Seat No.	

Set **P**

M.Sc. (Semester – I) (New) (CBCS) Examination Oct/Nov-2019
Physics (Nanophysics)
MATHEMATICAL TECHNIQUES

Day & Date: Monday, 18-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Which of the following is an analytic function of the complex variable $z = x + iy$ in the domain $|z| < 2$?
   a) $(3 + x - iy)^7$ b) $(1 + x + iy)^4\ (7 - x - iy)^3$
   c) $(1 - x - iy)^4\ (7 - x + iy)^3$ d) $(x + iy - 1)^{\frac{1}{2}}$

2) Let $u(x, y) = x + \frac{1}{2}(x^2 - y^2)$ be the real part of analytic function $f(z)$ of the complex variable, $z = x + iy$. The imaginary part of $f(z)$ is _____.
   a) $y + xy$ b) xy
   c) y d) $y^2 - x^2$

3) If C is the contour defined by $|z| = \frac{1}{2}$, the value of the integral $\oint_c \frac{dz}{\sin^2 Z}$ is _____.
   a) ∞ b) $2\pi i$
   c) 0 d) πi

4) The Cauchy – Riemann equation in polar form is given as _____.
   a) $\frac{\partial u}{\partial r} = \frac{\partial v}{\partial \theta}\ and\ \frac{\partial u}{\partial \theta} = \frac{\partial v}{\partial r}$ b) $\frac{\partial u}{\partial r} = r\frac{\partial v}{\partial \theta}\ and\ \frac{\partial u}{\partial \theta} = -\frac{\partial v}{\partial r}$
   c) $\frac{\partial u}{\partial r} = \frac{1}{r}\frac{\partial v}{\partial \theta}\ and\ \frac{1}{r}\frac{\partial u}{\partial \theta} = -\frac{\partial v}{\partial r}$ d) $\frac{\partial u}{\partial r} = \frac{\partial v}{\partial \theta}\ and \frac{1}{r}\frac{\partial u}{\partial \theta} = -\frac{\partial v}{\partial r}$

5) If A, B and C are non-zero Hermitian operators, which of the following relations must be false?
   a) $[A, B] = C$ b) $AB + BA = C$
   c) $ABA = C$ d) $A + B = C$

6) A unitary matrix is defined by the expression: _____.
   a) $U = U^T$, where superscript T means transpose
   b) $U = U^\dagger$
   c) $U = U^*$
   d) $U^{-1} = U^\dagger$

7) Any set of linearly independent vectors can be orthonormalized by the _____.
   a) Pound – smith procedure b) Gram – Schmidt procedure
   c) Sobolev method d) Sobolev – P method

8) What are the eigenvalues of $\begin{pmatrix} 1 & -i \\ i & 1 \end{pmatrix}$?
   a) Both are 0 b) 0 and 1
   c) 0 and -1 d) 0 and 2

9) The differential equation of all parabolas having axis parallel to y- axis is _____.

a) $\frac{d^3x}{dy^3} = 0$ b) $\frac{d^3y}{dx^3} = 0$

c) $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} = 0$ d) $\frac{d^2y}{dx^2} = 0$

10) The degree of $x\frac{d^2y}{dx^2} + \sin\frac{dy}{dx} = 0$ is _____.

a) 1 b) 2

c) 3 d) Not defined

11) Which of the following is an "even" function of t?

a) $t^2 - 4t$ b) $t^3 + 6$

c) t^2 d) $\sin(2t) + 3t$

12) What are the conditions required for a signal to fulfill to be represented as Fourier series?

a) Dirichlet's conditions b) Gibbs phenomenon

c) Fourier conditions d) Fourier phenomenon

13) Which of the following pairs of the given function f(t) and it's Laplace transform f(s) is NOT CORRECT?

a) $f(t) = \delta(t), f(s) = 1, (singularity\ at + 0)$

b) $f(t) = 1, f(s) = {}^{1}/_{s}, (s > 0)$

c) $f(t) = \sin kt, f(s) = \frac{s}{s^2 + k^2}, (s > 0)$

d) $f(t) = t\,e^{kt}, f(s) = \frac{1}{(s-k)^2}, (s > k, s > 0)$

14) The Fourier transform $\int_{-\infty}^{\infty} dx\, f(x)e^{ikx}$ of the function $f(x) = \frac{1}{x^2+2}$ is ___.

a) $\sqrt{2}\pi e^{-\sqrt{2}|k|}$ b) $\sqrt{2}\pi e^{-\sqrt{2}K}$

c) $\frac{\pi}{\sqrt{2}} e^{-\sqrt{2}K}$ d) $\frac{\pi}{\sqrt{2}} e^{-\sqrt{2}|K|}$

Q.2 A) Answer the following questions. (Any Four) **08**

1) Find the solution of the differential equation. $\frac{d^2y}{dx^2} - 7\frac{dy}{dx} + 6y = 0$

2) Classify the singularities and calculate the residue for $f(z) = \frac{A(z)}{\sin Z}$, where $A(z)$ is analytic and contains no zeros.

3) Find the eigenvectors of $H = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}$

4) Expand $f(x) = x$ for $-\pi \le x \le \pi$ in a Fourier series.

5) From the convolution theorem show that

$$\frac{1}{s}f(s) = \mathcal{L}\left\{\int_0^t F(x)dx\right\}$$

Where $f(s) = \mathcal{L}\{f(t)\}$

B) Write short notes. (Any Two) **06**

1) The Cauchy Principal Value
2) Properties of Fourier series
3) Linear dependent and independent set of vectors

Q.3 A) Answer the following questions. (Any Two) **08**

1) Show that the eigenvalues of a Hermitian matrix are all real.
2) State and prove Cauchy's Integral theorem.
3) Solve the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 2\cos x$

B) Answer the following (Any One) **06**

1) Using partial fraction expansion, show that for $a^2 \neq b^2$,

$$\mathcal{L}^{-1}\left\{\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right\} = \frac{1}{a^2-b^2}[a\sin(at) - b\sin(bt)]$$

2) By use of the residue theorem, evaluate $\int_0^{2\pi} \frac{d\theta}{(a+b\cos\theta)^2}$

where $a > b > 0$.

Q.4 A) Answer the following questions. (Any Two) **10**

1) Find the eigenvalues and eigenvectors of $A = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$
2) Find the Fourier transform of Gaussian distribution functions.
3) Solve the differential equation, $y^3\frac{dy}{dx} + \frac{1}{x}y^4 = x$

B) Answer the following questions. (Any One) **04**

1) If $f(x) = x + x^2$ is expanded in a Fourier series then show that

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

2) Find the value of integral $P\int_{-\infty}^{\infty} \frac{e^{ix}}{x}dx$

Q.5 Answer the following questions. (Any Two) **14**

a) Develop the Fourier expansion for $f(t) = \begin{matrix} \sin\omega t & 0 \leq \omega t \leq \pi \\ -\sin\omega t & -\pi \leq \omega t \leq 0 \end{matrix}$

b) Find a matrix s that diagonalizes.

$$A = \begin{pmatrix} 3 & -2 & 0 \\ -2 & 3 & 0 \\ 0 & 0 & 5 \end{pmatrix}$$

c) By use of the three-dimensional Fourier transform method, solve poisson's equation for the electrostatic potential function.

$$\nabla^2\phi(\vec{r}) = -\frac{\varrho(\vec{r})}{\in}$$

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Seat No.	

