B.Sc. 2nd Semester (Honours) Examination, 2020-21

PHYSICS

Course ID: 22412 **Course Code: SH/PHS/202/C-4**

Course Title: Waves and Optics (T4)

Time: 1 Hour 15 Minutes **Full Marks: 25**

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Section-I

1. Answer any ***five*** questions: 1×5=5

a. In what respect does holography differ from ordinary photography?
b. What is the radius of the first zone in a plate of principal focal length 20 cm for light of wavelength 500 nm?
c. What happens to the interference pattern when the entire arrangement of double slit experiment is dipped in water?
d. Calculate the coherence length of yellow light with 590 nm in 10^{-12} second.
e. What is the physical significance of the quality factor Q of a forced oscillator?
f. What do you mean by group velocity of a wave group?
g. Why a grating spectrum is called a normal spectrum?
h. What happens in the diffraction pattern in single slit experiment when the slit width is gradually increased?

Section-II

1. Answer any ***two*** questions: 5×2=10

a) i) Show that, in the steady state of a forced oscillator, the time-averaged input power equals the time-averaged power dissipated through damping**.**

ii) The kinetic energy of a particle executing simple harmonic oscillation is suddenly increased to $(1+\gamma^2)$ times of its initial value. Then show that the amplitude of oscillation is increased to $\left[1+\left(\gamma v/A\omega\right)^2\right]^{1/2}$ times of its original value A, where ω and v represent the angular frequency and velocity of that particle respectively. 3+2

P.T.O.

b) i) *"A grating having a higher dispersive power than another does not necessarily bear a higher resolving power*": Comment on it.

ii) An observatory telescope has an objective of diameter 2.54 m. Assuming the mean wavelength of light to be 5.5 x 10^{-7} cm, estimate the smallest angular separation of two stars that can be resolved by it. 3+2

c) i) Explain how localized fringes can be obtained in a Michelson's interferometer.

ii) Why an extended source of light is necessary for observing colours in thin films? 3+ 2

d) i) Find the Lissajous figures formed by the superposition of two simple harmonic vibrations at right angles when their periods are in the ratio 2:1 and there is a phase difference of 0 or $\pi/2$.

ii) The displacement of a particle performing periodic motion is given by$y = 4\cos^2(t/2)\sin 100t$.Show that this motion may be considered to be the result of superposition of three independent harmonic motions. 3+2

Section-III

3. Answer any ***one*** question: 10×1=10

a) i) A uniform string of length *l* is stretched between its fixed ends x = 0 and x = *l*. Find an expression for the transverse displacement y(x, t) of the string when it is struck at the centre so that the velocity varies linearly from 0 at the ends to v_0 at the centre.

ii) Determine the possible harmonics in the longitudinal vibration of a rod clamped in the middle.

iii) Establish the condition for missing order spectra in double slit diffraction pattern.

4+3+3

b) i) Explain how the refractive index of a liquid can be determined with the help of Newton's ring. What happens in Newton's ring experiment if the glass plate is replaced by a plane mirror?

ii) A plane transmission grating (say grating 1) has 2000 rulings in 4 cm and another (say grating 2) has 1000 rulings in 2 cm. Hence, compare the resolving power of two gratings.

iii) In a Lloyd's mirror experiment, find out the visibility of the fringes if the mirror reflects only 80% of the light incident on it. 4+4+2