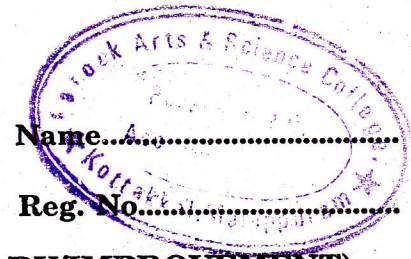
$$\lambda / \Delta n \cdot N_n$$

$$NA = \sin \theta$$

$$\frac{3000 \text{ m}}{3 \times 10^8}$$

D 11554

(Pages : 3)



**FIFTH SEMESTER B.Sc. DEGREE (SUPPLEMENTARY/IMPROVEMENT)
EXAMINATION, NOVEMBER 2016**

(UG—CCSS)

Physics/Applied Physics

PH 5B 11/AP 5B 13—PHYSICAL OPTICS AND MODERN OPTICS

(2009—2012 Admissions)

Time : Three Hours

Maximum : 30 Weightage

Section A

Answer all questions.

Each question carries $\frac{1}{4}$ weightage.

1. The reversibility of light rays follows from :
 - (a) Fermat's principle.
 - (b) Maxwell's law.
 - (b) Snell's law.
 - (d) Foucault's law.
2. The midpoint of the mirror is called :
 - (a) Centre of curvature.
 - (b) Principal axis.
 - (c) Vertex.
 - (d) Focal plane.
3. The inverse of the reduced focal length is known as _____.
4. The properties of an optical system can be obtained from
 - (a) Translation mix.
 - (b) Refraction matrix.
 - (c) Reflection matrix.
 - (d) System matrix.
5. Two source of light are coherent if the wave produced by them have the same :
 - (a) Wavelength.
 - (b) Amplitude.
 - (c) Wavelength and constant phase difference.
 - (d) Amplitude and wavelength.
6. Laser light is :
 - (a) Coherent.
 - (b) Non-coherent.
 - (c) Divergent.
 - (d) Unco-ordinated source.

Turn over

7. In a bi prism experiment, if the equal angle of the two components prisms are slightly increased, the fringe pattern will
- (a) Get enlarged. (b) Shrink.
(c) Vanish. (d) None of these.
8. Diffraction ceases as :
- (a) Frequency tends to zero. (b) $\lambda \rightarrow \infty$.
(c) $\lambda \rightarrow 0$. (d) Energy tends to increase.
9. Light waves can be polarized because they are _____.
10. Plane polarized light can be produced by :
- (a) Bi prism. (b) Zone plate.
(c) Grating. (d) Nicol prism.
11. One of the following is a non linear optical effect :—
- (a) Raman effect. (b) Zeeman effect.
(c) Compton effect. (d) Interference.
12. Light rays are propagated through an optical fiber by the mechanism of :
- (a) Refraction. (b) Reflection.
(c) Total internal reflection. (d) Diffraction.

(12 × ¼ = 3 weightage)

Section B

Answer all questions.

Each question carries 1 weightage.

13. Distinguish between refraction and translation.
14. Define magnification of a system.
15. What are the conditions for producing interference fringes ?
16. Soap bubble spread over the surface of water appears colored in sunlight. Why ?
17. Distinguish between Fraunhofer diffraction and Fresnel diffraction.
18. Radio waves diffract around buildings while light waves do not. Explain.
19. What is double diffraction ?
20. What are the advantages of cladding?
21. What is meant by self focusing ?

(9 × 1 = 9 weightage)

Section C

*Answer any five questions.
Each question carries 2 weightage.*

22. Derive the laws of refraction using Fermat's principle.
23. Obtain the system matrix for a combination of *two* thin lenses of focal lengths separated by a distance D and hence find out the equivalent focal length of the system.
24. Red light from a He-Ne laser ($\lambda = 632.6 \text{ nm}$) is incident on a screen containing very narrow horizontal slits separated by 0.2 mm . A fringe pattern appears on a screen held 1.0 m . away. How far above and below the central axis are the first zeroes of irradiance? How far from the axis is the fifth bright band.
25. In a Newton's ring experiment, the diameter of the Fourth bright ring is 2.52 cm . Now the wedge between the glass plate and the convex lens is filled with a liquid and the diameter of the ring changes to 2.2 cm . What is the refractive index of the liquid?
26. Discuss the diffraction pattern due to a straight edge. Find the positions of maximum and minimum intensity.
27. How is elliptically polarized light produced and detected?
28. What is a fiber guide? Discuss the working principle of a fiber guide. What do you mean by a graded index fiber and a step index fiber?

