

4/PHY-250 Syllabus-2023

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(May-June)

FYUP : 4th Semester Examination

PHYSICS

(Optics—II and Acoustics)

(PHY-250)

Marks : 75

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Answer any ten questions

1. (a) What is chromatic aberration? Show that for achromatic combination of lenses in contact, the power of the convex lens is equal to that of a concave lens if they are made from the same material. 1+4=5
- (b) Two convex lenses of the same material are kept 13 cm apart. If the system is an achromat, find the focal length of the lenses. Given $f_1 : f_2 = 5 : 8$. 2½

(2)

2. (a) What are aplanatic points? Show that a spherical refracting surface is aplanatic with respect to a certain position of an object. $1+4=5$
- (b) What is an oil-immersion objective? Mention one of its uses. $1\frac{1}{2}+1=2\frac{1}{2}$
3. (a) Discuss the construction of Huygen's eye-piece. Show that the equivalent focal length of the eye-piece is $\frac{2}{3}$ times the focal length of the eye lens. $2+3\frac{1}{2}=5\frac{1}{2}$
- (b) What do you understand by spatial and temporal coherences? $1+1=2$
4. (a) Discuss Stokes' treatment to explain the phase change of a light wave reflected from a denser medium. 4
- (b) What are fringes of equal inclination? Where can they be observed? $1+\frac{1}{2}=1\frac{1}{2}$
- (c) Why is it necessary to have a broad source of light in order to observe interference in thin films? 2
5. (a) What are Newton's rings? Illustrate the formation of Newton's rings by reflected light. $1+3=4$

(3)

- (b) In Newton's rings experiment done with sodium light ($\lambda = 5893 \text{ \AA}$), find the radius of curvature of a plano-convex lens if the radius of the 10th dark ring was found to be 0.5 cm. $2\frac{1}{2}$
- (c) What change will be observed to Newton's rings when sodium light is replaced by white light? 1
6. Explain the interference due to the reflected light from a thin wedge-shaped film. Discuss how will you estimate the difference of the film thickness between two points. $7\frac{1}{2}$
7. With a neat diagram, describe the construction of Michelson's interferometer. Clearly explain how you will obtain circular fringes. $3+4\frac{1}{2}=7\frac{1}{2}$
8. (a) Explain how you will standardize a metre in terms of wavelength of light using Michelson's interferometer. 5
- (b) Outline the principle behind the working of a Fabry-Perot interferometer. $2\frac{1}{2}$
9. (a) What are the conditions for Fresnel and Fraunhofer diffractions? $1+1=2$
- (b) What is a zone plate? Describe its construction and theory. $5\frac{1}{2}$

10. Describe with necessary theory the Fresnel type of diffraction due to a straight edge. $7\frac{1}{2}$
11. (a) What is polarization of light? Explain the terms (i) plane polarized light and (ii) circularly polarized light. $1+1+1=3$
- (b) Discuss the production of polarized light by double refraction. 3
- (c) Determine Brewster's angle for glass of refractive index 1.5 immersed in water of refractive index 1.33. $1\frac{1}{2}$
12. (a) What are absorption bands? 2
- (b) Discuss normal and anomalous dispersions. $2+2=4$
- (c) Explain why the sky is blue during the day. $1\frac{1}{2}$
13. (a) What is a Fourier series? State Dirichlet conditions for the expansion of a function in a Fourier series. $1+2=3$

- (b) A square wave is defined by

$$f(t) = A \text{ for } 0 < t \leq \frac{T}{2}$$

$$f(t) = -A \text{ for } \frac{T}{2} < t \leq T$$

Expand $f(t)$ in a Fourier series. $4\frac{1}{2}$

14. (a) Discuss the importance of Fourier analysis in acoustics. $2\frac{1}{2}$
- (b) What is a piezo-electric crystal? Explain briefly how such a crystal can be used for the generation of ultrasonic waves. $1+4=5$
15. (a) Discuss the principle of echo depth sounding. Mention its applications. $3+1=4$
- (b) Explain a decibel in sound intensity. $1\frac{1}{2}$
- (c) Define reverberation and reverberation time of an auditorium. $1+1=2$
16. (a) Deduce the Sabine formula for the reverberation time of a live room. 5
- (b) A Hall measuring $64 \times 40 \times 25 \text{ ft}^3$ has a reverberation time of 1.6 sec when it is empty. What will be its reverberation time when an audience of 250 persons is present. Assume that sound absorption by each person is 4 sabins. $2\frac{1}{2}$
