V/ PHY (v)

2015

(5th Semester)

PHYSICS

FIFTH PAPER

(Mathematical Physics—I)

Full Marks : 75

Time : 3 hours

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

1. *(a)* Assuming $u \quad u(r, \ )$, write down the two-dimensional Laplace's equation in polar coordinates and find its general solution. 1+4=5

(b) Obtain the series solution of the differential equation

$$2x^2y \quad xy \quad (1 \quad x^2)y \quad 0$$ 5

Or

(a) Solve the heat diffusion equation 6

$$\frac{}{t} \quad h^2 \frac{^2}{x^2}$$

under boundary conditions

$$(0, t) \quad (l, t) \quad 0, t \quad 0$$

and $(x, 0) \quad x, 0 \quad x \quad l$

where l is the length of the rod.

(b) Obtain the D'Alembert's solution of the wave equation

$$\frac{^2y}{x^2} \quad \frac{1}{c^2} \frac{^2y}{t^2}$$

in a vibrating string, where c is the wave velocity. 4

2. *(a)* Prove that $J_{1/2}(x) \quad \sqrt{\frac{2}{x}} \sin x$, where $J_{1/2}(x)$ represents Bessel's function. 2

(b) Prove the following recurrence relations : 4+4=8

(i) $xJ_n(x) \quad nJ_n(x) \quad xJ_{n \ 1}(x)$

(ii) $xJ_n(x) \quad nJ_n(x) \quad xJ_{n \ 1}(x)$

Or

(a) Using Rodrigues' formula for $P_n(x)$, show that—

(i) $\int_{-1}^{1} P_0(x)\,dx = 2$;

(ii) $\int_{-1}^{1} P_n(x)\,dx = 0, \quad (n \neq 0)$. 2+2=4

(b) Show that $H_n(x)$ is the coefficient of z^n in the expansion of $e^{x^2 - (z-x)^2}$. 6

3. *(a)* Check whether the functions *(i)* $f(z) = |z|$ and *(ii)* $f(z) = z^{-1}$ are analytic functions. 4

(b) By contour integration, prove that

$$\int_0^{\infty} \frac{\sin mx}{x}\,dx = \frac{\pi}{2}$$ 6

Or

(a) Find the residues of

$$f(z) = \frac{z^2 - 2z}{(z-1)^2(z^2+4)}$$

at all its poles. 4

(b) Use residue theorem to evaluate

$$\int_0^{2\pi} \frac{d\theta}{a + b\cos\theta}$$

where $a > b > 0$. Hence show that

$$\int_0^{2\pi} \frac{d\theta}{2 + \cos\theta} = \frac{2\pi}{\sqrt{3}}$$ 5+1=6

4. *(a)* Obtain the expression for $\vec{\nabla}\phi$ (where ϕ is a scalar) in orthogonal curvilinear coordinate system. Hence, find its expression in cylindrical and spherical polar coordinates. 4+2=6

(b) Show that the cylindrical coordinate system is orthogonal. 4

Or

(a) What do you mean by covariant and contravariant tensors? Show that the gradient of a scalar function and velocity are respectively a covariant and a contravariant tensor both of rank 1. 2+2+2=6

(b) Show that if A^i and B^j are two contravariant vectors, then the n^2 quantities $C^{ij} = A^i B^j$ are the components of a contravariant tensor of rank 2. 3

(c) How many components does the tensor A^{ij}_{kl} have in three-dimensional space? 1

5. (a) Find the inverse of the matrix 4

$$A = \begin{matrix} 1 & 3 & 2 \\ 3 & 0 & 5 \\ 2 & 5 & 0 \end{matrix}$$

(b) Solve the following simultaneous equations by matrix method : 4

$$\begin{matrix} 2x & 3y & z & 9 \\ x & y & z & 6 \\ x & y & z & 2 \end{matrix}$$

(c) Show that the matrix

$$A = \begin{matrix} \frac{1}{\sqrt{2}} & 1 & 1 \\ i & & i \end{matrix}$$

is unitary. 2

Or

(a) Diagonalize the matrix

$$A = \begin{matrix} \cos & \sin & 0 \\ \sin & \cos & 0 \\ 0 & 1 & \end{matrix}$$ 4

