(a) Name of the department : Department of Physics and Astrophysics

(b) Name of the course : B.Sc. Hons. (Physics)– CBCS (Old course)

(c) Semester : II – Semester

(d) Name of the paper : Waves and Optics

(e) Unique paper code : 32221202_OC

(f) Question paper set no. : 2

Maximum Marks : 75 Time : 3 hours

Attempt any **four** questions. All questions carry equal marks.

1(a). State the principle of superposition and prove that it holds only for linear differential equations.

(b). Two collinear simple harmonic motions acting simultaneously on a particle are given by :

$X_1 = A \cos \omega t$

$X_2 = A \cos (\omega t + \phi)$

Show that the motion of the particle is simple harmonic. Also obtain the expression for amplitude and phase constant of the resultant motion in terms of A_1, A_2 and ϕ.

(10 + 8.75)

2(a). What are beats? Give an analytical description and theory of formation of beats. Obtain expression for the beat frequency.

(b). What are progressive and stationary or standing waves? How stationary waves are formed? Give mathematical analysis to find the positions of nodes and antinodes.

Write characteristic properties of stationary waves.

(10+8.75)

3(a). Obtain an expression for the fringe width in Young's double slit interference experiment.

(b). What do you mean by coherence? Illustrate temporal and spatial coherence.

Compute the coherence length of yellow light with $5893A^0$ in 10^{-12} second pulse duration. Also find the bandwidth.

(10+8.75)

4(a). Describe the construction and working of Michelson's interferometer. How would you use it to measure the wavelength of a given line in the spectrum?

(b). What is the role of compensating plate in Michelson interferometer? Under what conditions would you observe the fringes in Michelson's interferometer with white light?

A thin film of plastic of refractive index 1.45 for light of wavelength 5890 Å is inserted normally in the path of one of the interfering beams. The central bright band shifts through 5 fringes. Find the thickness of the film.

(10+8.75)

5(a). Discuss the theory of Fresnel's diffraction at straight edge. Illustrate the physical appearance of the intensity distribution curve due to a straight edge.

(b). Distinguish between Fresnel class and Fraunhofer class of diffraction.

Find the radii of the first three transparent zones of a zone plate whose first focal length is 1 m for monochromatic light of wavelength 5893 Å.

(10 + 8.75)

6(a). What do you mean by the resolving power of an optical instrument? State Rayleigh's criterion for resolution and apply it to deduce an expression for the resolving power of a plane transmission grating.

(b). Obtain a relation between the resolving power and dispersive power of a grating.

Find the separation of two points on the moon that can be resolved by a telescope of aperture diameter 5 m. The distance of moon is 3.8×10^5 km. The eye is most sensitive to wavelength 5500 Å .

(10 + 8.75)