(5 × 2 = 10 weightage)

Section D

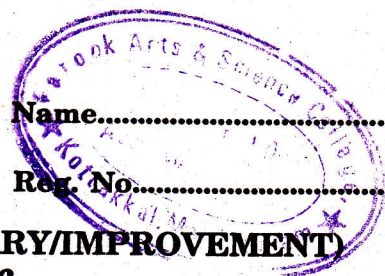
*Answer any two questions.
Each question carries 4 weightage.*

29. What is attenuation in an optical fiber? Explain intrinsic attenuation and extrinsic attenuation. What is the attenuation of an optical fiber of 15 % of the power fed at the launching end in lost in a 0.5 km . fiber?
30. Explain the working of a Michelson interferometer. Describe how the difference between two close wavelengths can be determined using the interferometer.
31. Describe the necessary theory how the wave length of a monochromatic source of radiation can be determined using Newton's ring arrangement.
32. Discuss the theory of a zone plate and compare it with that of a converging lens. Does the zone plane suffer from chromatic aberration? Justify.

(2 × 4 = 8 weightage)

D 11561

(Pages : 3)



**FIFTH SEMESTER B.Sc. DEGREE (SUPPLEMENTARY/IMPROVEMENT)
EXAMINATION, NOVEMBER 2016**

(UG—CCSS)

Physics

PH 5B 11—PHYSICAL OPTICS AND MODERN OPTICS

(2013 Admissions)

Time : Three Hours

Maximum : 30 Weightage

I. Objective questions (Answer *all* questions) :

- 1 When a ray of light travels from a rarer to a denser medium, at the reflection boundary, it undergoes a phase change of :
 - (a) π radians.
 - (b) 2π radians.
 - (c) $\pi/2$ radians.
 - (d) $\pi/3$ radians.
- 2 Which among the following does not belong to the case of interference by division of wavefront ?
 - (a) Fresnel's biprism.
 - (b) Fresnel's double mirror.
 - (c) Lloyd's mirror.
 - (d) Michelson interferometer.
- 3 In the case of interference by a thin film, visibility of the fringes is :
 - (a) More in reflected system.
 - (b) More in transmitted system.
 - (c) Equal in both the systems.
 - (d) Very poor in both the systems.
- 4 The grating spectrum arises from :
 - (a) Dispersion.
 - (b) Diffraction.
 - (c) Reflection.
 - (d) Polarization.
- 5 The optical phenomenon _____ proves that light waves are transverse in nature.
 - (a) Interference.
 - (b) Diffraction.
 - (c) Polarization.
 - (d) Dispersion.
- 6 When a linearly polarized light is passed through a polarizer, how many times it will be extinguished in one full rotation of the polarizer ?
 - (a) Once.
 - (b) Twice.
 - (c) Thrice.
 - (d) Four times.

Turn over

- 7 A Fresnel's zone plate acts as a :
- (a) Mirror. (b) Prism.
(c) Concave lens. (d) Convex lens.
- 8 The radii of Newton's rings are proportional to :
- (a) Wavelength of light used.
(b) Square of the wavelength of light used.
(c) Square root of the wavelength of light used.
(d) Inverse of the wavelength of light used.
- 9 At the core-cladding interface of an optical fiber, the angle of incidence must be _____ the critical angle.
- (a) Greater than. (b) Less than.
(c) Equal to. (d) Tangent of.
- 10 When a quartz crystal is exposed to an intense ruby laser pulse of wavelength 6943 \AA , it generated a low intense second harmonic wave. Which among the following is the second harmonic wavelength ?
- (a) 13886 \AA . (b) 3471.5 \AA .
(c) 6943 \AA . (d) 20829 \AA .
- 11 When light enters from a medium of refractive index n_1 to another medium of refractive index n_2 , with angle of incidence and angle of refraction i and r , respectively, the Snell's law relating these quantities can be written as _____.
- 12 For sustained interference, the path difference between the overlapping waves must be _____ than the coherence length of the waves.

