R–4570

Sub. Code
521201

M.Sc. DEGREE EXAMINATION, APRIL 2021

Second Semester

Physics

QUANTUM MECHANICS – I

(CBCS 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What are the admissibility conditions for the wave function?

2. Write the time dependent Schrodinger equation.

3. Write the Hamiltonian for the three dimensional harmonic oscillator.

4. What is the parity of the ground state of the one dimensional harmonic oscillator?

5. Define Hilbert space.

6. What are stationary states?

7. Write the Hamiltonian for a Helium atom.

8. What is Stark effect?

9. How does approach for time dependent perturbation differ from time independent perturbation?

10. What is the difference between spontaneous emission and stimulated emission?

Part B $(5 \times 5 = 25)$

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

11. (a) Discuss the postulates of quantum mechanics and their implications.

Or

(b) Calculate $\left[x,\ p_x^2\right]$.

12. (a) Consider a particle in a infinite square well potential with walls at $x = 0$ and $x = a$. Its initial wave function is given as the even mixture of the first two stationary states.

$\Psi(x,0) = A(\Psi_1(x) + \exp(i\theta)\ \Psi_2(x))$.

Find the normalization constant A and $\Psi(x,t)$.

Or

(b) Write a short note on alpha emission.

13. (a) Distinguish between Schrodinger picture and Heisenberg picture.

Or

(b) A particle is represented by the wavefunction

$\Psi(x) = A(x + a)(x - a)$ if $-a < \alpha$

$= 0,$ otherwise

Find the normalization constant A.

14. (a) Explain in brief about Zeeman effect without considering electron spin.

Or

(b) Illustrate the salient features of the variation method.

15. (a) Write a short note on adiabatic and sudden approximation.

Or

(b) What are forbidden transitions? Show that for such transitions the probability for the transition vanishes.

Part C $(3 \times 10 = 30)$

Answer any **three** questions.

16. State and prove Ehrenfest's theorem.

17. Solve the Hydrogen atom problem and obtain the solution.

18. Solve the one dimensional harmonic oscillator using ladder operators.

19. For the non degenerate case, find the first order and second order corrections to energy eigen values and eigen functions in the time independent perturbation theory.

20. Derive Fermi golden rule.

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R–4571

Sub. Code
521202

M.Sc. DEGREE EXAMINATION, APRIL 2021

Second Semester

Physics

MATHEMATICAL PHYSICS II

(CBCS 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Using Cauchy Riemann conditions find out whether the function $f(z) = z^3$ is analytic or not.

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

3. Write heat equation of PDE.

4. What is meant by self adjoint differential equation?

5. Define contravariant tensor of rank 2.

6. What is symmetric tensor?

7. Define class.

8. Define subgroup.

9. Write the need of probability.

10. What is the relation between mean and variance in Poisson distribution?

Part B $(5 \times 5 = 25)$

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

11. (a) Derive the Cauchy Riemann conditions.

Or

(b) Find the residue of the function $f(z) = \frac{1}{(z^2+1)(z-1)}$ at $z = 1$.

12. (a) Explain the method of Green function in the solution of nonhomogenous differential equation.

Or

(b) Write an algorithm for the Gram-Schmidt orthogonalization process.

13. (a) Discuss the definition of tensor using coordinate transformation. Also show that a vector is a tensor of rank 1.

Or

(b) If $a,b,c,$ are three-dimensional vectors, show that their scalar triple product can be written as $(a \times b).c = (a \times b).c = \varepsilon_{ijk} a_i b_j c_k$, where $a_i b_j c_k$ are the Cartesian components of a, b, c respectively and the summation convention is used.

14. (a) Describe irreducible representations of groups.

Or

(b) Construct the character table for C_{3v} point group.

15. (a) Write a note on binomial distribution.

Or

(b) Explain in brief about Poisson distribution.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. State and prove Cauchy fundamental theorem. Also derive Cauchy integral formula for calculating residues.

17. Using method of separation of variables, solve the laplace equation in Cartesian coordinate system.

18. List the algebraic operations between two tensors and explain each of them with examples.

19. State and prove Orthogonality theorem.

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

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R–4572

Sub. Code
521203

M.Sc. DEGREE EXAMINATION, APRIL 2021

Second Semester

Physics

ELECTROMAGNETIC THEORY

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Calculate the work done to move a charge from a to b in a line distribution.

2. Define Biot — Savart law.

3. What is conservation of momentum?

4. Write down the physical significance of an EMW propagates in a conducting medium.

5. What is Klystron oscillator? Mention its importance.

6. Write down the kinematic laws for reflection and refraction phenomenon.

7. Define total scattering cross section.

8. Define coherence and incoherence of light.

9. Mention the difference between conductor and plasma.

10. What is magnetic confinement?

Part B $(5 \times 5 = 25)$

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

11. (a) Derive the equation of magnetic vector potential using Biot – Savart law.

Or

(b) (i) Write down the differential form of Gauss law.