(b) Find the eigenvalues and normalized eigenvectors of the matrix

$$\begin{matrix} 2 & 3 \\ 4 & 1 \end{matrix}$$ 4

(c) If A and B be two Hermitian matrices, then show that—

(i) AB BA is Hermitian;

(ii) AB BA is skew-Hermitian. 2

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Subject Code : V/ PHY (v)

Booklet No. A

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DEGREE 5th Semester
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2015

(5th Semester)

PHYSICS

FIFTH PAPER

(Mathematical Physics—I)

(PART : A—OBJECTIVE)

(*Marks* : 25)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 10)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×10=10

1. The differential equation of a circle having origin at (0, 0) and radius r is

(a) $x^2 + y^2 = r^2$ ( )

(b) $x\,dx + y\,dy = 0$ ( )

(c) $y\,dx + x\,dy = 0$ ( )

(d) $x\,dx - y\,dy = 0$ ( )

2. Consider the equation

$$x^2 \frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$$

Here $x = 0$ is

(a) an ordinary point ( )

(b) a regular singular point ( )

(c) an irregular singular point ( )

(d) None of the above ( )

3. Which of the following values of the Hermite polynomial is correct?

(a) $H_0(x) = x$ ( )

(b) $H_1(x) = 2x^2$ ( )

(c) $H_n(-x) = (-1)^n H_n(x)$ ( )

(d) $H_{2n}(0) = 0$ ( )

4. Which of the following values of the Legendre polynomial is not correct?

(a) $P_n(1) = 1$ ( )

(b) $P_n(-1) = (-1)^n$ ( )

(c) $P_n(-x) = (-1)^n P_n(x)$ ( )

(d) $P_{2n}(-x) = -P_{2n}(x)$ ( )

5. If C is the circle defined by $|z| > 1$, then the value of the integral $\oint_C \frac{dz}{z^2 + z}$ is

(a) 0 ( )

(b) 2π ( )

(c) $2\pi i$ ( )

(d) $-2\pi i$ ( )

6. If $z = e^{i\theta}$, then $\cos\theta$ is given by

(a) $z + \frac{1}{z}$ ( )

(b) $\frac{1}{2}\left(z + \frac{1}{z}\right)$ ( )

(c) $z - \frac{1}{z}$ ( )

(d) $\frac{1}{2}\left(z - \frac{1}{z}\right)$ ( )

7. In curvilinear coordinate system (u_1, u_2, u_3), the divergence of a vector field $\vec{A}$ is given by

(a) $\vec{\nabla} \cdot \vec{A} = \left[\frac{\partial A_1}{\partial u_1} + \frac{\partial A_2}{\partial u_2} + \frac{\partial A_3}{\partial u_3} \right]$ ( )

(b) $\vec{\nabla} \cdot \vec{A} = \left[\frac{\partial}{\partial u_1} (A_1 h_2 h_3) + \frac{\partial}{\partial u_2} (A_2 h_1 h_3) + \frac{\partial}{\partial u_3} (A_3 h_1 h_2) \right]$ ( )

(c) $\vec{\nabla} \cdot \vec{A} = \frac{1}{h_1 h_2 h_3} \left[\frac{\partial A_1}{\partial u_1} (h_2 h_3) + \frac{\partial A_2}{\partial u_2} (h_1 h_3) + \frac{\partial A_3}{\partial u_3} (h_1 h_2) \right]$ ( )

(d) $\vec{\nabla} \cdot \vec{A} = \frac{1}{h_1 h_2 h_3} \left[\frac{\partial}{\partial u_1} (A_1 h_2 h_3) + \frac{\partial}{\partial u_2} (A_2 h_1 h_3) + \frac{\partial}{\partial u_3} (A_3 h_1 h_2) \right]$ ( )

8. Let a_{ij} be the components of a tensor of rank 2. We can express a_{ij} as $a_{ij} = A_{ij} + B_{ij}$. Then

(a) both A_{ij} and B_{ij} are symmetric tensors ( )

(b) both A_{ij} and B_{ij} are anti-symmetric tensors ( )

(c) A_{ij} is symmetric, B_{ij} is anti-symmetric and both are of rank 2 ( )

(d) A_{ij} is symmetric, B_{ij} is anti-symmetric and both are of any rank ( )

