

CITY COLLEGE  
Internal Examination 2020  
Physics (Hons.) CBCS Semester-II  
Paper: CC-4: Waves & Optics  
Time: 2 Hours; Full Marks: 50

Group A

1. Answer any five questions from the following: 5x2=10
- What are the uses of Lissajous figures?
  - What are phase velocity and group velocity?
  - What do you mean by forced vibration?
  - Name two basic methods to produce coherent sources in practice with at least one example of each.
  - Calculate the fringe width of interference pattern produced in Young's double slit experiment with slits  $10^{-3}$  m apart on a screen 1m away. Wavelength of light is  $5893\text{\AA}$ .
  - In Fresnel's Bi-prism arrangement, the base angles of the Bi-prism are kept small - Why?

Group B

- Answer any five questions from the following: 5x5=25
- Two mutually perpendicular oscillations are  $X(t) = A_1 \sin \omega_1 t$  and  $Y(t) = A_2 \sin (\omega_2 t + \varphi)$ . If  $\omega_2 = 2\omega_1$ , sketch the Lissajous figures for the motion when –  
(i)  $\varphi = \pi$ , (ii)  $\varphi = \pi/2$ .
    - A progressive harmonic wave is represented by  $y(x, t) = a \sin (0.5 x - 10 t)$ , where  $x$  is in meters and  $t$  is in seconds. Obtain the wave velocity. (2+2)+1
  - Write down the equation of motion of a damped harmonic oscillator and mention each term of this equation.
    - What is critical damping? 3+2
  - What are plane and spherical waves?
    - Set up the differential equation of a plane progressive wave. 2+3
  - Derive an expression for the fringe width in Young's experiment in terms of wavelength, separation between two holes and the distance of the screen from the holes.
    - A parallel beam of light of wavelength  $589\text{nm}$  is incident on a thin plate of glass of refractive index 1.5 such that the angle of refraction inside the plate is  $60^\circ$ . Calculate the smallest thickness of the plate for which it appears dark by reflection. 3+2
  - What is a Zone plate? What is positive Zone plate.
    - The diameter of the first ring of a zone plate is 1mm. If plane waves of wavelength  $5000\text{\AA}$  fall on the plate, where should the screen be placed so that light is focussed to the brightest spot? (2+1)+2
  - What is missing order in a double slit diffraction pattern? Identify the orders of the interference maxima which are absent when  $b=2a$ , where  $a$  is the slit width and  $b$  is the width of the opaque space in between the two slits.
    - How many orders would be visible if the wavelength of incident light is  $5890\text{\AA}$  and the number of lines in the grating is 200/mm. (1+2)+2

Group C

Answer any five questions from the following:

5x3=15

8. a) Write down the theory to determine the wavelength of a monochromatic light with Fresnel's Bi-prism, eliminating index error of the apparatus.  
b) What is the nature of the Bi-prism fringes in space? 2+1
  
9. a) How the distance between the two virtual sources in Bi-prism experiment can be determined?  
b) In Bi-prism experiment, what will happen to the fringes when the distance between the slit and the Bi-prism is increased? 2+1
  
10. Write down the expression for the diameter of  $m^{\text{th}}$  order dark ring in Newton's ring experiment. Hence show that the rings gradually become narrower as their diameters increase. 1+2
  
11. Explain with necessary theory how you can determine the wavelength of a monochromatic light using Newton's ring. 3
  
12. How the thickness of a thin paper can be determined by measuring the width of the interference fringes produced by a wedge shaped film. 3
  
13. a) Sketch the intensity distribution in the diffraction pattern at a single slit.  
b) What do you mean by grating element? 2+1

-----

Answer scripts must be emailed to [sem2hcityphysics@gmail.com](mailto:sem2hcityphysics@gmail.com) within 15 minutes of the end of the examination.