1. Attempt any five questions. $5 \times 3 = 15$

(i) What is Compton effect? Write the expression for the Compton wavelength of scattering particle.

(ii) What are the conditions for observing sustained interference pattern?

- (iii) Distinguish between Haidinger and Fizeau fringes. What kind of fringes are seen in a Newton's rings setup?

(iv) An exceedingly thin film appears to be perfectly black when seen by reflected light. Why?

(v) Distinguish between Fresnel and Fraunhoffer class of diffraction. The diffraction of star light in a telescope is an example of what kind of diffraction?

(vi) Compare the double slit diffraction pattern observed in reality with the theory of Young's double slit experiment in terms of slit width and slit spacing.

2. (a) What is Photoelectric Effect? What are the observations that cannot be explained by the wave theory of light? How did Einstein explain photoelectric effect?

(b) Show that the group velocity of De-Broglie waves associated with a moving particle is equal to the particle velocity.

(c) Ultraviolet light of wavelength 3000 Å is falling on a surface whose work function is 2.28 eV. What is the maximum possible speed of the emitted electrons in m/s?

$$5+5+5=15$$

3. (a) Derive an expression for the diameter of the nth bright ring in Newton's rings apparatus.

(b) Explain how the refractive index of a liquid can be determined by Newton's rings method.

(c) In a Newton's rings experiment, the diameter of 15th ring was found to be 0.59 cm and that of the 5th ring was 0.336 cm. If the radius of plano-convex lens is 100 cm, calculate the wavelength of the light used.   6+4+5=15

4. (a) Derive an expression for the focal length of a zone plate.

(b) Explain multiple focii of a zone plate.

(c) The diameter of the first ring of a zone plate is 1.2 mm. If a plane wave of wavelength 6000Å is incident on the plate normally, where should the screen be placed so that the light is focused to the brightest point?

          8+4+3=15

5. (a) Derive the intensity distribution formula for Fraunhoffer diffraction by a grating of N slits given below.

$$I = I_0 \frac{sin^2\alpha}{\alpha^2} \frac{sin^2(N\gamma)}{sin^2\gamma} \qquad \frac{\pi a \; sin\theta}{\lambda} = \alpha \qquad \frac{\pi d \; sin\theta}{\lambda} = \gamma$$

Here the grating element d=a+b and other symbols have their usual meaning.

(b) How many orders will be visible if the light of wavelength 5000 Å is normally incident on a grating having 2620 lines per inch. (1 inch = 2.54 cm).

(c) Discuss the concept of missing orders. What orders will be missing if b = a.

          7+3+5=15