Course: M. Sc. I Semester   **Subject: Mathematical Methods in Physics**

Duration: 01 hour   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Separate Helmotz equation in Cartesian coordinates.   **(4 x2= 8marks)**

    b. Obtain Rodrigues formula for Laguerre's Polynomial & find the first 3 polynomial.

2. **a.** Obtain the general solution for Hermit Polynomial using power series solution method.   **(8 marks)**

    b. Obtain first two recursion relation of Bessel function.   **(4 marks)**

    OR

3. **a.** Obtain general solution for Bessel function using power series solution method.   **(8 marks)**

    b. Derive the expression for Orth-normalization condition for Legendre Polynomial.   **(4 marks)**

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1st Internal Assessment 2023-2024

Course: M. Sc I Semester   **Subject: Classical Mechanics**

Duration: 45 Minutes   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. a.   With neat diagram derive Angular Momentum   **(4 x 2 marks**

   b. Explain Fixed and Moving Coordinate System   **= 8marks)**

2. a. Define Euler Theorem and Prove   **(2+10 marks)**

                              OR

3. a. Define Euler Angle Explain the Three Set of Eulers Angales   **(2+10 marks)**

Course: M. Sc. I Semester   **Subject: Nuclear and Particle Physics**

Duration: 45 Minutes   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Explain any 4 basic properties of Nucleolus   **(4 x 2 marks**

    b. With neat diagram explain Neutron scattering   **= 8marks)**

2. **a.** With neat diagram write construction working Principal of High Energy   **(8 marks)**
    Electron Scattering

    b. Consider the BE of Particles in $_2He^4$. Nucleus which has an atomic mass =   **(4 marks)**
    4.00386amu. If the mass of the hydrogen atom is taken as 1.008142 amu and
    that of a neutron 1.008982 amu. Calculate the mass goes into BE.

                                            OR

3. **a.** Derive Spin and Magnetic Momentum of Odd A nuclei.   **(8 marks)**

    b. What is Separation energy and derive Proton Separation Energy   **(4 marks)**

Course: M. Sc I Semester   **Subject: Condensed Matter Physics**

Duration: 01 hour   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Distinguish between primitive and non-primitive cells.   **(4 x 2 marks**

    b. Discuss the classification of seven crystal systems.   **= 8marks)**

2. **a.** What is Bragg's Law? Obtain the mathematical expression.   **(8 marks)**

    b. Define Lattice point, Basis, Crystal structure and unit cell with neat   **(4 marks)**
    diagrams.

<div align="center">OR</div>

3. **a.** Explain the crystal structure of NaCl with neat diagram.   **(8 marks)**

    b. What are Miller Indices? Draw neat diagrams to show the (100), (110),   **(4 marks)**
    (111) and (200) planes in a cubic unit cell.

Course: M. Sc. I Semester   **Subject: Mathematical Methods in Physics**

Duration: 01 hour   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Verify whether following matrices are Hermitian or not   **(4 x 2 marks**

$$\begin{bmatrix} 2 & 3+4i \\ 3-4i & 1 \end{bmatrix} \text{ and } \begin{bmatrix} 1 & i \\ 2 & 3 \end{bmatrix}$$ **= 8marks)**

   b. Define Unitary Matrix. Prove that the Eigen values of a Hermitian matrix are all real.

2. a. Obtain Eigen Values and Eigen Vectors of Matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$ **(8 marks)**

   b. Define Orthogonal matrix &Skew Hermitian matrix .Give examples for each.   **(4 marks)**

<div align="center">OR</div>

3. a. Define Eigen values and Eigen vectors. The Eigen vectors corresponding to different Eigen values of a Hernitian matrix are orthogonal.   **(6 marks)**

   b. Diagonalize given matrix $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$ **(6 marks)**

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2nd Internal Assessment 2023-2024

Course: M. Sc. I Semester   **Subject: Classical Mechanics**

Duration: 01 hour   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. a. Derive conservation of angular momentum   **(4 x 2 marks**

   b. Explain Physical Significance of Hamiltonian   **= 8marks)**

2. a. Derive the Hamiltonian equation of Vibrational principal   **(8 marks)**

   b. Explain Legendre Transformation   **(4 marks)**

<div align="center">OR</div>

3. a. Derive Hamiltonian Equation of Motion also Derive Cartesian Coordinate   **(4+4+4marks)**
   and Polar Coordinates.

Course: M. Sc I Semester   **Subject: Nuclear Physics**

Duration: 01 hour   **Maximum Marks: 20**

Part A

Instruction: Question Number 1 is compulsory.