Set P

M.Sc.(Semester – I) (New) (CBCS) Examination Oct/Nov-2019
Physics (Nanophysics)
CONDENSED MATTER PHYSICS

Day & Date: Tuesday, 05-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Relative permittivity (ε_r) of the air is _____.
   a) 2 b) 0.5
   c) 1 d) 0

2) Reciprocal lattice vector G = _____.
   a) K'-K b) K - K '
   c) K ' + K d) $(K'+K)^2$

3) The electronic polarizability α_e of a monoatomic gas is _____.
   a) $4\pi\varepsilon_0$ b) $4\pi\varepsilon_0 R$
   c) $4\pi\varepsilon_0 R^3$ d) $4\pi\varepsilon_0^2$

4) Elemental solid dielectric has only _____ polarization.
   a) electronic b) ionic
   c) orientational d) all

5) The Fermi energy of intrinsic semiconductor is _____.
   a) $\frac{Ec+Ev}{2}$ b) $\frac{Ec+Ed}{2}$
   c) $\frac{Ec-Ev}{2}$ d) $\frac{Ec+Ea}{2}$

6) Number of tetrad axis in simple cubic system are_____.
   a) 2 b) 3
   c) 4 d) 8

7) Plane cut to negative x axis have the miller indices _____.
   a) 011 b) 001
   c) 110 d) 100

8) Which of the following cannot actually move?
   a) Majority carriers b) Ions
   c) Holes d) Free electron

9) Effective mass is equal to _____ mass for free electron.
   a) mean b) real
   c) residual d) zero

10) In an _____ polarization, electronic cloud is coming to one side to form dipole.
   a) orientational b) ionic
   c) electronic d) optical

11) FCC structure contains the contribution of _____ atoms.
   a) Two b) four
   c) nine d) six

12) In monoclinic lattice _____ are equal.
a) a, b, c b) α, β, γ
c) h, k, l d) none of these

13) Conductivity in metal depends on _____ mobility.
a) proton b) neutron
c) electron d) none of these

14) Penetration depth varies with _____.
a) pressure b) Temperature
c) volume d) Width

Q.2 A) Answer the following (Any Four) **08**
1) Define packing fraction.
2) Define coordination number.
3) What is dielectric loss?
4) What is penetration depth?
5) What is rectification?

B) Write short notes (Any Two) **06**
1) Brillion zones.
2) Effective mass of the electron.
3) Schottky barrier.

Q.3 A) Answer the following (Any Two) **08**
1) Derive the rectifier equation.
2) Write about orientational polarization.
3) Explain thermal properties of the superconductor.

B) Answer the following (Any One) **06**
1) Explain dielectrics loss angle and power factor.
2) Explain the defects in solids.

Q.4 A) Answer the following (Any Two) **10**
1) Show the absence of fivefold symmetry.
2) Explain Missner's effect.
3) Write about Reciprocal Lattice.

B) Answer the following (Any One) **04**
1) Distinguish direct and indirect band gap semiconductors.
2) Write about London equation.

Q.5 Answer the following (Any Two) **14**
a) Write about the behavior of electron in a periodic potential.
b) Give the theory of DC Josephson's effect.
c) Give the expression for inter planer spacing (d).

SLR-JW-441

Seat No.	

Set P

M.Sc. (Semester - I) (New) (CBCS) Examination Oct/Nov-2019
Physics (Nanophysics)
ANALOG & DIGITAL ELECTRONICS

Day & Date: Thursday, 07-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives. **14**

1) In a differential amplifier, the configuration is said to be an 'unbalanced output', if _____
   a) Output voltage is measured between two collectors
   b) Output is measured with respect to ground
   c) Two input signals are used
   d) All the above

2) An ideal operational amplifier has _____
   a) infinite output impedance b) zero input impedance
   c) infinite bandwidth d) all of the above

3) Another name for a unity gain amplifier is _____
   a) difference amplifier b) comparator
   c) single ended d) voltage follower

4) What should be the value of input resistance for an ideal voltage amplifier circuit?
   a) Zero b) Unity
   c) Infinity d) Unpredictable

5) The use of negative feedback _____
   a) reduces the voltage gain of an Op-amp
   b) makes the Op-amp oscillate
   c) makes linear operation possible
   d) answers (a) and (b)

6) Hartley oscillator is commonly used in _____
   a) Radio receivers b) Radio transmitters
   c) TV receivers d) None of the above

7) A Wein-bridge oscillator uses which feedback?
   a) only positive b) only negative
   c) both negative and positive d) none of the above

8) Circuit which consist of a quasi-stable state is called _____
   a) bistable circuit b) monostable circuit
   c) tri stable circuits d) tristate circuit

9) What is the range of the voltage level of the LM317 adjusted voltage regulator?
   a) 0 V to 5 V b) 1.2 V to 37 V
   c) -5 V to -24 V d) 5 V to 24 V

10) Simplify Y = AB'+ (A' + B) C
   a) AB' +C
   b) (A + B') (C'+D)
   c) (A'+B) (C'+D)
   d) (A+B') (C+D')

11) The EXCLUSIVE NOR gate is equivalent to which gate followed by an inverter.
   a) OR
   b) AND
   c) NAND
   d) XOR

12) The basic latch consists of _____
   a) two inverters
   b) two comparators
   c) two amplifiers
   d) two adders

13) Which is the 16-bit register for 8085 microprocessor?
   a) stack pointer
   b) accumulator
   c) register B
   d) register C

14) A bus connected between the CPU and main memory that permits transfer of information between main memory and CPU is known as _____
   a) DMA bus
   b) memory bus
   c) address bus
   d) control bus

Q.2 A) Answer the following questions. (Any Four) 08

1) Define open loop and closed loop amplifier circuits.
2) Explain CMRR.
3) Explain the conditions of the sustainable oscillator.
4) Define AND gate. Write its logic symbol and truth table.
5) State and prove De Morgan's theorem.

B) Write Notes. (Any Two) 06

1) Fixed regulators.
2) Explain the concept of virtual ground.
3) Dual input balance output differential amplifier.

Q.3 A) Answer the following questions. (Any Two) 08

1) Discuss the effect of feedback on closed loop gain.
2) Draw the circuit diagram and output wave forms of triangle wave generator.
3) Explain registers in 8085.

