F–6334	Sub. Code
	7MPH1C1

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

First Semester

Physics

MATHEMATICAL PHYSICS – I

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** questions.

1. Determine the vectors (1, 0, 1), (0, 1, 1), (1, 1,0) are linearly dependent or independent.

2. Find the value of the line integral $\int_C \vec{\nabla}(x + y - z).d\vec{r}$ from (0, 1, –1) and (1, 2, 0).

3. State any two applications of Cayley-Hamilton theorem.

4. Write the Wronskian of a second order differential equation. What is its significance?

5. Differentiate between poles and essential singularities of an analytic function.

6. Find the singularities of the function $f(z) = \frac{1}{\sin \frac{\pi}{z}}$. What is the nature of the singularity at $z = 0$?

7. Can you expand the function $f(x) = \tan x$ in Fourier series? State the reason.

8. What happens to Fourier series expansion of a periodic function if the function is even in nature?

9. Find the Fourier transform of the function $f(\vec{r}) = \frac{1}{4\pi r}$.

10. What do you mean by Fourier transform of the derivative of a function?

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

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

11. (a) Using Gauss divergence theorem evaluate $\iint_S x^3 dydx + y^3 dzdx + z^3 dxdy$, where S is the surface of the sphere $x^2 + y^2 + z^2 = a^2$.

Or

(b) State and prove Schwartz inequality.

12. (a) Obtain the solution of the differential equation $xy' + y = x^4$ with the initial conditions $y = 1$ at $x = 1$.

Or

(b) Determine the eigenvalues of the matrix $M = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$.

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

Or

(b) Evaluate $\oint_C \dfrac{2z+6}{z^2+4}\,dz$, where the contour C is the circle $|z-i| = 2$.

14. (a) Given that $f(x) = x + x^2$ for $-\pi < x < \pi$, find the Fourier expression of $f(x)$.

Or

(b) Represent the following function by a Fourier sine series

$$f(t) = \begin{cases} t & 0 < t < \dfrac{\pi}{2}, \\ \dfrac{\pi}{2} & \dfrac{\pi}{2} < t \le \pi \end{cases}.$$

15. (a) Find the complex form of the Fourier integral representation of $f(x) = \begin{cases} e^{-kx} & x > 0 \text{ and } k < 0 \\ 0 & \text{otherwise} \end{cases}$.

Or

(b) Obtain the Fourier cosine transform of

$$f(x) = \begin{cases} x & 0 < x < 1, \\ 2 - x & 1 < x < 2, \\ 0 & x > 2. \end{cases}$$

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. State and prove Stokes' theorem.

17. Diagonalize the matrix $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 3 & -1 \\ 0 & -1 & 3 \end{pmatrix}$.

18. Evaluate the $\int_0^\infty \frac{x \sin x}{x^2 + 9} dx$ using Cauchy residue theorem.

19. Show that for odd functions Fourier series reduces to Fourier sine series.

20. Using Fourier transform solve $u_t = u_{xx}$ subject to the conditions (a) $u(0,t) = 0$ (b) $u(x,0) = \begin{cases} 1 & 0 < x < 1 \\ 0 & x \geq 1 \end{cases}$ and (c) $u(x,t)$ is bounded.

F–6335

Sub. Code
7MPH1C2

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

First Semester

Physics

CLASSICAL DYNAMICS AND RELATIVITY

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Set up the equation of motion for the Lagrangian $l = e^{c_1 t}\left(\frac{\dot{x}}{2} - \frac{c_2}{2}x^2\right)$, where c_1 and c_2 are constants.

2. Point out the conserved quantity associated with time translation and space translation.

3. What do you understand by the central force problem? Give an example.

4. State Kepler's second and third law of motion.

5. Define phase velocity and group velocity.

6. What is the advantage of discussing the motion of coupled oscillators in the normal modes?

7. Define Poisson bracket between the dynamical variables $H(q_1, q_2 p_1, p_2)$ and $I(q_1, q_2 p_1, p_2)$ where q_i's and p_i's, i = 1,2, are generalized coordinates and momenta respectively.