1. Discuss Semi-empirical Mass Formula   (4x2=8Marks)

2. Derive Stability against spontaneous fission

Part B

Answer any one of the following

3. Explain Gamow's theory of alpha decay , relation between mean life and decay energy

                                                                (6+3+3=12Marks)

                                    OR

4. A. Explain Neutrino Hypothesis   (4 Marks)

   B. Define Gamma Decay also its transition in nuclei and its classifications. (8 Marks)

Course: M. Sc. I Semester   **Subject: Condensed Matter Physics**

Duration: 01 hour   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Explain the classification of Semiconductors.   **(4 x 2 marks**

   b. Write a note on Type-I and Type-II Superconductors.   **= 8marks)**

2. **a.** Obtain the expression for intrinsic carrier concentration.   **(8 marks)**

   b. Discuss the temperature dependency of electrical conductivity in   **(4 marks)**

   semiconductors.

<div align="center">OR</div>

3. **a.** Explain the occurrence and destruction of superconductivity.   **(8 marks)**

   b. What is Meissner effect? Explain.   **(4 marks)**

Semester: II   **Subject**: Quantum Mechanics-I   **Subject Code**:B420010

Duration: 45 Min   **Date**: 16 July 2024   **Maximum Marks**: 20

Instruction: Question Number 1 is compulsory.

1. **a** Derive Schrodinger time independent wave equation.   **(4 x 2 marks**

   b. Find the commutator relation of the following   **= 8marks)**

   (i). $[X, P_z]$ (ii). $[X^n, P_x]$

2. **a.** State and Prove the Ehrenfest theorem.   **(8 marks)**

   b. Define Dirac Notations with properties.   **(4 marks)**

                        OR

3. **a.** Using wave function, derive Schrodinger time dependent wave equation.   **(6 marks)**

   b. Discuss about the expectation value and derive its relation.   **(6 marks)**

Semester: II   **Subject: Atomic, Molecular and Optical Physics**   **Subject Code:B420020**

Duration: 45 Min   **Date: 18 July 2024**   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Explain Transition probability and lifetime of an excited state.   **(4 x 2 marks**

   b. What are the applications of Laser?   **= 8marks)**

2. **a.** Discuss the different processes involved in the interaction of radiation with matter.   **(8 marks)**

   b. What are Einstein's coefficients? Obtain Einstein's relation.   **(4 marks)**

OR

3. **a.** Explain construction and working of He-Ne laser with brief energy level diagram.   **(8 marks)**

   b. Discuss the importance of Population inversion in Laser.   **(4 marks)**

Semester: II   **Subject: Electronics**   **Subject Code:B420030**

Duration: 45 Min   **Date: 19th July 2024**   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** What are number system? Explain   **(4 x 2 marks**

   b. Write two Distributive Laws.   **= 8marks)**

2. **a.** With neat circuit diagram explain Boolean expressions.   **(4 marks)**

   b. With neat circuit diagram explain associative and distributive law.   **(8 marks)**

                                OR

3. **a.** Reduce the following function using K-map technique.   **(4 marks)**

   Y=ABC+ABC+ABC+ABC+ABC

   b. Simplify the following three variables expression using Boolean algebra   **(4 marks)**

   Y=Σm(1 3 5 7)

   c. Simplify Boolean expression Z=AB+AB(AC)   **(4 marks)**

Semester: II   **Subject**: Quantum Mechanics-I   **Subject Code**:B420010

Duration: 90 Min   **Date**: 30 August 2024   **Maximum Marks**: 40

Instruction: Question Number 1 is compulsory.

1. **a** Define Dirac Delta Function & list its properties.   **(4 x 4 marks**

    b. Evaluate the commutator relation for $[x, P_x]$ & $[Lz, x]$.   **= 16marks)**

    c. Explain the Fermi Golden Rule.

    d. Apply, the perturbation theory, to find the first order perturbation correction to the ground state energy of a one dimensional harmonic oscillator, for the perturbation, $H^1 = bx^4$.

2. .Derive the equation for the reflection and transmission coefficients for a   **(12 marks)**
    free particle through a rectangular potential barrier.

<div align="center">OR</div>

3. **a.** Derive the expression for components of angular momentum in polar   **(8 marks)**
    coordinates.

    b. Explain Parity of wave function.   **(4 marks)**

4. **a.** Explain time independent perturbation method**.**   **(8 marks)**

    b. Give the first order energy correction based on the time independent   **(4 marks)**
    perturbation theory**.**

<div align="center">OR</div>

5. **a.** Solve the radial part of wave function of hydrogen atom. Hence, show   **(8 marks)**
    that energy Eigen values are given by $(-13.6)/n^2$ eV.

    b. Calculate Eigen value & Eigen functions of free particle**.**   **(4 marks)**

Semester: II   **Subject: Atomic, Molecular and Optical Physics**   **Subject Code:B420020**

Duration: 90Min   **Date: 31 August 2024**   **Maximum Marks: 40**

Instruction: Question Number 1 is compulsory.