9. The matrix

$$\begin{pmatrix} 0 & 1+i \\ -1+i & 0 \end{pmatrix}$$

is

(a) Hermitian ( )

(b) skew-Hermitian ( )

(c) unitary ( )

(d) both Hermitian and unitary ( )

10. The inverse of the matrix

$$\begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$$

is

(a) $\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$ ( )

(b) $\begin{pmatrix} \cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$ ( )

(c) $\begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$ ( )

(d) $\begin{pmatrix} \sin\theta & \cos\theta \\ -\cos\theta & \sin\theta \end{pmatrix}$ ( )

SECTION—II

(*Marks* : 15)

Give short answers to the following questions : 3×5=15

1. Show that $y = e^x(a \cos x + b \sin x)$ is a solution of the differential equation $y'' - 2y' + 2y = 0$.

2. Write the Rodrigues' formula for Hermite polynomial and hence find the values of $H_1(x)$ and $H_2(x)$.

3. Expand $f(z) = \dfrac{1}{(z-1)(z-2)}$ in a Laurent series valid for $1 < |z| < 2$.

4. If a contravariant tensor of rank 2 is symmetric in one coordinate system, then show that it is symmetric in any other coordinate system.

5. Show that the eigenvalues of conjugate matrices are equal.

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V/PHY (vi)

2015

(5th Semester)

PHYSICS

SIXTH PAPER

(Quantum Mechanics—I)

Full Marks : 75

Time : 3 hours

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

1. *(a)* What do you mean by duality of radiation and matter? Why does the wave nature of matter not valid for macroscopic particles? Show that the de Broglie wavelength for a material particle of rest mass m_0 and charge q, accelerated from rest through a

potential difference of V volt relativistically is given by

$$\frac{h}{\sqrt{2m_0qV\ 1\ \frac{qV}{2m_0c^2}}}$$ 1+2+5

(b) What do you mean by the term wave packet? 2

OR

2. *(a)* Write the main features of Bohr's theory of hydrogen atom. Derive the expressions for radius of the orbits and total energy of the electron. 3+2+3

(b) What do you understand by the term complimentarity principle? 2

3. *(a)* What do you mean by Hermitian operator? Show that eigenvalues of Hermitian operators are real. 1+4

(b) What is expectation value? Show that momentum operator is Hermitian. 1+4

OR

4. *(a)* Write down the addition and multiplication conditions to be satisfied by a vector space. 2

(b) Describe Gram-Schmidt orthogonalisation process. Apply the process to find an orthonormal basis set for the subspace U of R^4 spanned by the following vectors : 3+5

v_1 (1, 1, 1, 1)

v_2 (1, 2, 4, 5)

v_3 (1, 3, 4, 2)

5. *(a)* Obtain Schrödinger time dependent equation. Write the equation in eigenvalue equation form. 6

(b) A wave function is given by Ae^{ikx}, show that the probability current density of the given wave function is given by $J \quad v|A|^2$, where v is velocity of the particle. 4

OR

6. *(a)* Show that when the wave packet associated with a particle reduces to a point, it is possible to write $m\frac{d\langle x\rangle}{dt} \quad \langle p_x\rangle$, where m is mass of the particle, x is position operator, p_x is momentum operator. 8

(b) Write down the conditions to be satisfied by an acceptable wave function in quantum mechanics. 2

7. Obtain the expression for energy eigenvalue of one-dimensional harmonic oscillator. What is zero-point energy of harmonic oscillator? 8+2

OR

8. *(a)* A free particle of energy E is incident on a potential step given by $V \quad 0$; $x \quad 0$ and $V \quad V_0$; $x \quad 0$. Show that all the waves are reflected when $E \quad V_0$. 7

(b) Normalised wave function of a free particle in a box is given by $\sqrt{\frac{2}{L}}\sin\frac{n\ x}{L}$, where $0 \quad x \quad L$. Plot the graph for the wave function and the probability density for $n \quad 2$.