B) Answer the following question. (Any One) 06

1) Derive an expression for input resistance and bandwidth of voltage series negative feedback amplifier.
2) Write logic diagram and truth table of RS flip flop and explain its working.

Q.4 A) Answer the following questions. (Any Two) 10

1) A phase shift oscillator uses register R=220 Ohms, what should be the capacitance value if the capacitor required for a phase shift oscillator of frequency of 120 Hz and 1 KHz.
2) Derive an expression for output resistance with feedback in a closed loop amplifier.
3) Write an assembly language program to add two 8 bit numbers.

B) Answer the following questions. (Any One) 04

1) Derive an expression for op. amp as integrator.
2) With a neat circuit diagram explain switching regulator.

Q.5 Answer the following questions. (Any Two) **14**

1) With a near circuit diagram explain master slave JK flip flop.

2) With a near circuit diagram explain the working of LC tunable shift oscillator.

3) Write an assembly language program for 2's complement of two 16-bit numbers.

SLR-JW-442

Seat No.	

Set P

M.Sc. (Semester – I) (New) (CBCS) Examination Oct/Nov-2019
Physics (Nanophysics)
CLASSICAL MECHANICS

Day & Date: Saturday, 09-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of non-programmable calculator is allowed.

Q.1 A) Fill in the blanks by choosing the correct alternatives given below. **08**

1) The configuration space is _____ dimensional space.
   a) 6N b) 3N
   c) 2N d) 4N

2) The Poisson bracket [u, q_j] = _____.
   a) $-\partial u/\partial p_j$ b) $+\partial u/\partial p_j$
   c) $\partial u/\partial q_j$ d) $-\partial u/\partial q_j$

3) The generating function F_2(q, P, t) generates _____ transformations.
   a) exchange b) identity
   c) none d) infinite

4) The Hamiltonian is defined as _____.
   a) H = T-V b) H = T.V
   c) H = T+V d) H = T/V

5) In Lagrangian the motion of the system has been described by the _____ consideration.
   a) force b) momentum
   c) energy d) acceleration

6) If mi $\ll$ m_2, then the centre of mass of system coincides with the centre of mass of _____.
   a) m_1 b) m_2
   c) in between m_1 and m_2 d) away from m_1

7) If $\in > 1$, then the shape of the orbit formed will be _____.
   a) Ellipse b) Circle
   c) Hyperbola d) Parabola

8) In mechanics the action is _____.
   a) Σ q.p b) Σ q + p
   c) Σ q - p d) Σ $q^2.p^2$

B) State True or False: **06**

1) The Lagrangian equation from D'Alembarts principle is based on Newton's laws.
2) [u , c] = 0 where c is constant.
3) The variational principle associated with Hamiltonian formulation is called the principle of least action.
4) The Hamiltonian formulation is more advantageous than Newtonian.
5) In the configuration space system is having unique path.
6) In mechanics the addition of q and p is called action.

Q.2 A) Answer the following questions (Any Four) **08**

1) What is phase space? Explain it with one example.
2) Define Poisson Bracket.
3) Show that the angular acceleration is the same in fixed and rotating frames.
4) Explain the concept of the inertial and non-inertial frames.
5) Explain the term differential scattering cross section.

B) Write short Notes. (Any Two) **06**

1) Holonomic and non- holonomic constraints
2) Properties of motion under central force field
3) Shapes of orbit formed under central force field

Q.3 A) Answer the following questions. (Any Two) **08**

1) State the Hamilton's variational principle and derive the Lagrange's equation of motion form it.
2) Show that the transformation P = q cot p and Q = log{(sin p)/q} is canonical.
3) Show that the poisson bracket obeys distributive law of algebra.

B) Write Short notes. (Any One) **06**

1) Rutherford scattering
2) Lagrange's equation of motion for one dimensional linear harmonic oscillator.

Q.4 A) Answer the following questions. (Any Two) **10**

1) Distinguish between the configuration space and phase space.
2) What is canonical transformation? Discuss the exact differential condition to show that the transformation is to be canonical.
3) Discuss the different types of generating functions useful for canonical transformations.

B) Write Short notes. (Any One) **04**

1) Advantages of Hamiltonian mechanics over the Lagrangian and Newtonian mechanics.
2) Principle of least action.

Q.5 Answer the following questions. (Any Two) **14**

1) Show that Poisson Brackets remains invariant under canonical transformations.

2) Show that the generating function $F = \sum q_k Q_k$ produce exchange transformation.

3) How a two body problem does reduce to a single body problem? Derive the equation of motion for it?

SLR-JW-444

Seat No.	

Set P

M.Sc.(Semester – II) (CBCS) Examination Oct/Nov-2019
Physics (Nano Physics)
QUANTUM MECHANICS

Day & Date: Monday, 04-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Classically, the concept of "tunneling" is impossible. Why?
   a) The kinetic energy of the particle would be negative
   b) The total energy of a particle is equal to the kinetic and potential energies
   c) The kinetic energy must be equal to the potential energy
   d) The total energy for the particle would be negative

2) When a particle approaching a potential step has a total energy that is greater than the potential step, what is the probability that the particle will be reflected?
   a) P < 0 b) P = 0
   c) P = 1 d) P > 0

3) A particle has a total energy that is less than that of a potential barrier, when the particle penetrates the barrier, it's wave function is _____.
   a) A positive constant b) Exponentially decreasing
   c) Exponentially increasing d) Oscillatory

4) A rigid diatomic molecule is free to rotate in a fixed plane. The rotational energy eigen values are given by _____.
   a) $\frac{\hbar \mathrm{m}^2}{2\mathrm{I}}$ b) $\frac{2\mathrm{mI}}{\hbar^2}$
   c) $\frac{\hbar^2 \mathrm{I}}{2\mathrm{m}}$ d) $\frac{\mathrm{mI}}{2\hbar^2}$

5) The degree of degeneracy for 3-D isotropic harmonic oscillator is _____.
   a) n^2 b) $2n+1$
   c) $\left(n+\frac{1}{2}\right)(2n+2)$ d) $\frac{1}{2}(n+1)(n+2)$

6) An electron is an infinite square well that is 9.6 nm wide. The electron makes the transition from the n=14 to the n=11 state. The wavelength of the emitted photon is closet to _____.
   a) 3400 nm b) 4100 nm
   c) 2800 nm d) 4700 nm

7) How does the probability of an electron tunneling through a potential barrier vary with the thickness of the barrier?
   a) It is independent of the barrier thickness
   b) It decreases exponentially with thickness
   c) It decreases inversely with thickness
   d) It decreases sinusoidally with thickness

8) For partial described by the wave function $\psi(x,t)$
   a) $|\psi(x_0,t)|^2$ is the probability of finding the particle at x_0
   b) The prob. of finding the particle between x_0 and x_0+dx is proportional to $|\psi(x_0,t)|^2$
   c) The prob. of finding the particle at x_0 is either 0 or 1.
   d) No information can be given about the particle's position.

