SAMPLE QUESTION PAPER

BLUE PRINT

Time : 2 Hours | **Max. Marks :** 35

S. No.		Chapter	Section-A (2 marks)	Section-B (3 marks)	Section-C (5 marks)	Total
8.	Unit-V	Electromagnetic Waves	–	1(3)	–	5(17)
9.	Unit-VI	Ray Optics and Optical Instruments	–	2(6)#	–	
10.		Wave Optics	–	1(3)#	1(5)	
11.	Unit-VII	Dual Nature of Radiation and Matter	–	1(3)	–	4(11)
12.	Unit-VIII	Atoms	1(2)	1(3)	–	
13.		Nuclei	–	1(3)	–	
14.	Unit-IX	Semiconductor Electronics : Materials, Devices and Simple Circuits	2(4)#	1(3)	–	3(7)
		Total Questions	**3(6)**	**8(24)**	**1(5)**	**12(35)**

*It is a choice based questions

#Out of the two or more questions only one question is choice based.

General Instructions :

(i) *There are 12 questions in all. All questions are compulsory.*

(ii) *This question paper has three sections: Section A, Section B and Section C.*

(iii) *Section A contains three questions of two marks each, Section B contains eight questions of three marks each, Section C contains one case study-based question of five marks.*

(iv) *There is no overall choice. However, an internal choice has been provided in one question of two marks and two questions of three marks. You have to attempt only one of the choices in such questions.*

(v) *You may use log tables if necessary but use of calculator is not allowed.*

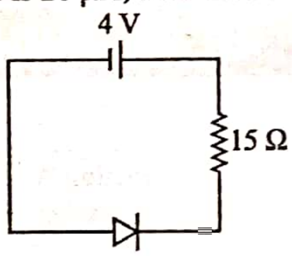
SECTION - A

1. Using Rutherford's model of the atom, derive the expression for the total energy of the electron in hydrogen atom. What is the significance of total negative energy possessed by the electron?

2. How does a light emitting diode (LED) work? Give two advantages of LED's over the conventional incandescent lamps.

OR

In the circuit shown if current for the diode is 20 μA, then find the potential difference across the diode.



3. (a) Distinguish between n-type and p-type semiconductors on the basis of energy band diagrams.

   (b) Compare their conductivities at absolute zero temperature and at room temperature.

SECTION - B

4. The rms value of the electric field of the light coming from the sun is 720 N C^{-1}. Then what is the average total energy density of the electromagnetic wave?

5. What will be the ratio of the energy released by 4 kg of hydrogen at sun by fusion process to 23.5 kg of ^{235}U in the nuclear reactor by fission process? (Assume energy released per fusion is 26 MeV and that per fission is 200 MeV)

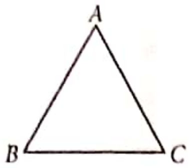
6. What is the conductivity of a semiconductor sample having electron concentration of 5×10^{18} m^{-3}, hole concentration of 5×10^{19} m^{-3}, electron mobility of 2.0 m^2 V^{-1} s^{-1} and hole mobility of 0.01 m^2 V^{-1} s^{-1}? (Take charge of electron as 1.6×10^{-19} C)

7. (a) Define the term 'critical angle' for a pair of media.

   (b) A point source of monochromatic light 'S' is kept at the centre of the bottom of a cylinder of radius

15.0 cm. The cylinder contains water (refractive index 4/3) to a height of 7.0 cm. Draw the ray diagram and calculate the area of water surface through which the light emerges in air.

8. (a) A ray of light incident on face AB of an equilateral glass prism, shows minimum deviation of 30°. Calculate the speed of light through the prism.



(b) Find the angle of incidence at face AB so that the emergent ray grazes along the face AC.

OR

A convex lens of focal length 20 cm is placed coaxially with a convex mirror of radius of curvature 20 cm. The two are kept 15 cm apart. A point object is placed 40 cm in front of the convex lens. Find the position of the image formed by this combination. Draw the ray diagram showing the image formation.

