## PART I (40 marks)
*Answer **all** questions.*

**Question 1.**

*(a)*   *For each question, there are four alternatives A, B, C and D.  Choose the correct alternative and circle it. Do not circle more than ONE alternative. If there are more than one choice circled, NO score will be awarded.*   **[10]**

(i)   A hole in a p-type semiconductor is
   A   an excess electron.
   B   a missing electron.
   C   a missing atom.
   D   a donor level.

(ii)   If the decay constant of a radioactive element radium is $4.28 \times 10^{-4}$ year$^{-1}$, its half- life will be
   A   2336.4 years.
   B   2000.4 years.
   C   1619.4 years.
   D   1240.4 years.

(iii)   If 'B' and 'H' are magnetic induction and magnetic field respectively, then
   A   $H = \dfrac{B}{\mu}$.

   B   $B = \dfrac{\mu}{H}$.

   C   $H = \dfrac{\mu}{B}$.

   D   $B = \dfrac{H}{\mu}$.

(iv)   When two lenses having powers +6D and -4D are placed in contact, the power of combination will be
   A   +4D.
   B   -4D.
   C   +2D.
   D   -2D.

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(v)     When a positive charge is taken from a lower potential point to a
        higher potential point in an electric field, then the
        A       work will be done by the field.
        B       intensity of the field will decrease.
        C       energy of the system will increase.
        D       energy of the system will decrease.

(vi)    The thermo emf of a thermocouple
        A       depends upon the temperature of cold junction and hot junction.
        B       is independent of the nature of the pair of metals used.
        C       depends upon the temperature of cold junction alone.
        D       depends upon the temperature of hot junction alone.

(vii)   Green light causes emission of photoelectrons from a metal surface
        but not yellow light because the
        A       frequency of green light is lesser than yellow light.
        B       frequency of green light is greater than yellow light.
        C       wave length of green light is equal to yellow light.
        D       wave length of green light is longer than yellow light.

(viii)  When a 100 mH coil carries a current of 1A, the energy stored in
        the form of magnetic field will be
        A       0.05J.
        B       0.5J.
        C       0.1J.
        D       1J.

(ix)    When Brewster's angle for air-glass interface is 56°, the angle
        of refraction in the glass will be
        A       56°.
        B       34°.
        C       28°.
        D       17°.

(x)     Which of the following graphs represents the variation of current
        with time when an L-R circuit is switched on at t = 0?
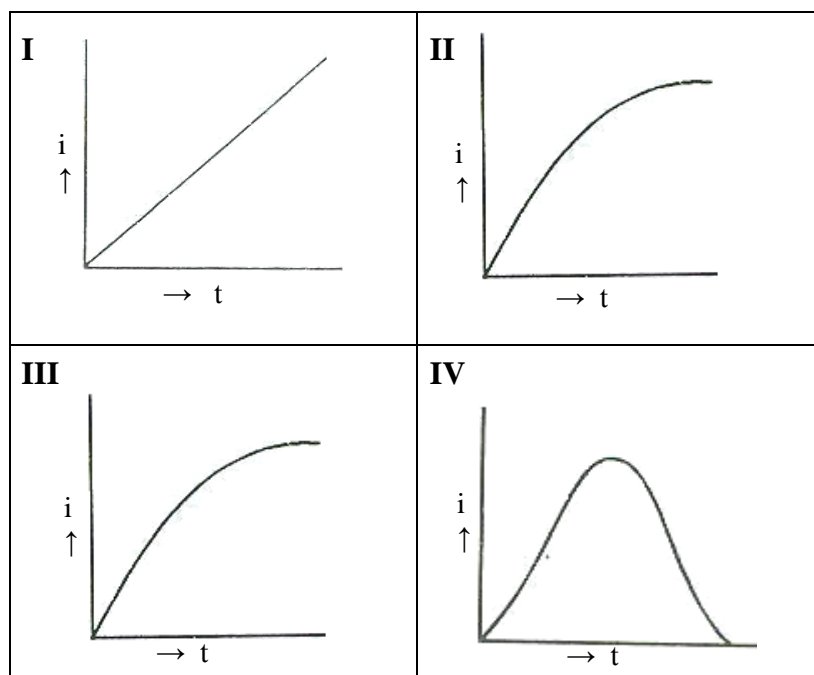


A       I
B       II
C       III
D       IV

*(b)*     ***Choose the correct word/s given in the brackets and write them in the space provided.*** **[6]**
(i)     The phenomenon of bending of light is called …………………….and it
        produces fringes of ……………………. intensity.
        (*interference/diffraction/decreasing/same*)
(ii)    The emission spectrum of hydrogen consists of ……………………. series
        and in ……………………. series electrons jump from higher state to
        n = 2 state. (*four/five/Balmer/Paschen*)
(iii)   The angle subtended by the ……………………. of a spherical surface at the
        centre of the sphere is called a solid angle and its maximum value is
        ……………………. steradian. (*volume/area/2π/4π*)
(iv)    Higher the average binding energy per …………………….., the stability of
        the nucleus …….………………. (*neutron/nucleon/increases/decreases*)
(v)     The amount of light radiated per second by the source in all directions is
        defined as ……………………. and its SI unit is ……………………..
        (*luminous intensity/luminous flux/lumen/candela*)