1. **a.** What are spectral terms? Give the spectral representation for L-S and j-j   **(4 x 4 marks**
    coupling scheme.   **= 16marks)**

    b. What are spin quantization and space quantization?

    c. Explain the properties of Laser beam.

    d. Write a note on Optical fiber connectors and Fiber alignments.

2. **a.** Explain the Spin-Orbit Interaction   **(8 marks)**

    b. What are Equivalent and non-equivalent electron systems   **(4 marks)**

                                        OR

3. **a.** Discuss the transition rate equation for three level system.   **(8 marks)**

    b. Give the electric dipole selection rule for L-S and j-j coupling scheme.   **(4 marks)**

4. **a.** Explain the construction and working Semiconductor Laser.   **(8 marks)**

    b.   **(4 marks)**

                                        OR

5. **a.** Discuss Ray transmission theory.   **(8 marks)**

    b. Explain the types of fibers.   **(4 marks)**

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1st Internal Assessment 2023-2024

Course: M. Sc III Semester   **Subject: Statistical Mechanics**

Duration: 01 hour   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Derive an Heat Reservoirs   **(4x2=8marks)**

    b. Explain Molecule an Ideal Gas

2. **a.** Derive an Infinitesimal Quasi – Static Process   **(4 marks)**

    b. Derive an Sharpness of the Probability Distribution   **(8 marks)**

                            OR

3. **a.** Derive a Calculation of mean values in a canonical ensemble.   **(8 marks)**

    b. Explain Gibbs Paradox.   **(4 marks)**

Course: M. Sc III Semester   **Subject: Classical Electrodynamics**

Duration: 45 minutes   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** What is charge density? Explain.   **(4x2=8marks)**

   b. Write a note on Poisson and Laplace equation.

2. **a.** Obtain the expression for electrostatic scalar potential.   **(4 marks)**

   b. What is electrostatic force? State and explain Coulomb law.   **(8 marks)**

                                        OR

3. **a.** What is electric flux? State and explain Gauss law.   **(4 marks)**

   b. Explain multipole expansion of electric potential.   **(8 marks)**

Course: M. Sc III Semester   **Subject: Condensed Matter Physics I**

Duration: 45 minutes   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** State and prove Bloch Theorem.   **(4x2=8marks)**

    b. Calculated the structure factor of FCC.

2. **a.** Give the relation for tight banding method.   **(8 marks)**

    b. Briefly explain one of its function.   **(4 marks)**

<div align="center">OR</div>

3. **a.** Derive the expression for structure factor.   **(8 marks)**

    b. Calculate the Structure factor of a Base centered cubic cell.   **(4 marks)**

<div align="center">OR</div>

1. **a.** Derive the expression for structure factor.   **(8 marks)**

    b. Calculate the Structure factor of a Base centered cubic cell.   **(4 marks)**

Course: M. Sc III Semester   **Subject: Statistical Mechanics**

Duration: 01 hour   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Derive Maxwell –Boltzmann Statistical   **(4x2=8marks)**

   b. Derive Langevin Equation

2. **a.** Derive Fokker Plank Equation   **(6 marks)**

   b. Derive Fluctuation and Onsagar Relations   **(6 marks)**

                                     OR

3. **a.** Explain Evaluation of Partition Function   **(4 marks)**

   b. Explain Electromagnetic radiation in thermal equilibrium inside an   **(8 marks)**

enclosure

Course: M. Sc III Semester   **Subject: Classical Electrodynamics**

Duration: 45 minutes   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Obtain the differential equations for Magnetostatics.   **(4x2=8marks)**

    b. Derive Clausius-Mossotti equation.

2. **a.** Explain dielectric constant and electric susceptibility   **(4 marks)**

    b. Obtain the expression for electrostatic energy in dielectric media.   **(8 marks)**

                                        OR

3. **a.** Discuss Ampere's law in relation to Magnetostatics.   **(4 marks)**

    b. State and explain Biot-Savart law.   **(8 marks)**

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2nd Internal Assessment 2023-2024

Course: M. Sc III Semester   **Subject: Condensed Matter Physics I**

Duration: 45 minutes   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a.** Explain the Fermi Surface..   **(4x2=8marks)**

    b. Derive the skin depth relation using Cyclotron resonance method.