State there are how many antinodes. 3

9. The expression for square of angular momentum is given by

$$L^2 \quad \hbar^2 \ \frac{1}{\sin} — \sin — \ \frac{1}{\sin^2} \ \frac{^2}{^2}$$

Obtain the eigenvalue of L^2. 10

OR

10. *(a)* Show that square of angular momentum commutes with any one of the components of angular momentum, i.e., $[L^2, L_x]$ 0. What is the physical meaning of the commutation? 4+1

(b) Let $_x$, $_y$, $_z$ be Pauli spin matrices. Let $\vec{A}$ and $\vec{B}$ be two vectors. Show that

$(\vec{} \ \vec{A})(\vec{} \ \vec{B}) \quad \vec{A} \ \vec{B} \quad i\vec{} \ (\vec{A} \quad \vec{B})$ 5

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2015

(5th Semester)

PHYSICS

SIXTH PAPER

(Quantum Mechanics—I)

(PART : A—OBJECTIVE)

(*Marks* : 25)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 10)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×10=10

1. de Broglie wavelength of electron accelerated through potential difference of 100 V is about

(a) 12 angstrom ( )

(b) 1·2 angstrom ( )

(c) 0·12 angstrom ( )

(d) 10 angstrom ( )

2. Which of the following is not permissible set of quantum numbers for electrons in an atom?

(a) $n = 4,\ l = 0,\ m = 0,\ s = -1/2$ ( )

(b) $n = 5,\ l = 3,\ m = 0,\ s = +1/2$ ( )

(c) $n = 3,\ l = 2,\ m = -3,\ s = -1/2$ ( )

(d) $n = 3,\ l = 2,\ m = -2,\ s = -1/2$ ( )

3. Let $|\psi\rangle$ be a vector, a be a constant. Then $a|\psi\rangle$ is equal to

(a) $|\psi\rangle a$ ( )

(b) $\langle a\psi|$ ( )

(c) $\langle a\psi|^*$ ( )

(d) $a|\psi\rangle$ ( )

4. If inner product between two vectors is zero, then the two vectors are

(a) perpendicular to each other ( )

(b) parallel to each other ( )

(c) Can be both *(a)* and *(b)* ( )

(d) None of the above ( )

5. Let ψ be a wave function, the quantity $\int \psi^* \psi \, dc$ represents

(a) probability density ( )

(b) probability ( )

(c) energy density ( )

(d) wave intensity ( )

6. According to Ehrenfest theorem, quantum mechanics reduces to classical mechanics when

(a) the wave packet is small ( )

(b) the wave packet is large ( )

(c) the wave packet is of any size ( )

(d) the wave extends to infinity ( )

7. For a free particle in one-dimensional infinite potential, the relation between energy eigenvalue E_n and the quantum state n is given by

(a) $E_n \propto n$ ( )

(b) $E_n \propto n^2$ ( )

(c) $E_n \propto \sqrt{n}$ ( )

(d) $E_n \propto \frac{1}{n^2}$ ( )

8. In quantum tunnelling effect, with the increase in barrier thickness

(a) transmission probability increases ( )

(b) transmission probability decreases ( )

(c) transmission probability first increases then decreases ( )

(d) transmission probability remains the same ( )

9. Eigenvalue of Z component of angular momentum L_Z is given by

(a) $l(l+1)\hbar^2$ ( )

(b) $l(l+1)\hbar$ ( )

(c) $m\hbar$ ( )

(d) $m^2\hbar$ ( )

10. Trace of Pauli spin matrices is

(a) 1 each ( )

(b) $-i$ each ( )

(c) -1 each ( )

(d) 0 each ( )

SECTION—II

(*Marks* : 15)

Give short answers to the following questions : 3×5=15

1. Show that group velocity v_g and phase velocity v_p are related to each other by

$$v_g = v_p - \lambda \frac{dv_p}{d\lambda}$$

2. Let

$$|\psi\rangle = |u_1\rangle + 2|u_2\rangle + i|u_3\rangle \text{ and } |\phi\rangle = 3|u_1\rangle - |u_2\rangle - 2|u_3\rangle$$

Compute the inner product $\langle\psi|\phi\rangle$.

3. Give the physical interpretation of wave function. What does normalization condition mean?

4. Normalized wave function of a free particle in a box is given by $\psi = \sqrt{\frac{2}{L}} \sin \frac{n\pi x}{L}$, where $0 < x < L$. Obtain the probability of finding the particle within $0 < x < \frac{2}{L}$.

