TDC (CBCS) Even Semester Exam., 2019

PHYSICS

(2nd Semester)

Course No. : PHYHCC–202T

(Waves and Optics)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *two* of the following questions : 1×2=2

(a) A wave of frequency 400 Hz is travelling with a velocity 800 m/sec. How far are two points situated whose displacement differs in phase by $\pi/4$?

(b) Show that $y = x^2 + c^2t^2$ is a solution of one-dimensional wave equation.

(c) Distinguish between ripples and gravity waves.

2. Answer *either* [*(a)* and *(b)*] *or* [*(c)* and *(d)*] :

(a) If a wave of frequency 500 Hz is travelling with a velocity of 200 ms^{-1}, then find the change in phase at a given point in space between a time interval of 10^{-3} sec. Also find the path difference between two points which differ in phase by $\pi/2$ radian. 4

(b) Prove that wave equation for a transverse wave in a string is given by

$$\frac{\delta^2 y}{\delta x^2} = \frac{1}{c^2}\frac{\delta^2 y}{\delta t^2}$$

where $c = \sqrt{\frac{T}{\rho}}$, T being tension and ρ the linear density of the string. 4

(c) What are beats? Show that the number of beats produced per sec is equal to the difference in the frequencies of the two sounding bodies. 4

(d) What are Lissajous figures? How will you trace graphically the Lissajous figures when time periods are equal and phase difference is $\pi/4$? 4

UNIT—II

3. Answer any *two* of the following questions : 1×2=2

(a) Find the temperature at which the velocity of sound in air becomes 1·5 times its value at 0 °C.

(b) What do you understand by phase velocity and group velocity?

(c) Show that the frequency of the fundamental note of an open organ pipe is twice that from a closed pipe of the same length.

4. Answer *either* [*(a)* and *(b)*] *or* [*(c)* and *(d)*] :

(a) Starting from the relation $v = \sqrt{\frac{E}{\rho}}$ for velocity of sound in a gas, show that $v = \sqrt{\frac{\gamma P}{\rho}}$, where P is the pressure and γ is the ratio of specific heat at constant pressure to specific heat at constant volume. 4

(b) Obtain the expression for phase velocity and group velocity in terms of angular frequency and propagation number. 4

(c) Calculate the energy of the S-th vibration of a stretched string plucked at h, the initial displacement of the plucked point being k. 4

(d) Describe Melde's experiment and explain how laws of vibration of strings can be verified with this experiment. 4

UNIT—III

5. Answer any *two* of the following questions : 1×2=2

(a) What are coherent sources? How are they realized in practice?

(b) Why is a broad source of light necessary for observing colours in thin films?

(c) What are temporal and spatial coherences?

6. Answer *either* [(a) and (b)] *or* [(c) and (d)] :

(a) Discuss in detail how the wavelength of monochromatic source of light can be determined with the help of Fresnel's biprism. 4

(b) How does interference take place in a thin film? Show that the reflected and the transmitted interference patterns are complimentary. 4

(c) Prove that the diameter of bright rings are proportional to the square root of odd simple numbers and that of dark rings are proportional to the square root of simple numbers in case of Newton's rings. 4

(d) Newton's rings are observed in reflected light of wavelength $5 \cdot 9 \times 10^{-7}$ m. The diameter of 10th dark ring is 0·5 cm. Find the radius of curvature of the lens and thickness of the air film. 4

UNIT—IV

7. Answer any *two* of the following questions : 1×2=2

(a) In Michelson's interferometer 100 fringes cross the field of view when the movable mirror is displaced through 0·02948 mm. Calculate the wavelength of monochromatic light used.

(b) Discuss the statement "A grating having higher dispersive power than another, does not necessarily has a higher resolving power".

(c) State the difference between the grating and the prism spectrum.

8. Answer *either* [(a) and (b)] *or* [(c) and (d)] :

(a) Discuss the intensity distribution of Fabry-Perot interferometer fringes and the ratio of I_{max} to I_{min}. 4

(b) Find the expression for the width of the central maximum in case of Fraunhofer diffraction pattern due to single slit. 4

(c) What is a plane diffraction grating? In a plane transmission grating the angle of diffraction for 2nd order maxima for wavelength 5×10^{-5} cm is 30°. Calculate the number of lines in 1 cm of the grating surface. 1+3=4

(d) Derive an expression for the resolving power of a plane transmission grating. 4

UNIT—V

9. Answer any *two* of the following questions : 1×2=2

(a) Explain clearly the difference between interference and diffraction.

(b) What is the difference between holography and photography?

(c) What is the radius of 1st zone of a zone plate of focal length 0·2 m for a light of wavelength 5000 Å?

10. Answer *either* [*(a)* and *(b)*] *or* [*(c)* and *(d)*] :

(a) Distinguish between Fresnel and Fraunhofer type of diffraction. 4

(b) Discuss the phenomenon of diffraction at a straight edge and state how you would determine the wavelength of light from the study of the fringes. 4

(c) What is the meaning of half period zones? Why are they called so? How are they constructed? 4

(d) What is the fundamental principle of hologram? How is it produced and how is the image reconstructed from it? 4

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