2020-21

Time - 3 hours
Full Marks – 60

*Answer **all groups** as per instructions.*
Figures in the right hand margin indicate marks.
Candidates are required to answer
in their own words as far as practicable.

Group-A

1. Answer all questions. [1x8]
   a) In what type of eyepiece, the condition of achromatism and minimum spherical aberration are completely satisfied?
   b) Name the axial points having unit positive linear magnification in a lens system.
   c) How much path difference is suffered by a ray on reflection from a denser medium?
   d) What is the life period of any radioactive substance?
   e) Does density of a nucleus depend on its mass number?
   f) How radius of a particular orbit of electron varies with order of orbit?
   g) How does the relativistic mass vary with a variation in velocity of body?
   h) Which series of hydrogen spectrum lies in ultraviolet region?

Group-B

2. Answer any eight of the following questions within two or three sentences each. [$1\frac{1}{2}$x8]
   a) What is the cause of chromatic aberration?
   b) Why the space between primary rainbow and secondary rainbow is comparatively dark?

c) What do you mean by coherent sources?

d) Discuss the statement "Interference is in accordance with the law of conservation of energy.

e) Define plane of vibration and plane of polarisation. What is the angle between the two?

f) State the postulates of special theory of relativity.

g) How can you show that velocity of light is the greatest possible velocity for a material body?

h) Find the energy released, when an electron of H-atom jumps from 3rd orbit to 2nd orbit.

i) What are the conditions that a wave function must obey?

j) Discuss the characteristics of nuclear force.

GROUP-C

3. Write notes on any eight of the followings within 75 words: [2x8]

a) Distinguish between Ramsden's eyepiece and Huygen's eyepiece.

b) The focal length of an achromatic combination of two lenses separated by a distance is 0.05 m. If focal length of one lens is 0.03 m, find focal length of other lens.

c) Light from a narrow slit passes through two parallel slits 0.4 mm apart and fringes when measured at a distance 0.4 m from the slit are 0.5 mm apart. Find the wavelength of light.

d) State and explain Brewster's law.

e) Calculate the velocity at which mass of the particle becomes 8 times of its rest mass.

f) Prove that

$$P^2 - \frac{E^2}{C^2} = M_0 C^2$$

Where the symbols have their usual meaning.

g) Calculate the de-Broglie wavelength of an electron of energy 10^4 eV.

h) Normalise the wave function

$\psi(x) = Ae^{ikx}$ for $-a \leq x \leq a$

$= 0$ elsewhere.

i) Derive an expression for expectation value of position.

j) If half life period of a radioactive substance = 20 days, after how many days 3.125% atoms are left?

GROUP- D

4. Answer any four questions within 500 words each. [6x4]

a) Give the construction, theory and uses of a Ramsden's eyepiece.

b) Describe Young's experiment for demonstration of interference of light. Find an expression for fringe width.

c) What is Compton effect? Obtain an expression for the change in wavelength of incident light due to scattering of photons from electrons.

d) Describe Davisson and Germer experiment for the establishment of concept of matter wave.

e) Obtain expressions for energy levels and normalised wave function for a particle in a box.

f) Derive time independent Schrodinger wave equation and predict its solutions.

g) Establish Lorentz transformation equations and discuss their significances.

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