5. Write a short note on Uhlenbeck and Goudsmit's hypothesis on electron spin.

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2015

(5th Semester)

PHYSICS

SEVENTH PAPER

(Classical Mechanics and Thermal Physics)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* Show that a two-body problem can be reduced to a one-body problem. Hence obtain the equation of motion of the equivalent one body. 2+3=5

(b) Using Kepler's second law show that the force acting on a planet is central. 2

Or

(a) Deduce Hamilton's canonical equations from Lagrangian equation. 3

(b) Explain d' Alambert's principle and derive the equation of motion from generalized coordinates. 1+3=4

2. What is Brownian motion? Discuss Einstein's theory of translational Brownian motion. 1+6=7

Or

Explain Stern's experimental verification of Maxwell's law of distribution of velocities. 7

3. *(a)* What is triple point? 1

(b) Discuss Saha's theory of thermal ionisation. Mention its applications. 5+1=6

Or

(a) Derive differential equation for diffusion of gases. 3

(b) Define entropy. Show that the entropy of a perfect gas remains constant in a reversible process but increases in an irreversible process. 1+3=4

4. *(a)* Starting with Boltzman distribution law, deduce an equation for the equipartition of energy. 5

(b) Differentiate between accessible and inaccessible states. 2

Or

(a) What do you mean by ensemble? Discuss the different types of ensemble. 1+3=4

(b) State and explain equal a priori probability. 1+2=3

5. *(a)* From MB distribution law, deduce the equation for the wave function and the energy levels of a single particle in a rectangular box. 2+2=4

(b) Deduce an equation for Fermi-Dirac statistics. 3

Or

Establish the Stefan-Boltzman law of blackbody radiation and hence establish an expression for radiation pressure. 5+2=7

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Subject Code : V/ PHY (vii)

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2015

(5th Semester)

PHYSICS

SEVENTH PAPER

(Classical Mechanics and Thermal Physics)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The gravitational potential outside the shell due to their spherical shell is given by

(a) $V = -\frac{GM}{r}$ ( )

(b) $V = \frac{GM}{r}$ ( )

(c) $V = \frac{GM}{r^2}$ ( )

(d) $V = -\frac{GM}{r^3}$ ( )

2. The r.m.s. velocity of an ideal gas is directly proportional to

(a) T^2 ( )

(b) T^3 ( )

(c) $T^{1/3}$ ( )

(d) $T^{1/2}$ ( )

3. The enthalpy during an isobaric process is given by the relation

(a) $h_f + h_i = H$ ( )

(b) $h_f - h_i = H$ ( )

(c) $h_i - h_f = H$ ( )

(d) None of the above ( )

4. The canonical particle function of a discrete system is given by

(a) $z = \Sigma\, e^{E/k_B T}$ ( )

(b) $z = \Sigma\, e^{-E/k_B T}$ ( )

(c) $z = \Sigma\, e^{k_B T/E}$ ( )

(d) $z = \Sigma\, e^{-k_B T/E}$ ( )

5. The mean occupation number of particles in any energy state ε_s is given by

(a) $\langle n_s \rangle = \dfrac{1}{e^{\beta(\varepsilon_s + \mu)} \pm 1}$ ( )

(b) $\langle n_s \rangle = \dfrac{e^{\beta(\varepsilon_s + \mu)} \pm 1}{N}$ ( )

(c) $\langle n_s \rangle = \dfrac{1}{e^{\beta(\varepsilon_s - \mu)} \pm 1}$ ( )

(d) $\langle n_s \rangle = e^{\beta(\varepsilon_s - \mu)} \pm 1$ ( )

SECTION—II

(*Marks* : 15)

Answer the following questions : 3×5=15

1. Establish Poisson's equation for Gravitational potential.

2. Show that n, the number of molecules per unit volume of an ideal gas is given by

$$n = \frac{PN}{RT}$$

where the symbols have their usual meanings.

