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)	–	6(17)
9.	Unit-VI	Ray Optics and Optical Instruments	–	2(6)#	–	
10.		Wave Optics	1(2)#	2(6)	–	
11.	Unit-VII	Dual Nature of Radiation and Matter	–	1(3)*	–	3(11)
12.	Unit-VIII	Atoms	–	–	1(5)	
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.

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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.

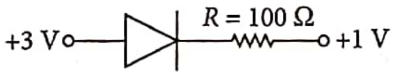
(iii) Section A contains three questions of two marks each, Section B contains eight questions of three marks each, Section C contains one case study-based question of five marks.

(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. Assuming that the junction diode is ideal, find the current in the arrangement shown in figure.



2. The refractive index of the material of an equilateral prism is 1.6. Find the angle of minimum deviation due to the prism.

OR

A parallel beam of light of 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 m away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of the screen. Calculate the width of the slit.

3. An intrinsic semiconductor has a resistivity of $0.50\ \Omega$ m at room temperature. Find the intrinsic carrier concentration if the mobilities of electrons and holes are 0.39 m^2/volt sec and 0.11 m^2/volt sec respectively.

SECTION - B

4. Two monochromatic waves emanating from two coherent sources have the displacements represented by $y_1 = a \cos \omega t$ and $y_2 = a \cos (\omega t + \phi)$ where ϕ is the phase difference between the two displacements. Show that the resultant intensity at a point due to their superposition is given by $I = 4 I_0 \cos^2 \phi/2$, where $I_0 = a^2$.

5. Name the parts of the electromagnetic spectrum which is

(a) suitable for radar systems used in aircraft navigation.

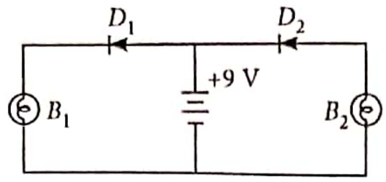
(b) used to treat muscular strain.

(c) used as a diagnostic tool in medicine.

Write in brief, how these waves can be produced.

6. A small bulb (assumed to be a point source) is placed at the bottom of a tank containing water to a depth of 80 cm. Find out the area of the surface of water through which light from the bulb can emerge. Take the value of the refractive index of water to be 4/3.

7. (a) In the following diagram, which bulb out of B_1 and B_2 will glow and why?



(b) Explain briefly the three processes due to which generation of emf takes place in a solar cell.

8. Use this equation to explain the concept of (i) threshold frequency and (ii) stopping potential.

OR

The kinetic energy of a given electron is five times more than a certain proton. How much the de-Broglie's wavelength of electron is bigger than the corresponding wavelength of the proton. (Assume that both particles are non-relativistic and $m_p = 2000\ m_e$)

9. When four hydrogen nuclei combine to form a helium nucleus estimate the amount of energy in MeV released in this process of fusion (Neglect the masses of electrons and neutrons). Given:

(i) Mass of ${}^1_1\text{H} = 1.007825$ u

(ii) Mass of helium nucleus = 4.002603 u, 1u = 931 MeV/c^2

10. When the frequency of the light used is changed from $4 \times 10^{14}\ s^{-1}$ to $5 \times 10^{14}\ s^{-1}$, the angular width of the principal (central) maximum in a single slit Fraunhoffer diffraction pattern changes by 0.6 radian. What is the width of the slit (assume that the experiment is performed in vacuum)?

11. Draw a ray diagram to show the formation of the image of an object placed on the axis of a convex refracting surface of radius of curvature 'R', separating the two media of refractive indices 'n_1' and 'n_2' ($n_2 > n_1$). Use this diagram to deduce the relation $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$, where u and v represent respectively the distance of the object and the image formed.

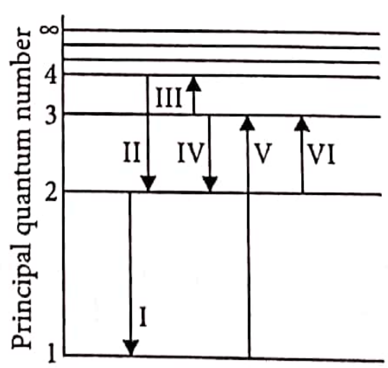
OR

An object is placed 30 cm in front of a plano-convex lens with its spherical surface of radius of curvature 20 cm. If the refractive index of the material of the lens is 1.5, find the position and nature of the image formed.

SECTION - C

12. **CASE STUDY : ELECTRON TRANSITIONS FOR THE HYDROGEN ATOM**

Bohr's model explains the spectral lines of hydrogen atomic emission spectrum. While the electron of the atom remains in the ground state, its energy is unchanged. When the atom absorbs one or more quanta of energy, the electrons moves from the ground state orbit to an excited state orbit that is further away.



The given figure shows an energy level diagram of the hydrogen atom. Several transitions are marked as I, II, III and so on. The diagram is only indicative and not to scale.

(i) In which transition is a Balmer series photon absorbed?
(a) II (b) III (c) IV (d) VI

(ii) The wavelength of the radiation involved in transition II is
(a) 291 nm (b) 364 nm (c) 487 nm (d) 652 nm

(iii) Which transition will occur when a hydrogen atom is irradiated with radiation of wavelength 103 nm?
(a) I (b) II (c) IV (d) V

(iv) The electron in a hydrogen atom makes a transition from $n = n_1$ to $n = n_2$ state. The time period of the electron in the initial state is eight times that in the final state. The possible values of n_1 and n_2 are
(a) $n_1 = 4, n_2 = 2$ (b) $n_1 = 8, n_2 = 2$ (c) $n_1 = 8, n_2 = 3$ (d) $n_1 = 6, n_2 = 2$

(v) The Balmer series for the H-atom can be observed
(a) if we measure the frequencies of light emitted when an excited atom falls to the ground state
(b) if we measure the frequencies of light emitted due to transitions between excited states and the first excited state
(c) in any transition in a H-atom
(d) none of these.