8. From the Hamiltonian $H = \frac{p^2}{2m} + \frac{1}{2}kq^2$, deduce the Lagrangian.

9. What is the principle of relativity?

10. How Lorentz transformations are superior to Galilean transformations?

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

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

11. (a) Set up the Lagrangian and obtain the Lagrange's equation for a simple pendulum. Deduce the formula for its time period.

Or

(b) Write down the Lagrange's equation of motion for a particle of mass m falling under the influence of gravity near the surface of earth.

12. (a) How will you reduce the two body problem into one-body problem? Hence explain the concept of reduced mass.

Or

(b) A particle describes a circular orbit under the influence of an attractive central force directed towards a point on the circle. Show that the force varies as the fifth power of the distance.

13. (a) Write a short note on symmetrical top.

Or

(b) Find the moments and products of inertia of a homogenous cube of side a for an origin at one corner, with axes directed along the edges.

14. (a) Apply the action-angle variables method to the one dimensional harmonic oscillator and obtain the solution of it.

Or

(b) Find the canonical transformation defined by the generating function

$$F(q,Q) = \frac{1}{2} mwq^2 \cot Q .$$

15. (a) State and explain the relativistic law of addition of velocities.

Or

(b) Show that the operator $\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2} - \frac{1}{c^2}\frac{\partial^2}{\partial t^2}$ is invariant under Lorentz transformations.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Derive Euler-Lagrange's equation of motion using Hamilton's principle.

17. State and prove Viral theorem.

18. Derive Euler's equations of motion in terms of Euler's angles.

19. Solve Hamilton-Jacobi equation for the system whose Hamiltonian is given by $H = \frac{p^2}{2} - \frac{\mu}{q}$.

20. What are four vectors? Find the components of the momentum four vector and derive the law of variation of mass with velocity.

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F–6336

Sub. Code
7MPH1C3

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021.

First Semester

Physics

QUANTUM MECHANICS – I

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Show that the function $\phi(x) = \sin\left(\frac{\pi x}{3}\right)$ in the limit $0 < x < 3$ is an acceptable wave function.

2. Check whether the operator $\hat{A} = \begin{pmatrix} 7i & 1 \\ 2 & -6i \end{pmatrix}$ is Hermitian or not.

3. What do you understand by the term bound states?

4. Point out any two important properties of the eigenfunctions of the particle in a box.

5. Find the value of the commutator $\left[\hat{x}, \hat{L}_x\right]$.

6. Explain the term space quantization.

7. When one should opt for pertubation theory? Mention any two perturbation methods that are widely used in quantum mechanics.

8. The second-order correction to the energy of the ground state is always negative. Why?

9. Show that the operators representing observables related to different (distinct) particles commute, while those related to a given (specific) particle satisfy the commutation relations valid for a single-particle system.

10. Define the term particle exchange operator.

Part B (5 × 5 = 25)

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

11. (a) State and prove Heisenberg's uncertainty principle.

Or

(b) If x and p_x are the coordinate and momentum operators, prove that $\left[x, p_x^n\right] = ni\hbar p_x^{n-1}$.

12. (a) Write down Schrödinger wave equation for a particle in a box. Solve it to obtain eigenfunctions and show that the eigenvalues are discrete.

Or

(b) Consider a particle of mass m in an infinite potential well of width a whose wave function is given by

$$\psi(x) = \begin{cases} \sqrt{\frac{105}{8a^7}} x\left(a^2 - x^2\right) & \text{for} \quad 0 < x < a \\ 0, & \text{everywhere} \end{cases}$$

Calculate position and momentum uncertainty, Δx and Δ_p, and the product $\Delta x\ \Delta_p$.

13. (a) Derive the eigenvalues of J^2 and J_z.

Or

(b) Find the angles between the angular momentum vector $\vec{L}$ and the z-axis giving all possible orientations of $\vec{L}$ for $l = 3$.

14. (a) Give the theory of first order Stark effect on the basis of quantum mechanics and discuss the splitting of the energy level.

Or

(b) Describe WKB approximation method and point out an application of this method.

15. (a) What are Pauli spin operators? Express Pauli spin operators in the form of a 2×2 matrices.