(12 × ¼ = 3 weightage)

II. Short answer questions (Answer *all* questions) :

- 13 Show that rectilinear propagation of light follows from Fermat's principle.
- 14 Write down the lens maker's formula for a thin lens and explain the terms involved.
- 15 What do you mean by the term optical path ?
- 16 Draw the schematic of a Michelson interferometer.
- 17 Compare Fresnel and Fraunhofer diffraction.
- 18 Distinguish between positive and negative crystals.

- 19 What is the principle of light propagation in an optical fiber ?
- 20 What do you mean by single mode and multimode optical fibres ?
- 21 Explain the term sum frequency generation in non-linear optics.

(9 × 1 = 9 weightage)

III. Short essay questions (Answer any *five* questions) :

- 22 Two thin converging lenses of powers 5 and 4 diopters are placed co-axially 10 cm. apart. Determine the focal length of the combination.
- 23 Estimate the radius of the first zone in a zone plate of focal length 20 cm. for light of wavelength 500 nm.
- 24 A parallel beam of monochromatic light is allowed to incident normally on a plane diffraction grating having 1250 lines/cm. and a second order spectral line is observed to be deviated through 30 degrees. Calculate the wavelength of the spectral line.
- 25 Determine the thickness of a half-wave plate of quartz for a wavelength 500 nm. Given, the refractive indices of the extra-ordinary and ordinary rays are $\mu_e = 1.553$ and $\mu_o = 1.544$, respectively.
- 26 Show that superposition of incoherent waves cannot produce interference.
- 27 Write down the relation between polarization and electric field in a non-linear medium and explain the related effects.
- 28 A step index fiber has a core of refractive index 1.55 and cladding of refractive index 1.5. Determine the numerical aperture of the fiber. Assume that light enters the fiber from air.

(5 × 2 = 10 weightage)

IV. Essay questions (Answer any *two* questions) :

- 29 Discuss the interference by a plane parallel film illuminated by a plane wave.
- 30 Explain the theory of Fresnel diffraction at a straight edge.
- 31 Discuss (i) Huygens theory of double refraction ; and (ii) Optical activity.

(2 × 4 = 8 weightage)

D 90921

(Pages : 3)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2015

(UG—CCSS)

Core Course—Physics

PH 5B 11—PHYSICAL OPTICS AND MODERN OPTICS

(2013 Admissions)

Time : Three Hours

Maximum : 30 Weightage

I. Objective questions (Answer *all* questions) :

1. On reflection at the boundary, a light wave travelling from a denser medium to a rarer medium undergoes :
 - (a) A phase change of $\pi/4$ radians.
 - (b) A phase change of $\pi/3$ radians.
 - (c) A phase change of $\pi/2$ radians.
 - (d) No phase change.
2. In a Michelson interferometer, the interference occurs by :
 - (a) Division of wavefront.
 - (b) Division of amplitude.
 - (c) Division of wavelength.
 - (d) Division of frequency.
3. The grating spectrum arises from :
 - (a) Dispersion.
 - (b) Diffraction.
 - (c) Reflection.
 - (d) Polarization.
4. Which optical phenomenon proves that light waves are transverse in nature ?
 - (a) Reflection.
 - (b) Refraction.
 - (c) Polarization.
 - (d) Dispersion.
5. When a circularly polarized light is passed through a quarter wave plate, it is converted into :
 - (a) Unpolarized.
 - (b) Elliptically polarized.
 - (c) Plane polarized.
 - (d) Circularly polarized.
6. The function of a Fresnel's zone plate is that of a :
 - (a) Convex lens.
 - (b) Concave lens.
 - (c) Prism.
 - (d) Mirror.