3. Derive the specific heat relation

$$C_P - C_V = -T \left(\frac{\partial V}{\partial T}\right)_P^2 \left(\frac{\partial P}{\partial V}\right)_T$$

4. What is phase space?

5. How does Fermi energy vary with temperature?

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V/ PHY (viii) (A)

2015

(5th Semester)

PHYSICS

EIGHTH (A) PAPER

(Spectroscopy)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. State Bohr's postulates for hydrogen-like atom. Derive an expression for total energy of the electron in the *n*th orbit of a hydrogen-like atom. What is the significance of the negative sign in the expression for energy? 2+4+1=7

Or

Discuss Stern-Gerlach experiment. Discuss its importance. 4+3=7

2. Apply Pauli's principle to account for the periodic classification of elements. 7

Or

Describe the general features of spectra of alkali-like atoms. Show how the concept of spinning electron accounts for the doubling of levels in the spectra of alkalies. 4+3=7

3. *(a)* Write down the rate equations for a three-level laser. 3

(b) Solve the rate equations under steady-state conditions and derive an expression for the population difference between the first and second energy levels for low laser powers. 4

Or

(a) What are the characteristic properties of laser light? 3

(b) Explain how the laser action can be produced by considering a three-level laser system. 4

4. *(a)* Give the general idea of Born-Oppenheimer approximation. 2

(b) Discuss the rotational spectra of polyatomic molecules. 5

Or

Considering vibrating diatomic molecule is a harmonic oscillator, obtain the expression for frequency, energy levels, and selection rules. 4+1+1+1=7

5. Explain the intensity variation of vibrational-electronic spectra using Franck-Condon principle. 7

Or

Write about the *P*, *R* and *Q* branches in the rotational fine structure of electronic-vibrational transitions of molecular spectra. Explain it by using appropriate diagram. 4+3=7

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Subject Code : V/PHY (viii) (A)

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2015

(5th Semester)

PHYSICS

EIGHTH (A) PAPER

(Spectroscopy)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The total energy of an electron in the first excited state of hydrogen atom is about $-3 \cdot 4$ eV. Its potential energy in this state is

(a) $3 \cdot 4$ eV ( )

(b) $6 \cdot 8$ eV ( )

(c) $-6 \cdot 8$ eV ( )

(d) $-3 \cdot 4$ eV ( )

2. In the doublet fine structure of hydrogen spectrum, which one of the following is not an allowed transition?

(a) $^2P_{3/2} \rightarrow {}^2D_{3/2}$ ( )

(b) $^2P_{3/2} \rightarrow {}^2D_{5/2}$ ( )

(c) $^2P_{1/2} \rightarrow {}^2D_{3/2}$ ( )

(d) $^2P_{1/2} \rightarrow {}^2D_{5/2}$ ( )

3. Laser is produced by

(a) stimulated emission ( )

(b) spontaneous emission ( )

(c) Both *(a)* and *(b)* ( )

(d) resonant scattering ( )

4. For a rigid diatomic molecule, the spectral lines are separated by a constant distance of

(a) $2B\ cm^{-1}$ ( )

(b) $3B\ cm^{-1}$ ( )

(c) $4B\ cm^{-1}$ ( )

(d) $5B\ cm^{-1}$ ( )

5. Stokes' lines in a Raman spectra are associated with

(a) frequency less than that of the incident radiation ( )

(b) frequency more than that of the incident radiation ( )

(c) frequency equal to that of the incident radiation ( )

(d) Independent of frequency of the incident radiation ( )

SECTION—II

(*Marks* : 15)

Give short answers of the following questions : 3×5=15

1. What is the highest state that unexcited hydrogen atoms can reach when they are bombarded with 12 · 6 eV electrons?

2. Derive an expression for the maximum number of electrons that can go into a shell with its principal quantum number *n*.

3. Write briefly about semiconductor laser.

4. State the transition rules for molecules as anharmonic oscillator.

5. What are the progressions in a vibrational coarse structure of molecular spectra?

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V/ PHY (viii) (B)

2015

(5th Semester)

PHYSICS

EIGHTH (B) PAPER

(C Language and Numerical Methods)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* Describe the structure of a C program. 4

(b) Discuss the 'keywords' in C language. 3

Or

(a) What do you mean by a variable in C? Discuss different types of variables in C language. State the rules for naming variables in C programming. 1+2+2=5