Or

(b) What is central field approximation method for evaluation potential energy function of many electron atoms?

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

Answer any **three** questions.

16. Discuss the Heisenberg representation for describing the dynamical behaviour of a system and obtain the equation of motion for an operator in this representation.

17. Solve the Schrödinger equation for a rigid rotator with free axis and obtain the eigenvalues and eigenfunctions.

18. Obtain Clebsch-Gordan coefficient when two angular momenta $j_1 = \frac{1}{2}$ and $j = \frac{1}{2}$ are coupled.

19. Discuss the variation method and calculate the expectation value of the Hamiltonian for a unit mass harmonic oscillator in ground state.

20. Find an expression for the electron density in Fermi-Thomas model and show that the radius of the sphere enclosing a fixed fraction of all electrons is proportional to $z^{-1/3}$.

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F–6337

Sub. Code
7MPHE1B

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

First Semester

Physics

Elective — CRYSTAL GROWTH PROCESSES AND CHARACTERIZATION

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Define the term *Supersaturation*.
2. How are seed crystals prepared?
3. Write the principle of gel growth.
4. What is *syneresis* process in gelling mechanism?
5. List the various crucible and heating materials used for melt growth methods.
6. What is dissociative sublimation?
7. Distinguish PVD and CVD.
8. List out some of the important transporting agents.
9. Write about the importance of indenter shape and material used in Vicker's microhardness tester.
10. Explain Beer-Lambert's law

Part B (5 × 5 = 25)

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

11. (a) Draw and explain Meir's T-C diagram and discuss the importance of metastable zone width.

Or

(b) Write short notes on Constant Temperature Bath and Crystallizer.

12. (a) Discuss the structure of silica gel with neat illustration and list out the advantages of gel method.

Or

(b) Describe chemical reduction and, complex and decomplexion methods of gel growth.

13. (a) Discuss the importance of different shapes of crucible and crucible material selection for Bridgman growth.

Or

(b) Write a short essay on Czochralski method of crystal growth.

14. (a) Discuss the various limitations of Chemical vapour deposition.

Or

(b) Describe electrocrystallization method of crystal growth.

15. (a) With neat schematic explain about atomic absorption spectrometer.

Or

(b) Describe the principle, instrumentation and working of SEM with neat diagram.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. (a) Discuss the different characteristics of good solvent.

    (b) Derive an expression for supersaturation.

    (c) Describe the slow evaporation and slow cooling methods with neat diagram. (3+2+5)

17. (a) Explain in detail the importance of gel method.

    (b) Describe single and double diffusion methods with suitable examples and diagrams. (5+5)

18. Describe the Bridgman method of crystal growth with neat diagrams.

19. With neat illustrations, explain the different design aspects of autoclaves for hydrothermal growth.

20. Explain the basic principle, instrumentation and working of powder X-ray diffraction method with neat diagram and discuss the various applications of Powder X-ray diffraction.

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F–6338

Sub. Code
7MPH2C1

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Second Semester

Physics

SOLID STATE PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Why zeroth order is not considered in X-ray diffraction?

2. Draw the Burgers circuit and Burgers vector for an edge dislocation.

3. Define shearing strain.

4. Explain the meaning of the normal modes of a lattice.

5. Define Fermi energy.

6. Explain the concept of hole.

7. Explain the term dielectric loss.

8. What is crystal field splitting?

9. What is Josephson tunneling?

10. What are magnons?

Part B (5 × 5 = 25)

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

11. (a) Describe the rotating crystal method to observe X-ray diffraction of any materials. What additional information do you get as compared to the Laue method?

Or

(b) Prove that *fcc* lattice is reciprocal to *bcc* lattice.

12. (a) Show that the velocity of the transverse wave in the [111] direction of a cubic crystal is given by $v_s = \left[\frac{1}{3}(C_{11} - C_{12} + C_{44})/\rho\right]^{\frac{1}{2}}$.

Or

(b) Define a phonon and list out its properties.

13. (a) Show that the Fermi-Dirac distribution function reduces to Maxwell-Boltzmann distribution function at very high temperature.

Or

(b) Write a short essay on tight bound approximation.

