1. Attempt all of the following : (5×3=15)

(a) What are coherent sources? What are the methods to obtain coherent sources?

(b) State and explain Stokes' treatment of phase change on reflection.

(c) Give three advantages of electron microscopy over optical microscopy.

(d) What is the radius of the first half period zone in a zone plate behaving like a convex lens of focal length 50 cm for a light of wavelength 5000 Å?

(e) The threshold frequency for photoelectric emission in a certain metal is 1.4×10^{15} Hz. Find the maximum energy of the photoelectrons when light of frequency 2×10^{15} Hz is incident on the metal surface.

2. (a) What do you understand by wave-particle duality? Explain a fundamental experiment used to explain the wave nature of a particle. (10)

(b) A light beam of wavelength 4000 Å falls on a metallic surface used in an experiment to study the photoelectric effect. If the stopping voltage is 1.5 V, calculate :

(i) the work function of the surface.

(ii) the maximum wavelength of light that will cause photoelectric emission. (5)

3. (a) What are the conditions for obtaining sustained interference? Find the conditions for bright and dark fringes formed due to interference. Graphically show and explain the intensity distribution of the interference pattern. (10)

(b) Newton's rings formed by a monochromatic light between a flat glass plate and a convex lens are viewed normally. Calculate the order of the dark ring which will have double the diameter of that of the 40th dark ring. (5)

4. (a) Explain the theory of Fresnel's half-period zone. Discuss the Fresnel's diffraction at a straight edge with the help of half-period zones. (10)

(b) Monochromatic light of wavelength 7.14×10^{-5} cm falls normally on a grating consisting of parallel wires equidistant from one another. The first-order spectrum is observed at 30° from the zero position. Find the value of the grating constant. (5)

5. (a) What is a plane diffraction grating? Show that the resolving power of a grating is proportional to the number of opaque rulings per metre. (10)

(b) Calculate the number of lines that a grating must have to resolve D1 & D2 lines of sodium in second order, given $\lambda 1 = 5890$ Å and $\lambda 2 = 5896$ Å.

(5)