R6729	Sub. Code
	521201

M.Sc. DEGREE EXAMINATION, APRIL – 2022

Second Semester

Physics

QUANTUM MECHANICS – I

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. What is degeneracy? Explain.

2. State Heisenberg uncertainty principle.

3. What is Alpha emission?

4. Write down the expression for ground state of hydrogen atom.

5. What is Hilbert's space?

6. Define Bra and Ket vectors.

7. What is Non-degenerate?

8. What is Stark effect?

9. Write down the expression for transition probability.

10. What are Einstein's A and B coefficients?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Give the physical interpretation of wave function.

Or

(b) Derive an expression for time dependent Schrödinger's equation.

12. (a) Obtain an expression for Energy of particle in a box.

Or

(b) Discuss the ground state of Linear Harmonic Oscillator using quantum treatment.

13. (a) Give the properties of stationary states.

Or

(b) Explain the matrix representation of wave function.

14. (a) Derive an expression for time independent perturbation theory.

Or

(b) Explain the Stark effect in hydrogen atom.

15. (a) Explain the Fermi's golden rule.

Or

(b) Distinguish between stimulated emission and spontaneous emission.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. State and prove Ehrenfest's theorem.

17. Derive the ground state energy of a Hydrogen atom using Radial part of the wave equation.

18. Discuss about the Schrodinger and Heisenberg pictures.

19. Obtain an expression for WKB approximation and its validity.

20. Derive the time dependent perturbation theory.

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R6730	Sub. Code
	521202

M.Sc. (Physics) DEGREE EXAMINATION, APRIL – 2022

Second Semester

Mathematical Physics II

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions. All questions carry equal marks.

1. Using Cauchy Riemann conditions, find out whether the function $f(z)=|z|$ is analytic or not.

2. Locate the singularities of $f(z)=\frac{1}{\sin z}$.

3. Write the Poisson equation.

4. Give an example for self adjoint ordinary second order differential equation.

5. Define covariant tensor of rank 3.

6. Define antisymmetric tensor.

7. Define cyclic group

8. How do you define conjugate element for an element in a group?

9. Write the Binomial distribution expression.

10. What is the Gaussian distribution for mean μ and variance σ^2 ?

Part B (5 × 5 = 25)

Answer **all** the questions, choosing either (a) or (b).

11. (a) Derive Cauchy integral formula.

Or

(b) Evaluate the integral $\oint \frac{dz}{z^2 - 2z}$, where the integration is carried over the unit circle, centered at origin.

12. (a) Explain the method for solving nonhomogenous PDEs.

Or

(b) How do you convert an linearly independent, non-orthogonal basis vectors in to an linearly independent, orthogonal basis vectors? Explain the process.

13. (a) Explain the Einstein summation convention used in tensors.

Or

(b) Show that rank of the tensor can be reduced by the operation contraction.

14. (a) Construct the character table for C_{2v} point group.

Or

(b) Discuss the structure of class in the group.

15. (a) List the important aspects of Binomial distribution.

Or

(b) Describe Gaussian distribution with any suitable physical example.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Derive the Cauchy Riemann conditions for analyticity. Also show that integral of an analytic function over a closed path is zero.

17. Explain the Gram-Schmidt orthogonalization process for constructing orthogonal basis.

18. Discuss in detail about metric tensors and geodesics.

19. Explain the physical applications of group theory, particularly in crystals.

20. Derive the mean and variance of the Poisson distribution.

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R6731	Sub. Code
	521203

M.Sc. DEGREE EXAMINATION, APRIL – 2022

Second Semester

Physics

ELECTROMAGNETIC THEORY

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. State Faraday's law.