14. (a) Derive Clausius-Mossotti equation.

Or

(b) Discuss the quantum theory of diamagnetism.

15. (a) Obtain an expression for the magnetization of ferromagnetic material on the basis of Weiss theory.

Or

(b) Explain the flux quantization in superconducting ring.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Describe the crystal structures of the following materials with suitable diagrams.

    (a) NaCl

    (b) Diamond

    (c) CsCl

17. (a) Describe the inelastic scattering neutrons for the experimental determination of phonon spectra. (5)

    (b) Discuss the normal and Umklapp processes in thermal conductivity of non-metallic solids. (5)

18. (a) Derive an expression for the electrical conductivity of a metal on the basis of free electron theory. (5)

    (b) What is Mathiessen's rule? What are the various mechanisms lead to electron-electron scattering and thus contribute to electrical resistivity in a metal. (5)

19. (a) Discuss the theory of paramagnetism for conduction electrons. (5)

    (b) Write a short note on Cooling by adiabatic demagnetization. (5)

20. Write an elaborate essay on high temperature superconducting materials.

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F–6339

Sub. Code
7MPH2C2

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Second Semester

Physics

MATHEMATICAL PHYSICS – II

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Find $L\left[e^t \cos^2 t\right]$.

2. Find the inverse Laplace transform of $\frac{3p+7}{p^2-2p-3}$.

3. What is the nature of the partial differential equation $\phi_{xx} + 4\phi_{xy} + 3\phi_{yy} + \phi_x + \phi_y = 2$.

4. A semi-infinite plate 10cm in thickness has its faces at 0º C and its base at 100º C. The steady state temperature at any point of the plate is written as $\psi(x,y) = \sum_{n=1}^{\infty} A_n e^{-nby} \sin nbx$. Find the values of A_n and b.

5. What is the value of $\delta_{ik}\varepsilon_{ikm}$?

6. If A_μ and B_γ are components of contravariant and covariant vectors, what is the nature of the quantity $A^\mu B_\gamma$?

7. Show that the group formed by three cube roots of unity is Abelian and cyclic.

8. Show that all even integers form the group under the law of ordinary addition.

9. Prove $\beta(p,q) = \beta(p+1,q) + \beta(p,q+1)$.

10. Prove that $H_n(-x) = (-1)^n H_n(x)$.

Part B (5 × 5 = 25)

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

11. (a) Find the Laplace transformation of a square wave function.

Or

(b) Using convolution theorem, evaluate $\frac{1}{\pi}\int_{-1}^{1} e^{itw}\left(1-w^2\right)^{-1/2} dw.$

12. (a) Obtain the solution of the partial differential equation $u_{tt} - u_{xx} = 0$ satisfying the boundary conditions $u(0,t) = 0 = u(L,t)$ and initial conditions $u(x,0) = \sin\left(\frac{\pi x}{2}\right)$ and $u_t(t=0) = \sin\left(\frac{2\pi x}{L}\right)$.

Or

(b) Derive the solution of the partial differential equation $u_t = u_{rr} + \frac{1}{r}u_r + \frac{1}{r^2}u_{\theta\theta} + v_{zz}$ by assuming $u(r,\theta,z,t) = R(r)f(\theta)g(z)L(t)$.

13. (a) Define symmetric and antisymmetric tensors. Show that any contravariant or covariant tensor of second rank can be expressed as the sum of a symmetric and an antisymmetric tensor of the same rank.

Or

(b) Define covariant derivative of a tensor and show that it is a covariant tensor of rank one greater that the given tensor.

14. (a) List the symmetries of a general rectangle. Work out the multiplication table and divide the elements into classes.

Or

(b) Prove that, if every element of a group is its own inverse then the group must be Abelian.

15. (a) Show that $H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n} e^{-x^2}$, where H_n is the Hermite polynomial.

Or

(b) Prove that $\cos x = J_0 - 2J_2 + 2J_4 - 2J_6 + \cdots$ where $J_n(x)$ is the Bessel function.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Solve $x'' + y' + 3x = 15e^{-t}$ and $y'' - 4x' + 3y = 15\sin 2t$, where prime denotes differentiation with respect to time t subject to $x(0) = 35, x'(0) = -48$, $y(0) = 27$, $y'(0) = -55$.