9) Probability current density $\vec{J}(x,t)$ is always _____.
   a) A real quantity.
   b) A purely imaginary quantity.
   c) Can be either real or purely imaginary depending on $\psi(x,t)$
   d) A complex quantity with possibly non-vanishing imaginary part.

10) The ionization potential of hydrogen atom is 13.6 volt. The energy required to remove an electron from the second orbit of hydrogen is _____.
   a) 3.4 eV b) 6.8 eV
   c) 13.6 eV d) 27.2 eV

11) The de-Broglie hypothesis associated with _____.
   a) Wave nature of electrons only
   b) Wave nature of ∝-particles only
   c) Wave nature of radiations
   d) Wave nature of all material particles

12) The de-Broglie wavelength of material particles which are in thermal equilibrium at temperature T is _____.
   a) $h/(2mKT)^{\frac{1}{2}}$ b) $\hbar/(2mKT)^{\frac{1}{2}}$
   c) $\hbar/(mKT)^{\frac{1}{2}}$ d) $\hbar/(2KT)^{\frac{1}{2}}$

13) In case of wave function, $\psi = \frac{e^{ikr}}{r}$; the probability current density is _____.
   a) $\frac{V}{r}$ b) $\frac{V}{r^2}$
   c) $\frac{V}{r^3}$ d) V

14) The wave function in the ground state of hydrogen atom is given as-
   $\psi = A\, e^{-\frac{r}{a}}$
   r: Measures distance from nucleus and
   a: Constant
   The Value of A is _____.
   a) $1/\sqrt{\pi a}$ b) $1/\sqrt{\pi a^3}$
   c) $1/a\sqrt{\pi}$ d) $1/\sqrt{\pi a^5}$

Q.2 A) Answer the following questions.(Any Four) **08**

1) Explain the terms :
   i) Stationary state
   ii) Bound state
2) Calculate the de-Broglie wavelength of a 0.05 eV ("thermal") neutron.
3) What is the interpretation of wave function ψ?
4) Show that the product of two hermitian operators is hermitian if they commute.

5) Calculate the mean value of the potential energy experienced by an electron in the 1s-orbital of the hydrogen atom.

B) Write notes (Any Two) **06**

1) Third postulates of quantum mechanics.
2) Linear operator and commutator.
3) One Dimensional Box.

Q.3 A) Answer the following questions.(Any Two) **08**

1) Show that if ψ is an eigen function of operator $\hat{A}$ with the eigen value a, then it is also an eigen function of exp(A) with eigen value exp(a).
2) Consider an electron in a macroscopic box of size, a = 2 cm.
   i) What value of n corresponds to energy of 1.5 eV? **02**
   ii) What is the difference in energies of the state n and n+1 in that energy region? **02**
3) Discuss the tunneling for a potential barrier in 1 – D.

$$v(x) = \begin{cases} 0 & \ldots\ldots x < 0 \\ \dfrac{A}{x} & \ldots\ldots x > 0 \end{cases}$$ (A: a +ve constant)

B) Answer the following questions.(Any One) **06**

1) How does the electronic structure of many - electron atoms can be qualitatively explained in terms of hydrogen like orbitals.
2) Show that a particle in a 1 - D box cannot have a definitely known momentum that the average value of the momentum is zero.

Q.4 A) Answer the following questions.(Any Two) **10**

1) Establish the following indentifies for the Dirac δ - function.
   i) $x\,\delta'(x) = -\delta(x)$
   ii) $\delta(x^2 - a^2) = \frac{1}{2|a|}[\delta(x-a) + \delta(x+a)]; a \neq 0$ and is real constant
2) A particle moves in a spherically symmetric attractive potential,
   $V(r) = \begin{cases} -V_0 & \ldots\ldots r < a \\ 0 & \ldots\ldots r > a \end{cases}$ $(V_0 > 0)$
   Obtain the bound state solutions to the Schrödinger equation if $l = 0, l \neq 0$. Is there always a bound - state guaranteed.
3) Discuss the normalization and the characteristics of the Eigen functions of a Harmonic oscillator.

B) Answer the following questions.(Any One) **04**

1) Explain the space Quantization of Electronic orbits.
2) Discuss the many-electron atom with the help of probability density as a function of distance from the nucleus.

Q.5 Answer the following questions.(Any Two) **14**

a) Discuss the case of molecular orbitals of the heteronuclear diatomic molecules.
b) What is the Hydrogen Molecule Ion? Explain in detail.
c) How does the Hartree and Hartree - Fock self-consistent field methods are helpful to estimate the ground state energy and wave functions of many electron atoms? Explain.

SLR-JW-445

Seat No.	

Set P

M.Sc. (Semester – II) (New) (CBCS) Examination Oct/Nov-2019
Physics (Nanophysics)
ELECTRODYNAMICS

Day & Date: Wednesday, 06-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) The electrostatic potential (v) due to octopole varies as _____.
   a) $v \sim \frac{1}{r^2}$ b) $v \sim \frac{1}{r^3}$
   c) $v \sim \frac{1}{r^4}$ d) $v \sim \frac{1}{r^1}$

2) The energy (U) of an ideal dipole having dipole moment P in electric field E is given by _____.
   a) $U = -P.E$ b) $U = B.E$
   c) $U = -q.E$ d) $U = q.E$

3) Which of the Maxwell's following equations is corrected on the basis of equation of continuity _____.
   a) $\nabla.E = \frac{\rho}{\epsilon_0}$ b) $\nabla.B = 0$
   c) $\nabla \times E = -\frac{\partial B}{\partial t}$ d) $\nabla \times B = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$

4) Maxwell's equation, $\nabla.B = 0$ is obtained from _____.
   a) Gauss law in electro-statics
   b) Faraday law in electromagnetic induction
   c) Ampere's Law.
   d) Gauss law in magneto-statics.