2. Mention your understanding of electromotive force.

3. What is skin depth? How does it relate with an EMW propagating in a conducting medium?

4. What is isotropic and anisotropic medium?

5. Define Brewster's law. Mention its importance.

6. What is group velocity and phase velocity?

7. What is differential scattering cross section?

8. Define Lorentz field. Mention the significance of electric fields involve to obtain the total field (E_{loc}).

9. Mention the difference between conductor and plasma.

10. What is pinch effect?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Write down the comparison between electrostatic and magnetostatic fields.

Or

(b) State and prove Gauss law. Deduce the equation of div of E using Gauss law.

12. (a) Deduce the expression of wave equation in terms of vector and scalar potential.

Or

(b) Calculate the Poynting vector ($\langle s \rangle$) of a plane electromagnetic wave propagating in a free space and show that the electrostatic energy is equal to magnetostatic energy.

13. (a) Obtain the Fresnel's equations, when E – vector is perpendicular to the plane of incidence.

Or

(b) Calculate the degree of polarization for ordinary light reflected from glass (μ = 1.5) at an angle of incidence of 45°. (Note: Use Snell's law, $R_{\perp}$ and $R_{\parallel}$ equations).

14. (a) Obtain the expression of an electromagnetic wave propagating in a dilute gas and derive the electrical polarisibility as $\alpha = \frac{e^2}{m} \sum_j \frac{f_i}{\left(\omega_0^2 j - \omega^2\right) - i y_0 j^{\omega}}$.

Or

(b) Give a brief explanation on coherence and incoherence of scattered light.

15. (a) Describe the plasma frequency from plasma – electron oscillation theory.

Or

(b) Explain the plasma behavior of a charged particle in homogeneous magnetic field.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Deduce the equation of magnetic vector potential as $A = \frac{\mu_0}{4\pi}\int \frac{J}{r} d\tau$, and calculate the value of A and B for a long current carrying wire of length L.

17. (a) Derive the equation of continuity and explain that electric charge is conserved.

(b) State and derive the equation of energy in electromagnetic field (Poynting theorem).

18. Describe that the cavity resonator is an energy storage device and deduce the expression of E_x, E_y, B_x and B_y components form TE mode.

19. What is polarizability of a material? Derive the equation of Clausius – Mossotti relation form dispersion phenomenon.

20. (a) What is magnetic confinement?

(b) Describe that plasma as a conducting fluid by magneto hydrodynamics phenomenon.

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R6732	Sub. Code
	521504

M.Sc. DEGREE EXAMINATION, APRIL – 2022

Second Semester

Physics

Elective – MICROPROCESSOR AND INSTRUMENTATION

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. What is hardware interrupts in 8086?

2. What is immediate addressing mode?

3. What is stack and stack pointer?

4. Mention the comments of any two arithmetic groups.

5. Write down the main features of microcontroller.

6. What is A and B register in microcontroller?

7. Mention the classifications of programmed data transfer scheme. Give its necessities.

8. List the contribution of 8259 with 8085 processor.

9. Mention the importance of sample and holder circuit.

10. What is piezoelectric effect?

Part B (5 × 5 = 25)

Answer **all** the questions, choosing either (a) or (b).

11. (a) Sketch the block diagram of Intel 8085. Explain its registers.

Or

(b) Mention and explain any five logical group operations in 8085.

12. (a) Mention the advantages and disadvantages of high level language.

Or

(b) Write down the assembly language program for traffic control system with neat flowchart.

13. (a) List the hardware features of microcontroller 8051.

Or

(b) Write down the multiplication program of two 8-bit data using immediate addressing and store the result in memory using 8051 microcontroller.

14. (a) Write down the assembly language program of temperature monitor with neat flowchart.

Or

(b) Sketch and explain the block diagram of interfacing of 8251 with 8085 microprocessor.

15. (a) Briefly explain the function of LVDT transducer.

Or

(b) Describe the working function of D/A converter using resister ladder network method.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Sketch and describe the architecture of 8086.

17. (a) Write down an assembly language program for addition of two 16 bit numbers.

    (b) Explain the term interrupt and interrupt service routine.