17. Write down Laplace equation in spherical polar coordinates and find its solution.

18. State and prove quotient law of tensors. Show its use with suitable examples.

19. Prove the great orthogonality theorem.

20. Prove that $\int_0^\infty e^{-x^2} H_n(x) H_m(x) dx = 2^n n! \sqrt{\pi} \delta_{n,m}$.

F–6340	Sub. Code
	7MPH2C3

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Second Semester

Physics

ELECTROMAGNETIC THEORY

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. State Coulomb's law.

2. Define electrostatic energy.

3. Write down the Lorentz force equation.

4. In what way magnetic potential differs from the electric potential?

5. List out the Maxwell's equation for free space.

6. Why Maxwell's displacement current contribute nothing in magnetostatics?

7. How will you define skin depth?

8. What is group velocity?

9. Differentiate normal and anomalous dispersion.

10. Recall Thomson scattering.

Part B (5 × 5 = 25)

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

11. (a) Write a note on differential form of Gauss law.

Or

(b) Derive an expression for the electric potential of a multipole expansion.

12. (a) Write a note on magnetic field due to an infinite current carrying wire.

Or

(b) Show that **B** = Curl **A**, magnetic induction is curl of vector potential.

13. (a) Briefly discuss Faraday's law of induction.

Or

(b) Mention the physical significance of Poynting vector.

14. (a) Solve Maxwell's equation in free space to show that electromagnetic field vectors E and H are both perpendicular to the direction of propagation vector **K**.

Or

(b) Elaborate the TM and TE modes of cylindrical waveguide.

15. (a) Elaborate the characteristics of normal dispersion.

Or

(b) Comment on polarization of scattered light.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. State and prove uniqueness theorem. Also describe Dirichlet boundary conditions on the basis Green's function.

17. Show that the force between two current loops is equal in magnitude but opposite by direction. Also state and prove Ampere's law in circuital form.

18. Derive Maxwell's equation for electromagnetic field and discuss their physical meaning.

19. Arrive at Fresnel's equation for non-conducting media when electric field vector E is parallel to the plane of incidence.

20. Explain the theory of scattering of electromagnetic waves.

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F–6341

Sub. Code
7MPH2C4

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Second Semester

Physics

QUANTUM MECHANICS – II

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Define Fermi's golden rule of transition probability
2. What is meant by sudden approximation?
3. What does partial wave refer to?
4. Give any two importance of scattering
5. Write down the Einstein's B coefficient.
6. What are the differences between absorption and emission?
7. Give the D'Alembert's operator.
8. Write down the 4 × 4 matrices of α in Dirac's spin matrices method.
9. Write down the non-relativistic Schrodinger's equation for a field.
10. When second quantization will occur?

Part B (5 × 5 = 25)

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

11. (a) Derive Schrodinger's time dependent perturbation theory.

Or

(b) Discuss the sudden change in energy using sudden approximation method.

12. (a) Derive an expression for scattering amplitude for a low energy scattering.

Or

(b) Express scattering amplitude in terms of Green's function.

13. (a) Calculate the electric dipole transition probability for an atom placed in a radiation field.

Or

(b) Explain how the selection rules follow naturally in the case of transition probabilities.

14. (a) Derive Klein-Gordon equation.

Or

(b) Discuss briefly the existence of negative energy states.

15. (a) State and explain Schrodinger field.

Or

(b) State and explain Dirac's field.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. State and prove Fermi's Golden rule for a transition of continuum.

17. Using partial wave analysis, prove that there exist a phase shift on the scattered wave for a low energy scattering process.

18. Prove that the transition probability of Linear harmonic oscillator oscillates sinusoid ally.

19. From the Dirac's relativistic wave equation deduce Dirac's spin matrices.

20. Derive quantum equation of the generalized field.

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F–6342

Sub. Code
7MPH3C1

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Third Semester

Physics

ATOMIC AND MOLECULAR PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is LS coupling scheme?