5) Poynting's vector S is _____.
   a) parallel to electric field vector
   b) parallel to magnetic field vector
   c) parallel to propagation vector $\vec{K}$
   d) perpendicular to propagation vector $\vec{K}$

6) Newton's third law does not hold good in _____.
   a) electro-statics b) magneto-statics
   c) electro-dynamics d) all above three

7) The expression for coefficient of reflection (R) is _____.
   a) $\frac{(n_1 - n_2)^2}{(n_1 + n_2)^2}$ b) $\frac{(n_1 + n_2)^2}{4n_1 n_2}$
   c) $\frac{(n_1 - n_2)^4}{4n_1 n_2}$ d) $\frac{(n_1 - n_2)^2}{2n_1 n_2}$

8) The expression for coefficient of transmission (T) is _____.
   a) $\frac{(n_1 - n_2)^2}{(n_1 + n_2)^2}$ b) $\frac{4n_1 n_2}{(n_1 + n_2)^2}$
   c) $\frac{(n_1 - n_2)^4}{4n_1 n_2}$ d) $\frac{(n_1 - n_2)^2}{2n_1 n_2}$

9) In the definition of skin depth, it is distance over which field amplitude reduces to _____.
   a) nearly one fifth b) $\frac{1}{e}$
   c) one half d) one fourth

10) For physical dipole the distance (d) between the charges is related to distance (r) of point of observation _____.
   a) $d \ll r$ b) $d \gg r$
   c) $d \simeq r$ d) $d = r$

11) In case of electric dipole, the radiation zone approximation is expressed as _____.
   a) $r \gg \frac{c}{\omega}$ b) $r \ll \frac{c}{\omega}$
   c) $r \approx \frac{c}{\omega}$ d) $r = \frac{c}{\omega}$

12) The plot of power radiated (P) against acceleration (a) of a charged particle in $(v \ll c)$ limit is _____.
   a) parabola b) Ellipse
   c) hyperbola d) straight line

13) The direction of Poynting vector in case of electromagnetic wave propagating in vacuum is _____.
   a) perpendicular to both Electric field and Magnetic field
   b) parallel to both Electric field and Magnetic field
   c) perpendicular to Electric field but not to Magnetic field
   d) perpendicular to Magnetic field but not to Electric field

14) The graph of Intensity of electromagnetic wave against electric field amplitude is _____.
   a) straight line b) Parabola
   c) ellipse d) Hyperbola

Q.2 A) Answer the following questions (Any Four) **08**

1) Explain in detail Biot and Savart's Law with example.
2) Give significance of Poynting's Theorem.
3) Give single application of Faraday's law in electro-magnetism.
4) Obtain the approximate potential at a point far from dipole.
5) Calculate the total charge on a thin ring of diameter one meter if linear charge density is $p(x) = \alpha x$ where $\alpha = 1.6$. How many electrons are there on the ring?

B) Write short notes (Any Two) **06**

1) Maxwell's equations in dielectric medium
2) Multi-pole expansion of electrostatic potential
3) Dipole moment of continuous charge distribution

Q.3 A) Answer the following questions (Any Two) **08**

1) Derive an expressions for energy stored in electric and magnetic field.
2) Discuss in detail Lorentz and Coulomb gauge.
3) Express the electromagnetic wave equations in D' Almbertian Operator.

B) Answer the following questions (Any One) **06**

1) For $\Phi(x, y, z) = 0.5xyz + 0.7yz + 0.9xy^2$, Calculate electric field $\overrightarrow{E}$ at point P(2,4,6).
2) Calculate the coefficient of Transmission (T) at the interface for pair of media having refractive indices $n_1 = 1.50$ and $n_2 = 1 \cdot 33$

Q.4 A) Answer the following questions (Any Two) **10**

1) Give full account of Maxwell's equations for moving medium.
2) Give Maxwell's correction to fourth equation on the basis of equation of continuity.
3) Explain the concept of Displacement current.

B) Answer the following questions (Any One) **04**

1) Give brief account of magnetic interaction of two current loops.
2) Discuss the case of oblique incidence of electromagnetic wave at boundaries.

Q.5 Answer the following questions (Any Two) **14**

a) Derive an expression for coefficient of Reflection (R) and Transmission (T).
b) Explain in detail the concept of radiation damping.
c) Derive an expression for linear and angular momentum associated with electromagnetic wave.

SLR-JW-447

Seat No.	

Set P

M.Sc. (Semester - II) (CBCS) Examination Oct/Nov-2019
Physics (Nanophysics)
STATISTICAL MECHANICS

Day & Date: Friday, 08-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of non-programmable calculator is allowed.

Q.1 A) Fill in the blanks by choosing correct alternatives given below. **08**

1) The state of a molecule of an ideal gas in a vessel is represented by a point in a phase space of _____.
   a) One dimension b) Two dimensions
   c) Four dimensions d) Six dimensions

2) In canonical ensemble, the system exchange _____.
   a) only matter b) only energy
   c) both energy and matter d) neither energy nor matter

3) Entropy in thermodynamics is measure of _____.
   a) order of system b) pressure of system
   c) volume of system d) disorder of system

4) The thermal inertia of a thermodynamic system is known as _____.
   a) its enthalpy b) its entropy
   c) its isothermal condition d) its adiabatic condition

5) A quantitative explanation of Brownian motion was given by _____.
   a) Albert Einstein b) Maxwell
   c) Robert Brown d) Boltzmann

6) The condition for thermal equilibrium is given by _____.
   a) $(\partial S_1/\partial U_1) = (\partial S_2/\partial U_1)$ b) $(\partial S_1/\partial N_{i1}) = (\partial S_2/\partial N_{i2})$
   c) $(\partial S_1/\partial T_1) = (\partial S_2/\partial T_1)$ d) $(\partial S_1/\partial V_1) = (\partial S_2/\partial V_1)$

7) The flow of heat from hot body to cold body is an example of _____ process.
   a) adiabatic b) irreversible
   c) reversible d) isothermal

8) The phonon is called as _____.
   a) Fermion b) Boson
   c) Antiparticle d) Boltzman particle

B) State True or False. **06**

1) In viral expansion for gas, the second viral coefficient is zero at the Boyle temperature.
2) The transition in $BaTiO_3$ is an example of second order phase transition.
3) Temperature should change in isothermal process.
4) The chemical potential for ideal bose gas is less than zero.
5) When heat propagates like a wave with a infinite velocity through the liquid helium. This phenomenon is called as second sound.
6) Photon, Phonon etc. obeys Fermi Dirac distribution function.

Q.2 A) Answer the following (Any Four) **08**

1) Calculate the equation of state of ideal Fermi gas and its classical limit.
2) State and derive most probable distribution for a quantum ideal gas.
3) Derive the equation for particle function in Grand Canonical Ensemble.
4) Distinguish between 1^{st} and 2^{nd} order phase transition graphically.
5) Show that during the second order phase transition $(\partial^2 \mathrm{G}_1 / \partial \mathrm{T}^2) \neq (\partial^2 \mathrm{G}_2 / \partial \mathrm{T}^2)$

B) Write Notes on (Any Two) **06**

1) Explain the concept of microstate and macrostates
2) Explain the concept of statistical equilibrium.
3) How will you explain the contact between thermodynamics and statistical mechanics?

Q.3 A) Answer the following (Any two) **08**

1) Show that in Bose-Einstein condensation all the particles accumulate in ground stat.
2) Establish Fokker Pank equation and solve it.
3) What is an energy fluctuation? Explain it in terms of canonical ensemble?