9. The photoelectric threshold for a certain metal is 3600 Å. Calculate the maximum energy of the ejected photoelectrons by a radiation of 2000 Å. (Given $h = 6.62 \times 10^{-34}$ J s)

10. Calculate the highest frequency of the emitted photon in the Paschen series of spectral lines of the Hydrogen atom.

11. Explain the following, giving reasons:

(a) When monochromatic light is incident on a surface separating two media, the reflected and refracted light both have the same frequency as the incident frequency.

(b) When light travels from a rarer to a denser medium, the speed decreases. Does this decrease in speed imply a reduction in the energy carried by the wave ?

(c) In the wave picture of light, intensity of light is determined by the square of the amplitude of the wave. What determines the intensity in the photon picture of light?

OR

(a) Why are coherent sources necessary to produce a sustained interference pattern?

(b) In Young's double slit experiment using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ, is K units. Find out the intensity of light at a point where path difference is $\lambda/3$.

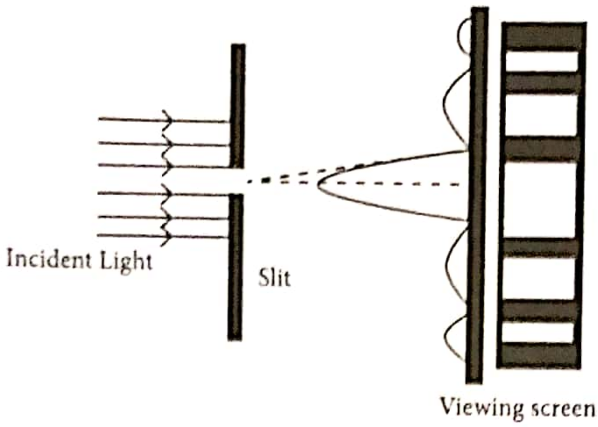
SECTION - C

12. CASE STUDY : DIFFRACTION DUE TO A SINGLE SLIT (FRAUNHOFER)

When light from a monochromatic source is incident on a single narrow slit, it gets diffracted and a pattern of alternate bright and dark fringes is obtained on screen, called "Diffraction Pattern" of single slit. In diffraction pattern of single slit, it is found that

(I) Central bright fringe is of maximum intensity and the intensity of any secondary bright fringe decreases with increase in its order.

(II) Central bright fringe is twice as wide as any other secondary bright or dark fringe.



(i) A single slit of width 0.1 mm is illuminated by a parallel beam of light of wavelength 6000 Å and diffraction bands are observed on a screen 0.5 m from the slit. The distance of the third dark band from the central bright band is

(a) 3 mm (b) 1.5 mm (c) 9 mm (d) 4.5 mm

(ii) In Fraunhofer diffraction pattern, slit width is 0.2 mm and screen is at 2 m away from the lens. If wavelength of light used is 5000 Å then the distance between the first minimum on either side the central maximum is

(a) 10^{-1} m (b) 10^{-2} m (c) 2×10^{-2} m (d) 2×10^{-1} m

(iii) Light of wavelength 600 nm is incident normally on a slit of width 0.2 mm. The angular width of central maxima in the diffraction pattern is (measured from minimum to minimum)

(a) 6×10^{-3} rad (b) 4×10^{-3} rad (c) 2.4×10^{-3} rad (d) 4.5×10^{-3} rad

(iv) A diffraction pattern is obtained by using a beam of red light. What will happen, if the red light is replaced by the blue light?

(a) Bands disappear.
(b) Bands become broader and farther apart.
(c) No change will take place.
(d) Diffraction bands become narrower and crowded together.

(v) To observe diffraction, the size of the obstacle

(a) should be $\lambda/2$, where λ is the wavelength. (b) should be of the order of wavelength.
(c) has no relation to wavelength. (d) should be much larger than the wavelength.