2. Give any two examples for halogens and chemically inactive elements.

3. Draw the molecular structure of butadiene.

4. Define optical pumping.

5. Differentiate the rotational spectra of symmetric top and asymmetric top molecules.

6. Mention the significance of characteristic frequencies of IR Spectra.

7. Give the selection rule for Raman spectroscopy.

8. How will you define dissociation energy?

9. Write down the basic principles of NMR.

10. Define 'g' factor.

Part B (5 × 5 = 25)

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

11. (a) Explain the fine structure of alkali Spectra.

Or

(b) State and explain Pauli's exclusion principle as applied to electrons in atoms.

12. (a) Briefly explain the phenomenon of Paschen - Back effect.

Or

(b) Illustrate Huckel's molecular approximation.

13. (a) Describe the rotational spectra of polyatomic molecule in microwave spectroscopy.

Or

(b) Elaborate characteristics and group frequencies in IR spectroscopy.

14. (a) Give a short note on Quantum theory of Raman Effect.

Or

(b) Analyse Franck-Condon Principle.

15. (a) With neat diagram, describe the single coil method in NMR.

Or

(b) Make a note on the characteristics and biological applications of ESR.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Give a detailed explanation of Stern and Gerlach experiment and point out the significance of the results.

17. Discuss the molecular orbital theory of H_2.

18. Explain the rotational spectra of polyatomic molecules.

19. Enumerate the rotational and vibrational Raman shifts of diatomic molecules.

20. Elucidate the following:

    (a) Bloch equations and

    (b) Importance of Chemical Shift in NMR Spectroscopy.

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F–6343	Sub. Code
	7MPH3C2

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Third Semester

Physics

NUCLEAR AND PARTICLE PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Define magic numbers.

2. Give a note on spin independence.

3. List out any two uses of particle detectors.

4. Write the principle of semiconductor detector.

5. List out the advantages of nuclear reactor.

6. What is controlled thermonuclear reaction?

7. When is the nuclear reaction said to be exoergic and endoergic?

8. Why is the theoretical formula of cross section also called as dispersion formula?

9. Differentiate Bosons and Fermions.

10. Write down the quark composition of proton and neutron.

Part B (5 × 5 = 25)

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

11. (a) Write the salient features of liquid drop model.

Or

(b) Explain Yukawa's meson theory of nuclear forces.

12. (a) Give a brief outline on nuclear isomerism.

Or

(b) Describe the construction and working of ionization chamber.

13. (a) With a neat diagram, explain the working of Betatron.

Or

(b) Describe the four factor formula in nuclear chain reaction.

14. (a) Classify the types of nuclear reaction and explain with example.

Or

(b) Comment on Stripping and Pick-up reactions.

15. (a) Classify elementary particles.

Or

(b) Figure out the importance of Quark model.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Enumerate the properties of deuteron nucleus and prove that it is loosely bound in ground state.

17. Relate disintegration constant and energy of the α particle using Gamow's theory of alpha decay.

18. Discuss the construction and working of a cyclotron with its limitations.

19. Elaborate the following in nuclear reactions:

    (a) Q equation (b) Compound nucleus

20. Elucidate the space-inversion invariance and combined inversion of CPT.

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F–6344	Sub. Code
	7MPH3C3

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Third Semester

Physics

ADVANCED ELECTRONICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Give the symbol and structure of Schottky diode.

2. What is a TRIAC? Give the symbol and structure of TRIAC.

3. Write the output expression for differentiator circuit.

4. For the non-inverting amplifier given that input voltage is 0.5V and R1=1KΩ and R_f =10KΩ. Calculate the output voltage.

5. What is race around condition? In which Flip-flop it is overcome.

6. Compare Static RAM with dynamic RAM.

7. Define the term accuracy of DACS.

8. What is VCO?

9. Define modulation index of FM.

10. What is strapping in magnetron? How is the same effect obtained without strapping?

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

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

11. (a) With neat diagram, explain the operation of Solar cell.

Or

(b) With neat diagram explain the operation of MOSFET in Enhancement mode.

12. (a) Explain how operational amplifier can be used as voltage follower.

Or

(b) Draw the neat circuit of first order low pass filter and describe it.