Turn over

7. The radii of Newton's rings are proportional to :
- Wavelength of light used.
 - Square of the wavelength of light used.
 - Square root of the wavelength of light used.
 - Cube root of the wavelength of light used.
8. The numerical aperture of an optical fiber does not depend on :
- Refractive index of the core.
 - Refractive index of the cladding.
 - Refractive index of the sheath.
 - None of these.
9. When a quartz crystal is exposed to an intense ruby laser pulse of wavelength 6943 \AA , it generated a low intense second harmonic wave. Which among the following is the second harmonic wavelength ?
- 13886 \AA .
 - 20829 \AA .
 - 6943 \AA .
 - 3471.5 \AA .
10. For Fraunhofer diffraction at a circular aperture, when the diameter of the aperture is increased, the radius of the central bright ring _____.
11. When light enters from a medium of refractive index n_1 to another medium of refractive index n_2 , with angle of incidence and angle of refraction are i and r , respectively, the Snell's law relating these quantities can be written as _____.
12. The length of a wave over which it is sinusoidal and has a predictable phase is called _____.

($12 \times \frac{1}{4} = 3$ weightage)

II. Short answer questions (Answer *all* questions) :

- Explain Fermat's principle of least time.
- What are the cardinal points for an optical system ?
- What do you mean by the term optical path ?
- Distinguish between the Newton's rings formed by reflected and transmitted monochromatic light.
- Distinguish between Fresnel and Fraunhofer diffraction.
- Compare the properties of ordinary and extraordinary rays.
- Draw the refractive index profile of a step index and a graded index fiber.
- Discuss the phase matching condition in second harmonic generation.
- What do you mean by difference frequency generation in non-linear optics ?

($9 \times 1 = 9$ weightage)

III. Short essay questions (Answer any *five* questions) :

22. Obtain the system matrix for a thin lens placed in air made of refractive index 1.5 and radii of curvature 50 cm each.
23. Determine the radius of the second zone in a zone plate of focal length 10 cm for light of wavelength 500 nm.
24. Estimate the minimum number of lines in a grating that will just resolve, in the second order, the lines whose wavelengths are 589 nm and 589.6 nm.
25. A plane polarized light passes through a uniaxial crystal with its optic axis parallel to the faces. Determine the least thickness of the plate for which the emergent beam is plane-polarized.

Given $\mu_e = 1.5533$, $\mu_o = 1.5442$, $\lambda = 500nm$.

26. Prove that superposition of incoherent waves cannot produce interference.
27. Discuss the origin of second harmonic generation.
28. A step index fiber has a core of refractive index 1.55 and clad of refractive index 1.5. Determine the numerical aperture of the fiber. Assume that light enters the fiber from air.

(5 × 2 = 10 weightage)

IV. Essay questions (Answer any *two* questions) :

29. Discuss the interference by a plane parallel film illuminated by a plane wave.
30. Discuss the Fraunhofer diffraction due to a single slit. Draw the intensity distribution.
31. Explain what is meant by a quarter wave plate. Using a neat diagram, discuss the production of an elliptically and circularly polarized light using a quarter wave plate.

(2 × 4 = 8 weightage)

D 70949

(Pages : 3)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2014

(U.G.-CCSS)

Core Course—Physics/Applied Physics

PH 5B 11/AP 5B 13—PHYSICAL OPTICS AND MODERN OPTICS

Time : Three Hours

Maximum : 30 Weightage

Section A

Answer all questions.

1. The bending of light ray at the corners of opaque obstacles is called :
 - (a) Reflection.
 - (b) Refraction.
 - (c) Interference.
 - (d) Diffraction.
2. At polarising angle, the angle between reflected and refracted rays is :
 - (a) π .
 - (b) $\frac{\pi}{2}$.
 - (c) $\frac{\pi}{4}$.
 - (d) $\frac{\pi}{6}$.
3. The colours in thin films is due to :
 - (a) Interference.
 - (b) Diffraction.
 - (c) Polarisation.
 - (d) Refraction.
4. Polarimeter is a device to measure :
 - (a) Intensity of light.
 - (b) Wavelength.
 - (c) Frequency.
 - (d) Optical rotation.
5. For a quarter wave plate, phase difference between ordinary and extraordinary rays is :
 - (a) $\frac{\pi}{2}$.
 - (b) π .
 - (c) $\frac{\pi}{4}$.
 - (d) $\frac{\pi}{6}$.
6. Hologram is :
 - (a) One dimensional image of object.
 - (b) Two dimensional image of object.
 - (c) Three dimensional image of object.
 - (d) n dimensional image of object.