(ii) Calculate how much work would it take to assemble an entire collection of point charge?

12. (a) State and prove the Poynting theorem.

Or

(b) Deduce the wave equation by propagating an electromagnetic wave in free space.

13. (a) Explain the total internal reflection phenomenon for propagating an electromagnetic wave in an interface.

Or

(b) What is wave guide? Deduce the expression of E_x, E_y, B_x and B_y for an electromagnetic wave propagating in a rectangular wave guide.

14. (a) Discuss the theory of scattering of electromagnetic wave.

Or

(b) Obtain the expression of normal and anomalous dispersion from Lorentz theory.

15. (a) Calculate the plasma frequency and Alfven velocity from plasma wave theory.

Or

(b) Describe the occurrence of plasma and conditions for plasma existence.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Derive the expression for divergence and curl of B.

17. Derive the value of α and β by propagating an electromagnetic wave in a conducting medium and hence calculate the energy density.

18. Obtain the Fresnel's formula of the amplitude of reflected and transmitted electromagnetic wave between two dielectrics, when E — parallel and perpendicular to the plane of, incidence.

19. Derive the equation of dispersion in liquids and solids. Relate the obtained result with *Clausius* – Mossotti equation.

20. Explain the behaviour of plasma in the presence of magnetic field.

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R–4573	Sub. Code 521504

M.Sc. DEGREE EXAMINATION, APRIL 2021

Second Semester

Physics

MICROPROCESSOR AND INSTRUMENTATION

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. What is fetch operation?

2. What is the branch control group? Give examples.

3. Mention the requirements of subroutine in microprocessor program.

4. Mention the difference between assembly language and high level language.

5. What is data pointer in microcontroller?

6. List the different interrupt enable register.

7. Sketch the diagram of bidirectional port in 8051 controller.

8. How is 8259 programmed?

9. What is thermo-resistive transducer?

10. Define photoconductive cell.

Part B (5 × 5 = 25)

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

11. (a) What is timing diagram? Draw and explain the timing diagram for Opcode fetch operation.

Or

(b) Elucidate the data transfer group of Intel 8085 with any five examples.

12. (a) What is stack operations? Discuss stack after and before PUSH operation.

Or

(b) Define Pseudo instruction. Mention and explain the assembler directives of 8085.

13. (a) Write down the comparisons between microprocessor and microcontroller.

Or

(b) Explain the special function register of microcontroller 8051.

14. (a) Discuss the interfacing of 8259 with 8085 microprocessor.

Or

(b) Write down the assembly language program for stepper motor with neat flowchart and algorithm.

15. (a) Explain the construction and working of thermo - resistive transducer.

Or

(b) Describe the principle, construction and working of Piezoelectric force transducer.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. List the special functions of 8086 registers and flag register.

17. Write down the assembly language program for traffic control system with neat flowchart and algorithm.

18. Explain the basic functional blocks of a microcontroller and brief about the alternate functions of port pins.

19. Illustrate the signals and internal block diagram of 8255.

20. Sketch the circuit and describe the working of A/D converter using successive approximation method.

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R5462	Sub. Code
	521401

M.Sc. (Physics) DEGREE EXAMINATION, APRIL – 2021

Fourth Semester

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 susceptibility.

2. What is Lorentz field?

3. How does antiferroelectricity differ from ferroelectricity?

4. Name any two piezoelectric materials.

5. Write the energy expression for the Heisenberg model.

6. What is exchange energy?

7. Write the relation between mass of the isotopes and critical temperature.

8. What are Cooper pairs?

9. Write the relation between density of states and energy in one dimensional materials.

10. Write all the allotropes of carbon.

Part B (5 × 5 = 25)

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

11. (a) Explain the classical theory of electronic polarizability.

Or

(b) Derive the expression for local electric field at an atom in the solid by considering cubic arrangement of neighbours.

12. (a) Classify the ferroelectric crystals.

Or

(b) Explain ferroelectric transition.

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

Or

(b) Derive the spontaneous magnetization in the Weiss molecular field theory.

14. (a) List the salient features of the BCS theory.

Or

(b) Explain coherence length in superconductors.

15. (a) Explain any two methods for preparation of nanomaterials.

Or

(b) Write a note on carbon nanotubes as nanomaterials.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Derive Clausius-Mossotti relation.

17. Explain ferroelectric domains and domain wall motion.

18. Derive the dispersion relation for spin waves in a ferromagnet in one dimension with nearest neighbor interactions.

19. Obtain the expression for superconducting current in the Dc Josephson effect and Ac Josephson effect.

20. Explain in detail the effects of quantum confinement on materials.

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R5463	Sub. Code
	521402

M.Sc DEGREE EXAMINATION, APRIL – 2021

Fourth Semester

Physics

NUCLEAR AND PARTICLE PHYSICS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** the questions.