13. (a) Explain JK flip-flop with truth table, logic symbol and logical circuit.

Or

(b) Explain 4-bit Asynchronous ripple counter.

14. (a) Explain the operation of binary weighted resistor DAC.

Or

(b) With a neat diagram explain the action of phase shift oscillator.

15. (a) With a graph explain the characteristics of Gunn diode.

Or

(b) Explain the indirect method of generation of FM wave.

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

Answer any **three** questions.

16. Draw and explain the circuit diagram of a NPN transistor CE configuration and the input and output characteristics.

17. The non-inverting input and the inverting input of an operational amplifier are connected to 150 μV and 140 μV respectively. The amplifier has a differential gain of 4000 and CMRR =100. Determine the output voltage of the operational amplifier.

18. Describe the working principle of charged coupled devices.

19. Explain the operation of successive approximation ADC.

20. Explain the generation of SSB using balanced modulator.

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F–6345

Sub. Code
7MPHE2B

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Third Semester

Physics

Elective : MODERN OPTICS AND LASER PHYSICS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Write down the relation between speed of light and electric constants.

2. How will you define linear, circular and elliptical polarization?

3. Define coherence length.

4. Point out any two advantages of Fourier transform spectroscopy.

5. List out any four examples for Fraunhofer diffraction.

6. Why is thin lens considered as phase transformer?

7. What is nonlinear polarization?

8. Is self-focusing a nonlinear refraction phenomenon? Justify.

9. List the various pumping schemes available to achieve population inversion.

10. Draw the layout of semiconductor laser.

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

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

11. (a) Write a note on phase and group velocity.

Or

(b) Mention the significance of Evanescent waves in total internal reflection.

12. (a) Perform Young's double slit experiment to demonstrate interference.

Or

(b) Explain the function and nature of fringes of Michelson interferometer.

13. (a) Elaborate Huygen's - Fresnel principle.

Or

(b) Analyze the role of film nonlinearity and thickness in holography.

14. (a) Arrive at an expression for nonlinear polarization.

Or

(b) Prove that $\eta(\omega) = \eta(2\omega)$ is the phase matching condition.

15. (a) Why is population inversion not possible in two level laser rate equations?

Or

(b) How does a ruby laser work?

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. Briefly describe the reflection and refraction at a plane boundary.

17. Determine the wavelength of monochromatic light using Fabry-Perot interferometer.

18. Describe in detail Gabor hologram. Also mention how hologram can be used in microscopy?

19. Give a detailed note on

    (a) Franken experiment and

    (b) Stimulated Raman scattering.

20. Explain the construction, working and involved electronic transitions in Nd:YAG laser.

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F–5120	Sub. Code
	7MPHE1A

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

FIRST SEMESTER

Physics

Elective – NUMERICAL METHODS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** the questions.

1. Write the statement of least-squares approximation.

2. What is meant by geometrical regression?

3. Define pivot row and pivot element in the Gauss elimination method.

4. Write the modification introduced by Jordan in the Gauss elimination method.

5. Define the forward and backward difference quantities.

6. Compute the value of $f(0.6)$ using the data $(x, f) = (0,1)$ and $(1,2.718)$ by the Lagrange interpolation method.

7. Find $x(0.1)$ applying Euler method to the equation $x' = -x + \sin t,\ x(0) = 1$.

8. Write the Runge-Kutta formula for solving a system of three first-order equations.

9. Write the general formula of the numerical integration algorithms.

10. Obtain a formula for the second derivative of a function.

Part B (5 × 5 = 25)

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

11. (a) Explain the detection of errors in a graphical method.

Or

(b) Explain the method of linear regression.

12. (a) For the Newton-Raphson method show that the order of convergence is quadratic.

Or

(b) Write a C program for finding a root of the equation $0.75E^2 + 0.35E - 0.023 = 0$ with 5 decimal accuracy by the Newton-Raphson method with the initial guess of $E = -0.5$.

13. (a) The measured value of current I in an electronic circuit as a function of applied voltage V is given below. It is required to know the current for the applied voltage $1.65V$. Calculate it using Lagrange interpolation formula.