18. Explain the general purpose and special function registers in 8051.

19. Write down the assembly language program for stepper motor with neat flowchart and algorithm.

20. (a) Explain the construction and working of resistive strain gauge transducer.

    (b) Discuss the working of photoconductive cell.

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R6733

Sub. Code
521401

M.Sc. DEGREE EXAMINATION, APRIL – 2022

Fourth Semester

Physics

CONDENSED MATTER PHYSICS – II

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

All questions carry equal marks.

1. Define dielectric polarization.
2. What is depolarization field?
3. When can a crystal is identified as ferroelectric crystal?
4. Distinguish ferroelectricity from antiferroelectricity.
5. What is ferrimagnetism?
6. What are the advantages of spintronics over electronics?
7. How does superconductor differ from perfect conductor?
8. Name any two high temperature superconducting materials along with their critical temperatures.
9. Discriminate the bulk materials and nanomaterials using surface to volume ratio.
10. What is exciton?

Part B (5 × 5 = 25)

Answer **all** questions choosing either (a) or (b).

11. (a) Explain ionic and orientation polarizations.

Or

(b) Evaluate the local field for cubic structure.

12. (a) Explain the first order transition from ferroelectric to paraelectric state.

Or

(b) Discuss ferroelectric domain walls.

13. (a) Derive the expression for magnetization in the quantum theory of paramagnetism.

Or

(b) Explain hard and soft magnetic materials and their applications.

14. (a) Differentiate between Type I and Type II superconductors.

Or

(b) Obtain the expression for London penetration depth.

15. (a) Explain excitons in nano semiconductors.

Or

(b) Write a note on qualitative description of quantum confinement of nanostructures.

Part C

(3 × 10 = 30)

Answer any **three** questions.

All questions carry equal marks.

16. Derive the relation between dielectric constant and polarizability in insulators.

17. Explain the origin of piezoelectricity and the phenomenological approaches to piezoelectric effects.

18. Elaborate Neel's theory of antiferromagnetic order.

19. Describe in detail the effects associated with the tunneling of superconducting electron pairs from a superconductor through a layer of an insulator into another superconductor.

20. Elucidate the role of carbon in nanotechnology using its allotropes.

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R6734	Sub. Code
	521402

M.Sc. DEGREE EXAMINATION, APRIL – 2022

Fourth Semester

Physics

NUCLEAR AND PARTICLE PHYSICS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. What are the parameters the nuclear exchange forces depend on?

2. Write the expression for nuclear quadrupole moment.

3. Define nuclear binding energy.

4. What are Schmidt lines?

5. Write anyone of the nuclear fusion reaction.

6. What are the steps involved in nuclear reaction in nucleus compound theory?

7. What are the values of mass and spin of neutrinos?

8. Write equation for beta decay.

9. List all the six quarks.

10. Write the Gell Mann — Okubo mass formula.

Part B (5 × 5 = 25)

Answer **all** the questions, choosing either (a) or (b).

11. (a) List the characteristics of nuclear forces.

Or

(b) Explain singlet and triplet states in n-p system.

12. (a) Explain how shell model can be employed to predict the magnetic moment of nuclei.

Or

(b) Write a short note on Bohr-Mottleson collective model.

13. (a) Describe the partial wave analysis of nuclear reaction cross section.

Or

(b) Write a note on types of nuclear reactors.

14. (a) Explain the usage of Kurie plot to find the form of electron momentum spectrum.

Or

(b) Write a note on nonconservation of parity in beta decay.

15. (a) Classify the fundamental forces and compare them.

Or

(b) Write a note on weak interaction.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Demonstrate how spin dependence of the nuclear forces is necessary to explain the discrepancy in observed scattering cross section.