(b) Explain increment and decrement operators in C. 2

2. *(a)* Discuss formatted input and output functions in C. 5

(b) Give two examples of each of unformatted input and output functions. 2

Or

(a) Explain standard library functions and user defined functions. 4

(b) Discuss the need of user defined functions in C programming. 3

3. *(a)* Briefly discuss how pointers are declared and initialized in a C program. Write down important features of pointers. 2+2=4

(b) Using pointers, write a C program that can be used to reverse the digits of a multidigit positive integer. 3

Or

Discuss 'structure' and 'union' in C with reference to their definition and declaration. Give an example of each. Mention the difference between structure and union. 6+1=7

4. *(a)* What do you mean by absolute error and relative error? The exact value of a quantity is $9 \cdot 80$ and its computed value is $9 \cdot 7842$. Calculate the percentage error in the computation. 1+1+1=3

(b) Deduce the Taylor series expansion of a function $f(x)$ about the point x_0. Obtain the Taylor series expansion of the function $(1 + x)^n$ about the origin. 2+2=4

Or

(a) Explain the method to find a real root of an equation by Newton-Raphson method. 4

(b) Evaluate a real root of the equation $2x^4 - 3x - 1 = 0$ by Newton-Raphson method correct up to 3-decimal places. 3

5. *(a)* Explain trapezoidal rule for numerical integration of a function $f(x)$ between the limits $x = a$ and $x = b$ with $a < b$. 4

(b) Evaluate the integral $\int_0^1 \frac{1}{1+x^3} dx$ numerically by trapezoidal rule with 10 sub-intervals. 3

Or

Discuss the binary, octal and hexadecimal number systems. Find the hexadecimal equivalent of the decimal number 234. 6+1=7

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Subject Code : V/ PHY (viii) (B)

Booklet No. A

Date Stamp .....

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To be filled in by the Candidate

DEGREE 5th Semester
(Arts / Science / Commerce / .....) Exam., **2015**

Subject .....
Paper .....

To be filled in by the Candidate

DEGREE 5th Semester
(Arts / Science / Commerce / .....) Exam., **2015**

Roll No. .....
Regn. No. .....

Subject .....
Paper .....

Descriptive Type
Booklet No. B .....

INSTRUCTIONS TO CANDIDATES

1. **The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.**
2. **This paper should be ANSWERED FIRST and submitted within** *45 minutes* **of the commencement of the Examination.**
3. **While answering the questions of this booklet, any cutting, erasing, over-writing or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.**

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(5th Semester)

PHYSICS

EIGHTH (B) PAPER

(C Language and Numerical Methods)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The value of the arithmetic expression $(22 + 13)\%(22 - 13) * 3 / 4$ in C is

(a) 9 ( )

(b) 6 ( )

(c) 3 ( )

(d) 0 ( )

2. Consider the program segment in C :

```
int a = 3, b;
b = sqrt (++a);
b - -;
printf ("Final values : a = %d, b = %d", a, b);
```

The output given by the printf( ) function in the program segment will be

(a) Final values : a = 4, b = 2 ( )

(b) Final values : a = 4, b = 1 ( )

(c) a = 4, b = 2 ( )

(d) a = 4, b = 1 ( )

3. In a C program, the function fputc performs the task of

(a) displaying a character on the VDU ( )

(b) writing a character to a file ( )

(c) getting a character from a file ( )

(d) reducing a character from a file ( )

4. If $f(x)$ is a polynomial such that $f(a)$ and $f(b)$ have opposite signs ($a < b$), then the equation $f(x) = 0$

(a) will always have a root in (a, b) ( )

(b) will never have a root in (a, b) ( )

(c) will always have a root outside (a, b) ( )

(d) will have a root at $a = b$ ( )

5. The binary number 10101 has the decimal equivalent

(a) 19 ( )

(b) 20 ( )

(c) 21 ( )

(d) 22 ( )

SECTION—II

(*Marks* : 15)

Give very short answers to the following questions : 3×5=15

1. Explain precedence of arithmetic operators in C.

2. Define one-dimensional, two-dimensional and multi-dimensional arrays.

3. Distinguish between the functions printf( ) and fprintf( ).

4. Using the method of least squares, find the best fitting straight line for the following data :

x	1	2	3	4
y	14	27	40	55

5. State De Morgan's theorems in Boolean algebra and prove them using simple truth tables.

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