V in volts	1	1.5	2
I in ampere	0.1	0.15	0.2

Or

(b) The mass of a radioactive decaying sample measured at 4 times is given below. Determine the mass of the sample after 12 days using Gregory-Newton forward interpolation formula.

Time in days	0	5	10	15
Mass in mg	1	0.42	0.17	0.08

14. (a) Derive the improved Euler formula for first-order differential equation.

Or

(b) The velocity of a particle is given by $1–exp(–t)$. If the initial position of the particle is 1 m from the origin calculate the position of the particle at $t = 0.1$ sec by the improved Euler method.

15. (a) Derive the trapezoidal rule.

Or

(b) The distance traveled by a car at intervals of 5 minutes are given below. Evaluate the speed of the car at 10 minutes applying an appropriate difference formula.

Time in minutes	0	5	10	15	20
Distance in km	0	4.5	10	14.8	21

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. A particle of charge q is accelerated to 5 different potentials of V volts and the corresponding masses m are measured. The ratio m/m_0 where m_0 is the rest mass as function of V is given below. Fit the data to the relation $m = m_0(aV + b)$.

V in volts	1	2	3	4	5
m/m_0	1.5	2	2.5	3	3.5

17. Find a root of the equation $x^3 - 8 = 0$ with 5 decimal accuracy using $x_0 = 2.5$ by Newton- Raphson method.

18. The distance of a particle measured at various time is given below. Calculate the distance of the particle at t = 0.9 minute using divided difference formula.

Time in minutes	0	0.5	1.1	1.5
Distance in metre	0	2.2	4.3	5.9

19. Given $y' = x - y$ with $y(0) = 1$ compute $y(0.1)$ using the fourth-order Runge-Kutta method.

20. Write a single C program to evaluate the integral $I = \int_0^3 x(\sin \pi x)(\sin 2\pi x)dx$ by both trapezoidal and Simpson's 1/3 rules.

F–5406

Sub. Code
7MPHE2A

M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

Third Semester

Physics

ELECTIVE–MICROPROCESSOR AND MICROCONTROLLERS

(CBCS – 2017 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. How many memory locations can be addressed by a microprocessor with 14 address lines?

2. Which register can be used as a data pointer in 8085?

3. Give one example is implied addressing mode.

4. Which instruction is used to operate the stack?

5. What are the internal devices of 8255?

6. What are the functions performed by port-C of 8255?

7. Name the five interrupt sources of 8051.

8. Explain the functions of the pin PSEN of 8051.

9. Where the successive approximation type ADCs used?

10. What is signal conditioning?

Part B (5 × 5 = 25)

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

11. (a) Explain the requirement of program counter, stack pointer and status flags in the architecture of 8085 microprocessor.

Or

(b) Briefly explain the function of interrupt pins in microprocessor 8085.

12. (a) Write an ALP to connect the Hexadecimal number to a decimal number.

Or

(b) Discuss 8085 microprocessor instructions for data transfer schemes with suitable examples.

13. (a) What are the operating modes of 8255A? Explain with suitable examples.

Or

(b) Explain DMA controller 8257 with suitable diagrams.

14. (a) What is a Timer? Explain Timer mode 0 in 8051 microcontroller.

Or

(b) Explain PSW (program status word) in 8051 microcontroller.

15. (a) Explain the principle of operation of successive approximation ADC.

Or

(b) Write an assembly language program for D/A interfacing for generating square waveforms.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. (a) Explain interrupt system in 8085.

(b) Explain the internal architecture of ALU and resister organization in 8085 with suitable diagrams.

17. (a) (i) Example the 8085 architecture and logical instruction with some examples.

(ii) Describe the execution of PUSH and POP instructions.

(b) Explain software interrupts and interrupt service routine (ISR).

18. (a) Explain USART (8251A)

(b) Explain the control word of 8253 timer/counter.

19. (a) Explain I/O port structure of 8051.

(b) (i) Distinguish types of JMP and CALL instruction of 8051 with example.

(ii) Explain Interrupt enable (IE) and Interrupt priority (IP).

20. (a) Explain in detail Temperature measurement and control.

(b) Explain pulse width measurement (frequency measurement) using 8051.

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