Turn over

7. The outer layer of the optical fibre is called :
- (a) Core. (b) Cladding.
(c) Plastic coating. (d) Jacket.
8. Condition for constructive interference is :
- (a) $I_{\max} = a^2$. (b) $I_{\max} = 2a^2$.
(c) $I_{\max} = 3a^2$. (d) $I_{\max} = 4a^2$.
9. The annular area enclosed between first and second circles is called :
- (a) First half period zone. (b) Second half period zone.
(c) Third half period zone. (d) Fourth half period zone.
10. The resolving power of a grating is :
- (a) nN . (b) $\frac{n}{N}$.
(c) \sqrt{nN} . (d) n^2N .
11. Phenomenon of splitting of light ray, when it is passed through calcite crystal is :
- (a) Refraction. (b) Double refraction.
(c) Diffraction. (d) Interference.
12. Diffraction of sound is very easy to observe in day to day life. This is not so with light. This is because :
- (a) $\lambda_s > \lambda_l$. (b) $\lambda_s < \lambda_l$.
(c) $\lambda_s = \lambda_l$. (d) None.

(12 × ¼ = 3 weightage)

Section B

Answer all questions.

13. What is refraction matrix ?
14. State the conditions for obtaining sustained interference pattern on a screen.
15. Mention any *two* uses of Michelson's interferometer.
16. Define resolving power of a grating.
17. What is a half wave plate ? Why is it called so ?
18. Give *four* applications of holography.
19. Distinguish between step index fibre and graded index fibre.

20. What is meant by parametric oscillation ?
 21. Distinguish between Fresnel and Fraunhofer diffraction.

(9 × 1 = 9 weightage)

Section C

Answer any five questions.

22. The numerical aperture of an optical fibre is 0.24. If the refractive index of the core is 1.48, calculate the refractive index of the cladding.
 23. Calculate the thickness of quartz which will rotate the plane of polarisation of sodium yellow by $\frac{\pi}{2}$. Specific rotation is $21.72^\circ/\text{mm}$.
 24. Calculate the velocity of O-ray and E-ray in calcite (a) along the optic axis ; (b) in a plane perpendicular to the optic axis $\mu_o = 1.65$, $\mu_E = 1.486$, $c = 3 \times 10^8 \text{ m/s}$.
 25. Calculate the minimum number of lines that a grating should have such that it just resolves in the second order, the lines whose wavelength are $5.890 \times 10^{-5} \text{ cm}$ and $5.896 \times 10^{-5} \text{ cm}$.
 26. Find the angular width of the central bright maximum in the Fraunhofer pattern of a slit of width $12 \times 10^{-5} \text{ cm}$ when the slit is illuminated by monochromatic light of wavelength 6000 \AA .
 27. A zone plate has the radius of the first ring 0.05 cm . If the plane waves ($\lambda = 5000 \text{ \AA}$) fall on the plate, where should the screen be placed so that the light is focused to a bright spot.
 28. When one of the mirror in a Michelson's interferometer is moved through a distance of 0.5 mm , calculate the no. of fringes that will cross the field of view ($\lambda = 6000 \text{ \AA}$).

(5 × 2 = 10 weightage)

Section D

Answer any two questions.

29. Explain how Michelson's interferometer is used to determine the difference in wavelengths very close to each other such as D_1 and D_2 lines of sodium.
 30. What is a system matrix ? Derive an expression for the system matrix for a thin lens and hence obtain the formula for a thin lens.
 31. What is polarisation ? Explain the production of :

(i) Elliptically polarised.

(ii) Circularly polarised light with necessary theory.

(2 × 4 = 8 weightage)

D 50731

(Pages : 3)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2013

(UG-CCSS)

Physics (Core Course)

PH 5B 11/AP 5B 13—PHYSICAL OPTICS AND MODERN OPTICS

(Common for Applied Physics)

Time : Three Hours

Maximum : 30 Weightage

Section A

Answer all questions.