B) Answer the following (Any One) **06**

1) How the paradoxical situation arises when we mix the samples of same gas.
2) Write a note on Critical Indices.

Q.4 A) Answer the following (Any Two) **10**

1) Distinguish between Classical and Quantum statistics.
2) Write note on Fluctuation-Dissipation theorem.
3) Explain the second order phase transition with an example of $\mathrm{BaTiO_3}$.

B) Write Notes on (Any Two) **04**

1) What is an ensemble? Explain the concept of Canonical Ensemble.
2) State Liouville's theorem. What is the principle of conservation of density in it?

Q.5 Answer the following (Any two) **14**

a) What is Brownian motion? Set up the diffusion equation and solve it. Show that $< \mathrm{r}^2(\mathrm{t}) > = 6Dt$, where D is the diffusion coefficient.

b) Derive Ehrenfest equation for second order phase transition.

c) 1 kg of water at temperature $30^0\mathrm{C}$ is mixed with 2 kg of water at $90^0\mathrm{C}$ in a calorime of negligible heat capacity at constant pressure of 1 atm. Find the change in entropy of the system.

SLR-JW-448

Seat No.	

Set P

M.Sc.(Semester - III) (New) (CBCS) Examination Oct/Nov-2019
Physics (Nano Physics)
SEMICONDUCTOR PHYSICS

Day & Date: Monday, 18-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of nonprogrammable calculator is allowed.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) The intrinsic carrier concentration for Si is _____.
   a) $2.3 \times 10^{13}/cm^3$ b) $1.5 \times 10^{10}/cm^3$
   c) $2 \times 10^{6}/cm^3$ d) $2.1 \times 10^{11}/cm^3$

2) _____ theory of crystal growth is based on the thermodynamic treatment of equilibrium state.
   a) Surface energy b) Diffusion
   c) Adsorption d) Screw dislocation

3) The Fermi-Dirac distribution function is _____.
   a) $f(E) = \frac{1}{(1 + e^{(E-E_f)/KT})}$ b) $f(E) = \frac{1}{(1 - e^{(E-E_f)/KT})}$
   c) $f(E) = \frac{1}{(1 + e^{(E_f-E)/KT})}$ d) $f(E) = \frac{1}{(1 - e^{(E_f-E)/KT})}$

4) A particle oscillating in a box, the value of $|\Psi^2(x,t)|$ gives _____ between x and x+dx at given time.
   a) Energy of particle
   e) Probability of momentum of particle
   c) Probability of finding a particle
   d) Frequency of particle

5) An empty state in the valance band is referred as _____.
   a) An electron-hole pair b) An electron
   c) A hole d) An electron-electron pair

6) The _____ is the quantity that used to simplify band structure by molding the behavior of a free particle with that mass.
   a) average b) rest
   c) effective d) root mean square

7) A vapour phase of volume 'V', temperature 'T', pressure 'P' contains i_v molecules with chemical potential μ_v then its thermodynamic potential of vapour phase is given by _____.
   a) i_v / μ_v b) $i_v . \mu_v$
   c) μ_v / i_v d) I_v / μ_v .p

8) If the excitation occurs by the introduction of current into the sample, the resulting luminescence is called _____.
   a) Cathodoluminescence b) Electroluminescence
   c) Luminesce d) Photoluminescence

9) The resulting carrier concentration equation for electron is _____.
   a) $n = n_i e^{-(f_n - E_i)/KT}$ b) $n = n_i e^{(f_n - E_i)/KT}$
   c) $n = n_i e^{-(E_i - f_n)/KT}$ d) $n = n_i e^{(E_i - f_n)/KT}$

10) The energy gap E_g is also called a _____.
   a) valence band b) forbidden band
   c) conduction band d) none of these

11) Nucleation is the _____ process.
   a) electrical b) mechanical
   c) magnetic d) thermodynamic

12) The concentration of minority carriers in n-type semiconductor is depends on _____.
   a) number of impurity atoms
   b) applied voltage in forward bias
   c) applies voltage in reverse bias
   d) temperature of semiconductor

13) Average distance between the two successive collisions of electron in a semiconductor is known_____.
   a) free path b) mean free path
   c) square of free path d) square of mean free path

14) The nucleation processes starts in an initial bulk phase if the solution is _____.
   a) saturated b) cooled
   c) supersaturated d) heated

Q.2 A) Answer the following questions. (Any Four) **08**

1) What is the specific heat?
2) What is mean by nucleation?
3) Define the optical absorption.
4) Explain the term electrical conductivity.
5) What is the fermi level in materials?

B) Write Notes. (Any Two) **06**

1) Electrical mobility
2) Photoluminescencence
3) Czochralski melt growth technique

Q.3 A) Answer the following questions. (Any Two) **08**

1) Explain the ohmic contact between metal and n-type semiconductor.
2) Discuss the direct and indirect band gap of semiconductor.
3) What is the zone melting process? Explain the zone refining.

B) Answer the following questions. (Any One) **06**

1) Derive an expression for inverse effective mass tensor.
2) Write a note on the quasi-Fermi level for electrons and holes.

Q.4 A) Answer the following questions. (Any Two) **10**

1) Explain the temperature dependence of carrier concentration in extrinsic semiconductor.
2) What is epitaxial growth? Explain the molecular beam epitaxy.
3) Show that particle in a potential wall follows $\Delta x . \Delta y \geq \hbar$.

B) Answer the following questions. (Any One) **04**

1) Explain metal-metal junction with reference to energy band.
2) Derive the equation of continuity in semiconductor.

Q.5 Answer the following questions. (Any Two) **14**

a) Explain the types of atomic bonding in materials.
b) Drew labeled diagram and explain Haynes Shockley experiment.
c) How are metals, insulators and semiconductors classified?

SLR-JW-449

Seat No.	

Set P

M.Sc. (Semester – III) (New) (CBCS) Examination Oct/Nov-2019
Physics (Nanophysic)
ATOMIC AND MOLECULAR PHYSICS

Day & Date: Tuesday, 05-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of Non-programmable calculator is allowed.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Spherical tops type of molecules have all moment of _____.
   a) $I_A = I_B = I_C$ b) $I_A = I_B \neq I_C$
   c) $I_A \neq I_B = I_C$ d) $I_A = 0, I_B \neq I_C$

2) The Lande g factor single state is for $^5F_2$ state.
   a) 0 b) 2
   c) 1 d) 3

3) The magic number in nuclear physics arises mainly due to _____.
   a) Short character of nuclear force
   b) Dipole-dipole interactions
   c) Coulomb interaction
   d) Spin orbit interaction

4) The Scattering amplitude of n-p interaction is _____.
   a) $F(\theta) = \frac{e^{-i\delta\theta} \sin\delta\theta}{k}$ b) $F(\theta) = \frac{e^{i\delta\theta} \sin\delta\theta}{k}$
   c) $F(\theta) = \frac{e^{-2i\delta\theta} \sin\delta\theta}{k}$ d) $F(\theta) = \frac{\sin\delta\theta}{k}$