1. Define differential cross section and total cross section.

2. What are singlet and triplet states?

3. Write the semi-empirical mass formula.

4. What are magic numbers? Why are they called so?

5. Write any one of the nuclear fission reaction.

6. State reciprocity theorem.

7. What is nuclear isomerism?

8. Name any sources on positron emitters.

9. What are the values of isospin quantum numbers of proton and neutron?

10. What is the fundamental representation of SU(2) group?

Part B (5 × 5 = 25)

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

11. (a) Obtain the relation between effective range and cross section for n-p scattering at low energies.

Or

(b) Demonstrate the spin dependence of nuclear forces.

12. (a) Demonstrate the effect of adding spin-orbit coupling to central potential.

Or

(b) Write a note on liquid drop model.

13. (a) List the steps involved in finding the Q value of the nuclear reaction.

Or

(b) Describe pick-up and stripping reactions.

14. (a) Explain briefly the features of Gamow's theory alpha decay

Or

(b) Elaborate the application of nuclear particles in cancer therapy.

15. (a) List all the quantum numbers of electron and muon.

Or

(b) Compare the four fundamental forces.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Solve the Schrodinger equation and get the ground state of deuteron.

17. Illustrate the salient features of the Shell model.

18. Describe the Breit-Wigner dispersion formula for resonant condition.

19. Give detailed account of Fermi theory of beta decay.

20. Draw the octet and decuplet diagrams of hadrons.

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R5464	Sub. Code
	521403

M.Sc DEGREE EXAMINATION, APRIL – 2021

Fourth Semester

Physics

THERMODYNAMICS AND STATISTICS MECHANICS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** questions.

1. Differentiate between extensive and intensive variables in thermodynamics.

2. Three coins are tossed. Write the microstates corresponding to get two heads and one tail.

3. State equipartition theorem.

4. Write the expression for free energy of an ideal gas.

5. How will you distinguish non-equilibrium process from equilibrium process?

6. Which statistics will you apply for gas of free electrons?

7. Define Fermi energy and Fermi momentum.

8. Define chemical potential.

9. What is specific heat capacity?

10. State Gibbs phase rule.

Part B (5 × 5 = 25)

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

11. (a) List the thermodynamic processes and explain each of them.

Or

(b) Distinguish between enumeration of microstates and macrostates in classical systems and quantum systems.

12. (a) Derive Maxwell distribution of molecular velocities.

Or

(b) Explain the relation between grand canonical and canonical partition functions.

13. (a) Discuss Joule Thomson process.

Or

(b) Derive Maxwell-Boltzmann distribution law for microstates in a classical gas.

14. (a) Write a note on Brownian motion.

Or

(b) Write a note on Bose condensation.

15. (a) Discuss one dimensional Ising model and its solution.

Or

(b) Define phase transition and classify based on order and symmetry.

Part C

$(3 \times 10 = 30)$

Answer any Three questions.

16. Derive Maxwell relations in thermodynamics.

17. Resolve Gibbs paradox and obtain the correct formula for entropy.

18. Obtain the expression for fluctuations in canonical ensemble for Bose Einstein and Fermi Dirac distributions.

19. Deduce the Planck's distribution law for black body radiation.

20. Elaborate Einstein and Debye theory for specific heat of solids,

R5465	Sub. Code
	521510

M.Sc. DEGREE EXAMINATION, APRIL – 2021

Fourth Semester

Physics

ELEMENTARY NUMERICAL ANALYSIS

(CBCS – 2019 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** the questions.

1. What are the arithmetic operators available in C?

2. What is the role of getchar functions in C?

3. Distinguish between accuracy and precision.

4. What are the pitfalls of Newton's method?

5. What is quadratic interpolation?

6. List the interpolating methods.

7. Write the function f(x) in Taylor series about a point $X = X_0$.

8. What is the truncation error involved in Trapezoidal rule?

9. What are the pitfalls of the Gauss elimination method?

10. What is meant by ill-conditioned systems

Part B (5 × 5 = 25)

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

11. (a) What are pointers? Why are they preferred in C?

Or

(b) Explain structure in C using an example.

12. (a) Write the algorithm for bisection method for finding roots.

Or

(b) Write the algorithm for secant method.

13. (a) Discuss the method of Newton's divided difference interpolation.

Or

(b) Discuss central difference interpolation.

14. (a) Explain steps involved in the Euler's method for solving the first order ordinary differential equations.

Or

(b) Using Simpson's 1/3 rule, evaluate the integral $\int_0^1 x^2 dx$ numerically.

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

Or

(b) Describe LU factorization method.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. List the control statements available in C and explain each of them along with their syntax.

17. Use Newton's method to estimate the root of $e^{-x} - x$ employing initial guess of $X_0 = 0$.

18. Enlist the steps involved in Lagrange interpolation. Also derive the Lagrange form from Newton's interpolating polynomial.

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. Sketch the algorithm of Jacobi method and Gauss-Seidel method. Discuss in detail about the convergence of the both methods.

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