17. Write the Weizacker's formula and explain each term present in it.

18. Explain neutron cycle in a thermo nuclear reactor.

19. Describe the Gamow's theory of alpha decay.

20. List all the quantum numbers for all the leptons.

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R6735	Sub. Code
	521403

M.Sc. (Physics) DEGREE EXAMINATION,
APRIL – 2022

Fourth Semester

Physics

THERMODYNAMICS AND STATISTICAL MECHANICS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. Define intensive variable.

2. What is quasi static process?

3. State equipartition theorem and virial theorem.

4. What do you mean by one orbital partition function?

5. When can one apply classical statistics for a physical system?

6. Write the Boltzmann equation for quantum statistics.

7. What is the value of chemical potential for photons?

8. How do you find Fermi energy for a physical system?

9. State Dulong-Petit law

10. State Gibbs phase rule.

Part B (5 × 5 = 25)

Answer **all** the questions, choosing either (a) or (b).

11. (a) Distinguish between reversible and irreversible processes.

Or

(b) Write the thermodynamic relations and their significance.

12. (a) Obtain the molecular velocity distribution function.

Or

(b) Explain Gibbs paradox and sketch the methodology for resolving it.

13. (a) Develop MB distribution law for microstates in a classical gas.

Or

(b) Give an account of nonequilibrium processes.

14. (a) Describe the salient features of Fermi gas at zero temperature.

Or

(b) Write a note on random walk and Brownian motion.

15. (a) Derive the Debye expression for specific heat capacity.

Or

(b) Classify phase transitions based on order and symmetry. Give examples.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Explain microstates and macrostates enumeration in classical and quantum systems. Find the density of states and volume occupied by a quantum gas.

17. Formulate the canonical partition function for ideal gas and deduce the expression for free energy.

18. Discuss fluctuations in microcanonical and canonical ensembles.

19. Obtain the Bose-Einstein distribution function for photons.

20. Derive the exact and variational solutions for one dimensional Ising model.

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R6736	Sub. Code
	521510

M.Sc. DEGREE EXAMINATION, APRIL – 2022

Fourth Semester

Physics

ELEMENTARY NUMERICAL ANALYSIS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. What are the logical operators available in C?
2. What is the usage of putchar function?
3. Compare Newton and Secant methods.
4. Give any one example for error propagation.
5. How does Lagrange interpolation is different from Newton's method?
6. What is central difference interpolation?
7. Write the formula for Euler's method.
8. Expand a function $f(x)$ is Taylor series.
9. What is partial pivoting?
10. Of the direct and iterative methods for solving system of linear equations, which method will give better results? Why so?

Part B (5 × 5 = 25)

Answer **all** the questions, choosing either (a) or (b).

11. (a) Explain the role of library functions.

Or

(b) Elaborate the usage of pointers in C.

12. (a) Write the algorithm for Newton's method for finding roots.

Or

(b) Explain least square data fitting.

13. (a) List the properties of divided differences.

Or

(b) Discuss inverse interpolation.

14. (a) Using trapezoidal rule, evaluate the integral $\int_0^1 x\ dx$ numerically by dividing the interval into four equal parts.

Or

(b) Using Simpson's 1/3 rule, evaluate the integral $\int_0^1 x\ dx$ numerically.

15. (a) Find the inverse of the matrix $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 2 & 1 \\ 0 & 2 & 3 \end{pmatrix}$.

Or

(b) Sketch the algorithm of Gauss-Seidel method.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain the basic structure of C program and also list the control states available in C.

17. Use Secant method to estimate the root of $e^{-x} - x$ employing initial guesses of 0 and 1.

18. Given the following set of data points, obtain the table of divided differences. Use the table to estimate the value of $f(1.5)$.

i	0	1	2	3	4
x_i	1	2	3	4	5
$f(x_i)$	0	7	26	63	124

19. For the equation,

$\frac{dy}{dx} = y$; with $y(0) = 1$.

Find the values $y(0.1)$ and $y(0.2)$ using Runge Kutta second order method using $h = 0.1$.

20. Describe the method of Gauss elimination with partial pivoting.

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