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(vi)    Deflection magnetometer is an application of ……………………. law and
        it is used to compare the magnetic ……………………..
        (*Coulomb's/tangent/force/moment*)


*(c)*    **Match the items in column A against the items in column B.  Rewrite the correct
        pairs by writing the number and the corresponding alphabet in the spaces provided.
        For example: (a) – xii.**                                                          **[4]**

| Column A | Column B |
|---|---|
| (a) α-particle | i. $\dfrac{C}{C_0}$ |
| (b) de Broglie wavelength | ii. radio therapy |
| (c) Dielectric constant | iii. A.B |
| (d) NOT | iv. heavy water |
| (e) AND | v. $m = \dfrac{hf}{c^2}$ |
| (f) Thomson | vi. helium |
| (g) Moderator | vii. inverter |
| (h) X-rays | viii. $\dfrac{e}{m} = \dfrac{v}{Br}$ |
|  | ix. hydrogen |
|  | x. A+B |
|  | xi. $\dfrac{h}{\sqrt{2mk}}$ |

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*(d)*     *Write True or False and give reasons for the false statements.*          **[4]**

   (i)     If the peak value is 1000A, the rms value of an alternating current
           is 70.7A.

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   (ii)    Radioactivity is a spontaneous process of integration of nucleus.

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   (iii)   The rate of emission of photoelectrons is directly proportional to the
           intensity of the incident light.

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   (iv)    For OR gate, output is 1 if, and only if all inputs are 1.

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*(e)*     *Answer the following questions.*
   (i)     Is it possible for the terminal potential difference across the cell
           to be zero?  Justify.                                                    **[2]**

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   (ii)    How are p-type semiconductors and n-type semiconductors
           produced?                                                               **[2]**

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(iii) How much energy will be created, if 2.0g of matter is destroyed completely? **[2]**

(iv) Even when the net charge in a current carrying conductor is zero, it experiences a force in a magnetic field. Why? **[2]**

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(v) (a) Explain the statement 'light added to light can produce darkness'. **[1]**

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(b)     Draw the intensity distribution pattern in diffraction.                **[1]**

(vi)    The converging lens of focal length 4cm is used as a simple microscope.

Calculate the magnifying power, if the distance of distinct vision is 25cm.     **[2]**

(vii)   Find the momentum of the photon of energy 3.0eV.                    **[2]**

(viii)  The phenomenon of X-ray production is also called 'inverse
        photoelectric effect'. Is it true? Justify.                        **[2]**

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## PART II
### SECTION A (28 marks)
*Answer any **four** questions.*

**Question 2.**

(a)     Define relaxation time of free electrons in metals.                **[1]**

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(b)     Compare Coulomb's law with Gauss' theorem in the table given below:     **[3]**

| Coulomb's Law | Gauss Theorem |
|---------------|---------------|
|               |               |

(c)     Derive Joule's law in terms of current and resistance in calories.     **[3]**

**Question 3.**

(a)     What is 'Curie temperature'?     **[1]**

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(b)    Explain how a potentiometer is used to measure the internal resistance of a cell.    **[3]**

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(c)     A circular coil having 10 turns and a mean radius of 8.0 cm carries a current
        of 2.0 A and is placed with its plane horizontal. The current appears clockwise
        as seen from a point vertically above the coil. Find the magnitude and direction
        of the magnetic field at the centre of the coil.                                    **[3]**

**Question 4.**

(a)     Derive an expression for the torque experienced by a magnetic dipole in
        a uniform magnetic field in terms of vectors.                                        **[3]**

(b)     Explain the principle and construction of an ac generator.                     **[2]**

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(c)     Why does the north pole of a magnetic needle incline downwards in the

northern hemisphere?                                                                **[2]**

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**Question 5.**

(a)     Describe the motion of charged particles in a uniform magnetic field when      **[2]**

(i)     $\vec{v}$ is perpendicular to $\vec{B}$ ,

(ii)    $\vec{v}$ is neither perpendicular nor parallel to $\vec{B}$ .