1. The superposition of two or more waves in a medium is known as :
 - (a) Reflection.
 - (b) Refraction.
 - (c) Interference.
 - (d) Polarisation.
2. The waves that cannot be polarised :
 - (a) Light waves.
 - (b) Sound waves.
 - (c) Electromagnetic waves.
 - (d) None.
3. Malus law is :
 - (a) $I = I_0 \cos^2 \theta$.
 - (b) $I = I_0^2 \cos^2 \theta$.
 - (c) $I = I_0 \sin^2 \theta$.
 - (d) $I = I_0^2 \sin^2 \theta$.
4. Optical fibre works on the principle of :
 - (a) Refraction.
 - (b) Total internal reflection.
 - (c) Interference.
 - (d) Diffraction.
5. In interference there is redistribution of :
 - (a) Amplitude.
 - (b) Frequency.
 - (c) Phase.
 - (d) Energy.
6. If the light is completely polarised by reflection at a plane refracting surface, then the angle between reflected and refracted light is :
 - (a) π .
 - (b) $\frac{\pi}{2}$.
 - (c) $\frac{\pi}{4}$.
 - (d) zero.

Turn over

7. Polarisation of light proves :
- (a) Quantum nature of light. (b) Corpuscular nature of light.
(c) Transverse nature of light. (d) Longitudinal nature of light.
8. Colours in a thin film results from :
- (a) Dispersion of light. (b) Interference of light.
(c) Absorption of light. (d) Scattering of light.
9. Two coherent sources of intensities I and $4I$ are superposed. The maximum and minimum possible intensities in the resultant beam is :
- (a) $5I$ and I . (b) $9I$ and I .
(c) $5I$ and $3I$. (d) $9I$ and $8I$.
10. The focal length of the zone plate is :
- (a) $f = \frac{r_n^3}{n\lambda}$. (b) $f = \frac{r_n}{n\lambda}$.
(c) $f = \frac{r_n^2}{n\lambda}$. (d) $f = \frac{r_n}{n^2\lambda}$.
11. The path difference between ordinary and extraordinary ray in a quarter wave plate is :
- (a) λ . (b) $\frac{\lambda}{2}$.
(c) $\frac{\lambda}{4}$. (d) Zero.
12. The inner portion of optical fibre is called :
- (a) Core. (b) Cladding.
(c) Jacket. (d) None.

(12 × ¼ = 3 weightage)

Section B

Answer all questions.

13. What is meant by system matrix ?
14. A very thin film does not show colour, why ?
15. Distinguish between interference bands and diffraction bands.

16. Compare zone plate with a convex lens.
17. What is optical activity ?
18. What is double refraction ?
19. What is a hologram ? How does it differ from a photograph ?
20. Mention a few applications of optical fibre.
21. What are coherent sources ? Give *two* examples.

(9 × 1 = 9 weightage)

Section C

Answer any five questions.

22. In an Young's double slit experiment, the two slits have a width ratio of 1 : 4. Find the ratio of maximum intensity to minimum intensity in the interference pattern.
23. A parallel beam of light ($\lambda = 5890 \text{ \AA}$) is incident on a thin glass plate ($n = 1.5$) such that the angle of refraction is 60° . Calculate the smallest thickness of the plate which will appear dark by reflection.
24. In Newton's ring experiment the diameter of the 4th dark ring is 0.34 cm. using a light of wavelength 589.3 nm. Calculate the radius of the curvature of the convex lens.
25. Calculate the size of the circular aperture on a screen which would transmit 4 Fresnel's zones to a point 10 m away, if the wavelength of light used is 589 nm ?
26. What is the longest wavelength of light for which a spectrum can be obtained using a grating of 6000 lines per cm, under normal incidence ?
27. Calculate the minimum thickness of a quarter wave plate of calcite for a wavelength 5893 \AA . Given $\mu_o = 1.652$, $\mu_E = 1.488$.
28. What is the concentration of sugar solution of length 15 cm. if the optical rotation produced is 7° and specific rotation is 65° .

(5 × 2 = 10 weightage)

Section D

Answer any two questions.

29. Give the theory of zone plate. Derive an expression for its focal length.
30. With necessary theory, explain the formation of colours in thin film.
31. What is numerical aperture ? Derive an expression for it.

(2 × 4 = 8 weightage)