2. **a.** Derive the Effect of magnetic field on Fermi Surface.   **(8 marks)**

    b. Give the relation for Slope at the Zone Boundaries.   **(4 marks)**

    OR

3. **a.** Derive Quantization of Orbit (Degenerace of Landau level).   **(8 marks)**

    b. Briefly explain de Hass-van Alphen effect.   **(4 marks)**

Semester: IV   **Subject**: Quantum Mechanics-II   <u>Subject Code</u>:

<u>Duration</u>: 45 Min   **Date**: 16ᵗʰ July 2024   <u>Maximum Marks</u>: 20

Instruction: Question Number 1 is compulsory.

1. **a**. Discuss, the Superposition Principle in Quantum Mechanics.   **(4 x 2 marks**

   b. Write a note on Quantum Poisson brackets.   **= 8marks)**

2. **a.** Derive the relation of Equation of motion.   **(4 marks)**

   b. State and prove the Eigen state of principle of Superposition   **(8 marks)**

OR

3. **a.** Explain about Co-ordinate and Momentum Representation.   **(4 marks)**

   b. Give the commutation relation and condition of Quantum Mechanics.   **(8 marks)**

Semester: IV   **Subject: AMMP**   **Subject Code:D420020**

Duration: 45 Min   **Date: 18 July 2024**   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. a. Derive the diffusion or Heat flow equation.   **(4 x 2 marks**

   b. Discuss about the Vibration of Circular Membrane.   **= 8marks)**

2. a. Write a note on Laplace equation for steady state temperature in a   **(6 marks)**
   Rectangular Plate.

   b. A long rectangular metal plate has its two long sides and the far end at 0°c   **(6 marks)**
   and the base at 100^{0}c. The width of the Plate is 10cm. Find the steady state
   temperature distribution inside the plate.

<div align="center">OR</div>

3. a. Derive the Wave equation Or Vibrating String.   **(4 marks)**

   b. Find the steady state temperature distribution 'u' in a semi-infinite solid   **(8 marks)**
   cylinder as shown in the figure & radius of the cylinder is 'a' ,if the base is
   held at 100^{0} & the curved sides at 0^{0}. Consider the boundary conditions u=0
   given for r = a.

Semester: IV   **Subject: Condensed Matter Physics-II**   **Subject Code:D420210**

Duration: 45 Min   **Date: 19th July 2024**   **Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a**. Write a note on fundamental absorption process.   **(4 x 2 marks**

   b. What is cyclotron resonance? Explain.   **= 8marks)**

2. **a.** Explain Energy gap determination from the electrical properties of   **(4 marks)**
   semiconductors.

   b. Discuss the process of electrical conductivity and mobility in   **(8 marks)**
   semiconductors.

<div align="center">OR</div>

3. **a.** Obtain the expression for diffusion length.   **(4 marks)**

   b. Discuss the hall effect in semiconductors.   **(8 marks)**

Semester: IV　　　**Subject: Condensed Matter Physics-III**　　　**Subject Code:D420220**

Duration: 45 Min　　　**Date: 20th July 2024**　　　　　　**Maximum Marks: 20**

Instruction: Question Number 1 is compulsory.

1. **a**. .With Neat Diagram explain Tunnel diode　　　　　　　　　**(4 x 2 marks**

　b. .Write working Principal of Double Heterostructure diode laser　　**= 8marks)**

2. **a.** .Deriver Quantum wire its Density of State　　　　　　　　**(4 marks)**

　b. .Derive Quantum well for low dimensional semiconductor structures　**(8 marks)**

　　　　　　　　　　　　　OR

3. **a.** Explain Two dimensional electron gas.　　　　　　　　　**(4 marks)**

　b. .Derive Quantum Dot low dimensional semiconductor structures　**(8 marks)**

Semester: IV   **Subject: Quantum Mechanics-II**   **Subject Code:D420010**

Duration: 90 Min   **Date: 29th August 2024**   **Maximum Marks: 40**

Instruction: Question Number 1 is compulsory.

1. **a**. Explain the Linear Operator.   **(4 x 2 marks**

    b. Explain Schrodinger Picture   **= 8marks)**

    c. Solve J=1, m_j = 1,0,-1 in J^2 and J_Z Method

    d. Derive Hamiltonian Approximation Method.

2. **a.**. Explain Heisenberg Picture.   **(4 marks)**

    b. Derive uncertainty Principle.   **(8 marks)**

                              OR

3. Derive L.H Oscillator.   **(12 marks)**

4. a.. Derive Degenerate energy level of first order correction.   **(4 marks)**

   b.. Derive the W.K.B Method   **(8 marks)**

                              OR

5. . Derive Ground State of Helium Atom.   **(12 marks)**

Semester: IV   **Subject: AMMP**   **Subject Code:D420020**

Duration: 90 Min   **Date: 30 August 2024**   **Maximum Marks: 40**

Instruction: Question Number 1 is compulsory.