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(b)     Do electric lines of force intersect each other? Support your answer.          **[2]**

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(c)    Each plate in a parallel plate capacitor has an area of $2.83 \times 10^{-3}m^2$ separated by 0.05 cm of air. What is the capacitance of the capacitor? What would be the radius of a sphere having the same capacitance?    **[3]**

**Question 6.**

(a)   A galvanometer of resistance $50\Omega$ is connected to a battery of 3V along with a resistance of $2950\Omega$ in series. A full scale deflection of 30 divisions is obtained in the galvanometer. What should be the value of resistance in order to reduce this deflection to 20 divisions?                                                            **[3]**

(b)   Why are coils of a resistance box made of doubled up insulated wires?          **[2]**

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(c)     Write *two* advantages of a moving-coil galvanometer over a tangent galvanometer.     **[2]**

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**Question 7.**

(a)     Why do we apply a radial field in a moving-coil galvanometer?     **[2]**

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(b)     Show that the current leads the emf by a phase angle $\dfrac{\pi}{2}$ in an ac circuit

containing only capacitance.     **[3]**

(c) How is an electric field at a point related to potential gradient? **[1]**

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(d) What is the difference between the atoms of diamagnetic and paramagnetic materials? **[1]**

| Diamagnetic | Paramagnetic |
|---|---|
|  |  |

## SECTION B (18 marks)
*Answer any **three** questions.*

**Question 8.**

(a) Name the ***four*** main parts of a spectrometer. **[2]**

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(b) Give ***one*** use for each of the following. **[2]**

(i) Microwaves

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(ii) Ultraviolet radiations

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(iii) Gamma rays

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(iv) Infrared radiations

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(c) A lamp has a luminous intensity of 75 candelas. Calculate its luminous flux. **[2]**

**Question 9.**

(a) What is meant by a plane polarized light? Describe a method by which a plane

polarized light can be distinguished from a partially polarised light. **[3]**

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(b)     Differentiate between a line spectrum and a band spectrum?                     **[3]**

| Line spectrum | Band spectrum |
|---|---|
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**Question 10.**

(a)     Describe *two* methods for the removal of a spherical aberration.                     **[2]**

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(b)     Deduce the conditions of maxima and minima in Young's double slit

experiment by using the expression of path difference i.e. $x = \dfrac{yd}{D}$ .     **[2]**

(c)     What is the critical angle for a ray of light going from glass to water? The refractive

indices of glass and water are 1.62 and 1.33 respectively.     **[2]**

**Question 11.**

(a)     What are the differences between coherent and incoherent sources of light?     **[3]**

| Coherent | Incoherent |
|----------|------------|
|          |            |


(b)     Derive the expression for an angular dispersion with the help of a diagram.     **[3]**

## SECTION C (14 marks)
*Answer any* **two** *questions.*

**Question 12.**

(a)     State any *two* postulates of Bohr's theory of hydrogen atom.                    **[2]**

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(b)     Show the logic symbol and truth table to obtain NOT gate from NAND gate.          **[2]**

(c)     Explain an artificial radioactivity.  Give *one* example.                         **[2]**

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(d)     What is the difference between an electron and a β-particle?                **[1]**

| Electron | β-particle |
|----------|------------|
|          |            |

## Question 13.

(a)     Explain how radiations are given out by LED.                                **[2]**

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(b)     Estimate the speed with which electrons emitted from a heated cathode of an
evacuated tube impinge on the anode maintained at a p.d. of 1.0kV with respect
to the cathode. Ignore the small initial speed of the electrons.

The specific charge ($\frac{e}{m}$) of an electron is $1.76 \times 10^{11}$ Ckg$^{-1}$.        **[2]**

(c)    Write down the functions of the main parts of a nuclear reactor.                    **[3]**

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**Question 14.**

(a)    Which shows the phenomenon of photoelectric effect, X-rays or microwaves?

Justify.                                                                                                    **[2]**

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(b) Derive the expression for the radius of the $n^{th}$ orbit of electron using the relation

$$\frac{m\upsilon^2}{r} = \frac{1}{4\pi\varepsilon_0}\frac{Ze^2}{r^2} \, .$$

[2]

(c) In a transistor, the base is made very thin and doped very lightly. Why?

[2]

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(d) Why are the gamma rays not deflected in a magnetic field?

[1]

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## [PHYSICAL CONSTANTS]

| | |
|---|---|
| Planck's constant | $h = 6.63 \times 10^{-34}$ J.s |
| Electron charge | $e = 1.6 \times 10^{-19}$ C |
| 1 electron volt | $1eV = 1.6 \times 10^{-19}$ J |
| Speed of electromagnetic wave | $c = 3 \times 10^8$ ms$^{-1}$ |
| Energy equivalent of | $1u = 931$ MeV |
| Mass of an electron | $m_e = 9.1 \times 10^{-31}$ kg |
| | $\varepsilon_0 = 8.85 \times 10^{-12}$ C$^2$N$^{-1}$m$^{-2}$ |
| | $\mu_0 = 4\pi \times 10^{-7}$ TmA$^{-1}$ |

*for Rough Work*

*for Rough Work*