5) For an atom in the state of $^2D_{5/2}$ the Lande 'g' factor should be _____.
   a) 1.00 b) 2.20
   c) 1.20 d) 1.02

6) According to the shell model of the nucleus which is incorrect?
   a) Nucleons in a nucleus interact with a general force field
   b) Magic number exists
   c) Nucleons interact with their nearest neighbours only
   d) Large electronic quadruple moment exists for certain nuclei

7) According to the single particle nuclear shell model, the spin parity of the ground state of $^{17}_{8}O$ is _____.
   a) $\frac{1^-}{2}$ b) $\frac{3^-}{2}$
   c) $\frac{5^+}{2}$ d) $\frac{3^+}{2}$

8) The binding energy of deuteron is _____.
   a) 2.226 MeV b) 0.226 MeV
   c) 1.226 MeV d) 3.226 MeV

9) In case of jj Coupling spin s_i* of each electron is quantized with respect to _____ to form a resultant j_i*.
   a) its own l_i* b) another electron's l_i*
   c) its own s_i* d) another electron's s_i*

10) If Q value of nuclear reaction is positive the reaction is _____.
   a) Exothermic b) Endothermic
   c) Endergonic d) None of these

11) Transition rule for the vibrational-rotational spectra are _____.
   a) $\Delta j = \pm 1, \pm 2 \ldots..$ b) $\Delta j = \pm 1$
   c) $\Delta n = \pm 1, \Delta j = \pm 1$ d) None of these

12) The electric quadrupole moment Q is zero for _____ nuclei.
   a) Oblate b) Spherical
   c) Prolate d) None of these

13) In case of LS coupling l_1=1 and l_2=2, then J= _____.
   a) 1,2,3,4 b) 0,1,2,3
   c) 2,3,4 d) 0,1,2,3,4

14) What is the moment of inertia I_B, of $^{1}H^{79}Br$ if the bond distance is 142 pm? Atomic masses are: ^{1}H = 1.008 u, ^{79}Br = 78.92 u.
   a) 3.33×10^{-47} kg.m^2 b) 3.00×10^{46} kg.m^2
   c) 2.34×10^{-37} kg.m^2 d) 1.22×10^{-7} kg.m^2

Q.2 A) Answer the following questions. (Any Four) **08**

1) How molecules are distinguish based on moment of inertia?
2) Explain the significance of the Q-Value of a nuclear reaction.
3) What is the range of the nuclear force? Why is it so short?
4) What is meant by Q values of nuclear reactions?
5) Define Hund's rule.

B) Write short notes. (Any Two) **06**

1) Calculate Lande g factor for $^{3}S_1$ and $^{3}P_1$ levels.
2) What are assumptions of liquid drop model of the nucleus?
3) Draw and label the vibrational energy levels for a diatomic molecule undergoing anharmonic oscillations.

Q.3 A) Answer the following questions. (Any two) **08**

1) State and explain Pauli's exclusion principle.
2) What is the moment of inertia (IB) of $^{1}H^{79}Br$ if the bond distance is 142 pm? (Given: Atomic masses are: ^{1}H = 1.008 amu, ^{79}Br = 78.92 amu.).
3) Distinguish between symmetric top and asymmetric top molecules.

B) Answer the following questions. (Any One) **06**

1) What is the evidence for shell structure of the nucleus? Explain the shell model of the nucleus.
2) The fundamental vibration frequency of HCl is 2989 cm^{-1}. Find the force constant of HCl bond. (Given: the mass of Hydrogen and Chlorine atoms are 1.673×10^{-27} kg and 58.06×10^{-27} kg respectively).

Q.4 A) Answer the following questions. (Any Two) **10**

1) Distinguish between the energy levels of a rigid and a non rigid rotor.
2) Calculate the magnetic moment and term shift of atom corresponding to the state $^{2}P_{1/2}$.

3) Rotational and centrifugal distortion constant of HCl molecule are 10.593 cm^{-1} and 5.3×10^{-4} cm^{-1} respectively. Estimate the vibrational frequency and force constant of molecule. (Given the mass of Hydrogen and Chlorine atoms are 1.673×10^{-27} kg and 58.06×10^{-27} kg respectively).

B) Answer the following questions. (Any One) **04**

1) What are types of nuclear reactions and discuss the nuclear reaction kinematics?
2) Discuss n-n scattering at high energy.

Q.5 Answer the following questions . (Any two) **14**

a) Why HCl molecule is microwave active and obtains the expression for moment of inertia for diatomic molecule as rigid rotator.

b) How the discrepancies caused in shell model is overcome in collective model?

c) Give the schematic representation of interaction energies between ps electrons in L-S coupling.

SLR-JW-449-RE

Seat No.	

Set P

M.Sc. (Semester - III) (New) (CBCS) Examination Oct/Nov-2019
Physics (Nanophysics)
ATOMIC AND MOLECULAR PHYSICS

Day & Date: Tuesday, 19-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of non programmable calculator is allowed.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Raman shift for stokes line is _____.
   a) zero b) Negative
   c) positive d) Infinity

2) The ratio of magnetic moment to the mechanical moment of orbital motion of electron is _____.
   a) $\frac{e}{2m}$ b) $2\frac{\mathrm{e}}{2\mathrm{m}}$
   c) $2\frac{\mathrm{e}}{\mathrm{m}}$ d) $\frac{\mathrm{e}}{\mathrm{m}}$

3) The effect of external electric field on spectral lines is known as _____.
   a) Zeeman effect b) Paschen-Back effect
   c) Stark effect d) Raman effect

4) The Land g factor for $ZS_{1/2}$ level (L=0, S=1/2, J=1/2) is _____.
   a) 1 b) 2
   c) 3 d) 4

5) If the final state of atom or molecule is same as initial state then the scattering is _____.
   a) Rayleigh Scattering b) Rutherford Scattering
   c) Raman Scattering d) Thomson Scattering

6) Pure rotational spectrum lies is _____ region.
   a) Infrared b) Microwave
   c) Visible d) X-ray

7) Multiplicity of the term $3D_{1,2,3}$ is given by _____.
   a) 1 b) 2
   c) 3 d) 4

8) For diatomic molecule following transitions are not allowed _____.
   a) $\Delta J = +1$ b) $\Delta J = -1$
   c) $\Delta J = 0$ d) None of these

9) Selection rule for anharmonic oscillator are _____.
   a) $\Delta\gamma = \pm 0 \ \& \ \pm 1$ b) $\Delta\gamma = \pm 1, \pm 2, \pm 3, \ldots$
   c) $\Delta J = \pm 0 \ \& \ \pm 1$ d) $\Delta J = \pm 1, \pm 2, \pm 3, \ldots$