1. **a.** State and Prove Green's theorem.   **(4 x 4 marks**

   b. Find the square root of 5, correct to four decimal places using Newton-   **= 16marks)**
   Raphson method.

   c. Explain the finite difference method for the solution of Laplace equation.

   d. Solve $dy/dx = 1+y^2$; y (0) = 0 using Euler's method to find y (0.2). Take
h=0.1.

2. **a.** Solve the system of linear equation   **(8 marks)**

$$6x + y + z = 20$$
$$x + 4y - z = 6$$
$$x - y + 5z = 7.$$
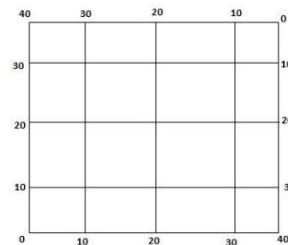
   b. Discuss the physical significance of gradient of a vector function.   **(4 marks)**

                                OR

3. **a.** Using Runge-Kutta method, solve the differential equation, $dy/dx = y-x$ **(8 marks)**
   where y(0)=2. Find y(0.1) & y(0.2) correct to three decimal places.

   b. Find the equation of the least fitting line y=ax+b for the following data   **(4 marks)**

x	5	10	15	20	25
y	16	19	23	26	30

.

4. **a.** Solve the equation $u_{xx}+u_{yy}=0$ in the domain of fig.   **(8 marks)**
   below by Gauss Seidel method.

   b. Apply the finite difference method to derive the Bender Schmidt formula.   **(4 marks)**

OR

5. a. Using bisection method, find the roots of the equation $x^2+2x+3=0$, lying **(4 marks)**

between 0 & -2, correct upto 3 decimal places.

b. Find f(0.23) & f(0.29) from the following table using Newton's **(8 marks)**

interpolation formula

x	0.2	0.22	0.24	0.26	0.28	0.30
F(x)	1.6596	1.6698	1.6804	1.6912	1.7024	1.7139

.

Semester: IV   **Subject: Condensed Matter Physics-II**   **Subject Code:D420210**

Duration: 90 Min   **Date: 31ˢᵗ August 2024**   **Maximum Marks: 40**

Instruction: Question Number 1 is compulsory.

1. **a**. Write a note on exciton absorption and free carrier absorption processes.   **(4 x 4 marks**

   b. What is Magnetoresistance? Explain its types.   **= 16marks)**

   c. Obtain the Clausius Mossotti relation.

   d. Discuss Dielectric relaxation.

2. **a.** Obtain the carrier concentration in n-type semiconductors.   **(4 marks)**

   b. Discuss the scattering mechanism in semiconductors.   **(8 marks)**

                                              OR

3. **a.** Obtain the expression for diffusion length.   **(4 marks)**

   b. Discuss the diffusion process in semiconductors.   **(8 marks)**

4. **a.** What are elemental and Compound Semiconductors   **(4Marks)**

    b. Discuss the band structure of semiconductors.   **(4Marks)**

    c. Discuss Photoconductivity.   **(4 marks)**

                                           OR

5. **a.** What are DMS?   **(4Marks)**

   b. Discuss the termperature dependency of Fermi level in semiconductors.   **(8Marks)**

Semester: IV   **Subject: Condensed Matter Physics-III**   **Subject Code:D420220**

Duration: 90 Min   **Date: 2nd Sept. 2024**   **Maximum Marks: 40**

Instruction: Question Number 1 is compulsory.

1. **a**. Write Comparison between Type 1 and Type 2 Superconductors.   **(4 x 4 marks**

    b. Discuss Structure and properties of cuprate superconductors BSCCO and YBCO.   **= 16marks)**

    c. Explain Basic Concepts of Tunneling.

    d. What is Epitaxial growth Explain?

2. **a.** Explain Thin Film.   **(4 marks)**

   b. With neat diagram explain Spray Pyrolysis.   **(8 marks)**

OR

3. **a.** Explain Electrical and Optical Method for Thickness Measurements   **(8 marks)**

   b. With neat diagram explain Chemical Vapor Deposition.   **(4 marks)**

4. **a.** Derive AC and DC Josephson effect   **(6+6Marks)**

                                        OR

5. **a.** Derive London Equation   **(6Marks)**

    b. Derive flux quantization of superconducting ring.   **(6Marks)**