10) If the coupling between l^* & S^* is broken is an external magnetic field, then we observe _____.
   a) Anomalous Zeeman effect b) Paschen Back effect
   c) Stark effect d) Raman effect
11) Pure Vibrational spectra is observed in _____ molecules.
   a) H_2 b) N_2
   c) O_2 d) HCL
12) Raman shift occurs is _____.
   a) visible b) Uv
   c) infra-red d) x-ray
13) The Selection rule for pure vibrational spectra is _____.
   a) $\Delta\gamma = 0$ b) $\Delta\gamma = \pm 1$
   c) $\Delta\gamma = \pm 2$ d) both (a) & (b)
14) The intensity of Rayleigh's line is _____ as compared to Raman lines.
   a) very high b) very low
   c) almost equal d) Zero

Q.2 A) Answer the following questions. (Any Four) **08**
1) State the selection rules for Anomalous Zeeman effect.
2) Give an explanation of magnetic quantum numbers.
3) Explain briefly the spectrum of sodium.
4) What is Raman effect?
5) State the basic principle of ESR.

B) Write Notes. (Any Two) **06**
1) Applications of Raman effect.
2) Central field approximation.
3) Auger effect resonance.

Q.3 A) Answer the following questions. (Any Two) **08**
1) Explain the working of NMR spectrometer.
2) Write a note on isotopic effect of rotational spectra.
3) Explain Pauli's Exclusion principle and its application to Identical particles.

B) Answer the following questions. (Any One) **06**
1) Write a note on width of Spectral lines.
2) Explain the quantum theory of Raman effect.

Q.4 A) Answer the following questions. (Any Two) **10**
1) Discuss ESR working and its applications.
2) Derive an expression for the term shift of Anomalous Zeeman effect.
3) Obtain an equation for the energy of Diatomic molecule as anharmonic Oscillator.

B) Answer the following questions. (Any One) **04**
1) Explain hyperfine Spectra.
2) Give the schematic representation of interaction energies between pd electrons in LS Coupling.

Q.5 Answer the following questions. (Any Two) **14**
1) Explain the coupling of orbital and spin angular momenta according to Vector Atom model.
2) Write a note on Born – Oppenheimer approximation.
3) Give the schematic representation of interaction energies between 4p4d electrons in jj coupling.

SLR-JW-450

Seat No.	

Set P

M.Sc. (Semester - III) (New) (CBCS) Examination Oct/Nov-2019
Physics(Nanophysics)
FUNCTIONAL NANOMATERIALS

Day & Date: Thursday, 07-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Neat diagram must be draw wherever necessary.
4) Use of logarithmic table and non-programmable calculator is allowed.

Q.1 Fill in the blanks by choosing correct alternatives given below. 14

1) _____ is an example of 2D nano material filler used in polymer nano composite.
   a) Fullerenes b) Nano wires
   c) Nano granules d) Nano tubes

2) The approximate percentage of fillers in polymer nano composite is in the range _____.
   a) 1 to 10% b) 10% to 20%
   c) 25% to 50% d) 55% to 75%

3) The relation for crystal growth rate is _____.
   a) $dr/dt = D\, d_m\, (C_b-C_i)/r$ b) $dr/dt = D\, (C_b-C_i)/r\, d_m$
   c) $dr/dt = D\, r\, (C_b-C_i)/\, d_m$ d) $dr/dt = r\, d_m\, (C_b-C_i)/D$

4) The curing process of thermoset is completely _____.
   a) Isothermal b) Reversible
   c) Irreversible d) Adiabatic

5) The term Nanotechnology was first introduced by _____.
   a) Norio Taniguchi b) Feynmann
   c) Drexler d) Lijima

6) Orbitals with energy lower than that of the atomic orbitals are called _____.
   a) Binding orbitals b) Dangling orbitals
   c) Antibinding orbitals d) None of these

7) In drop model of nucleation the uniformity refers to _____.
   a) Absorption b) Surface tension
   c) Emission d) None of these

8) In _____ nano meter sized water droplets are stabilized in an organic solvent by an amphiphilic surfactant.
   a) Aqueous synthesis b) Spin coating synthesis
   c) Chemical synthesis d) Sputtering synthesis

9) The electro spinning process can be adjusted to control the fibre diameter by varying _____ and polymer solution concentration.
   a) Magnetic field strength
   b) Electric field strength
   c) Electric and magnetic field strengths
   d) None of these

10) The nano fibre electro spinning unit (NEU) system consists of metering pump which control the _____ of spinning dope in syringe.
a) volume flow rate b) surface area flow rate
c) viscosity flow rate d) none of these

11) Nano fibre technology will provide a critical link between _____.
a) cm scale effect and macroscopic
b) meter scale effect and macroscopic
c) nano scale effect and macroscopic
d) meter scale effect and microscopic

12) The electrical property of TiO_2nano tube promotes oxygen evaluation by hole injection from valence band between 0.5 v and _____ potential.
a) 0.6 b) 1 v
c) 1.5 v d) 2 v

13) Nano indentation is an effective technique for probing _____ properties nano tubes.
a) electrical b) chemical
c) mechanical d) optical

14) Electrochemical and spectroscopic experiments have two intraband surface states for _____ array.
a) nano wire b) nano crystal
c) quantum dots d) nano tubes

Q.2 A) Answer the following question.(Any Four) **08**
1) What are the applications of quantum dots in biomedicine?
2) Draw neat diagram of laser assisted method.
3) Which methods are used to Synthesize Boron Nitride nano tubes?
4) What is nano filler? Give its any two types used in PNC.
5) What are the different synthesis methods of PNC?

B) Write Notes on. (Any Two) **06**
1) Write a short note on doubleQDQW.
2) What are the applications of TiO_2nano tube array?
3) Write a short note on electrospinning process.

Q.3 A) Answer the following question. (Any two) **08**
1) What are the types of polymer matrix nano composites?
2) Explain anodic formation yarns and fabrics formation.
3) Explain anodic formation of crystalline metal oxide nano tube.

B) Answer the following question.(Any One) **06**
1) Describe LBL assembly with nano tube and nano wire.
2) Explain any three improved properties of polymer nano composite.

Q.4 A) Answer the following question. (Any Two) **10**
1) What is polymerization? Explain in situ polymerization process for production of PNC.
2) Write s note on metal oxide frameworks.
3) Write a note on application of PNC.

B) Answer the following question. (Any One) **04**
1) Explain use of XRD and SEM in characterization of PNC.
2) Write potential applications of electrospun fibres.

Q.5 Answer the following question. (Any two) **14**

1) Explain the photocurrent transient measurement and capacitance measurement in detail.

2) Explain the basic material used for PNC in detail.

3) Describe the CSS nano crystal structure method in detail.