A–10197	Sub. Code
	4MPH1C1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

First Semester

Physics

MATHEMATICAL PHYSICS – I

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. A particle move along the curve $x = 2t^2$, $y = 4t^2 - 1,$, $z = 5t - 3,$ where t denotes time. Find the components of acceleration at $t = 1$ in the direction $\hat{i} - 2\hat{j} + 2\hat{k}$

2. Consider a spherical polar coordinate system given by $\vec{r} = r\cos\phi\sin\theta\hat{i} + r\sin\theta\sin\phi\hat{j} + r\cos\theta\hat{k}$. Find the unit vectors $\hat{e}_r$ and $\hat{e}_\theta$.

3. Find the value of k such that the set of equations $(1+k)x - y - 3z = 0$, $x + (2-k)y = 0, 3x + (2-k)z = 0$ have non-trivial solution.

4. Write the equations of the following conic section $x^2 + 6xy - 2y^2 - 2yz + z^2 = 24$ in matrix form.

5. Evaluate $\int_c \frac{1}{z} dz$, where C is the circle $|z| = 1$.

6. Obtain a series expansion for the function $f(z) = \frac{z}{(z-1)(z+2)}$ about $z = 0$.

7. Prove that the differential equation $y'' + y = 0$ has no solution for the boundary condition $y(0) = 1$ and $y(\pi) = 1$.

8. Find the order and degree of the differential equation $(1 + y')^{\frac{3}{2}} = y''$.

9. Find the Fourier transformation for $e^{-|x|}$

10. State any two applications of Fourier transforms.

Part B (5 × 5 = 25)

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

11. (a) Let $\vec{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$. Evaluate $\int \vec{F}.\hat{n}dS$, where S is the surface of the cube bounded by $x = 0$, $x = 1$ $y = 0$, $y = 1$, $z = 0$, $z = 1$.

Or

(b) Prove $\int\int\int_V (\phi\nabla^2\psi - \psi\nabla^2\phi)dV = \int\int (\phi\vec{\nabla}\psi - \psi\vec{\nabla}\phi).d\vec{s}$.

12. (a) Solve the following equations $x - y + 2z = 3$, , $x + 2y + 3z = 5$ $3x - 4y - 5z = -13$.

Or

(b) For the two vectors $A=(3+i,1,2-i,-5i,i+1)$, $B=(2i,4-3i,1+i,3i,1)$ verify that the Schwartz inequality is satisfied.

13. (a) Find the general solution of the differential equation $4x^2y''-8xy'+9y=0$.

Or

(b) Solve the system of differential equations $\frac{dx}{dt}=-y,\frac{dy}{dt}=x$ and the draw the graphs

(i) x verses t,

(ii) y verses t and

(iii) x verses y with t as a parameter.

14. (a) Evaluate $\int_c \frac{(4-3z)dz}{z(z-1)(z-2)}$, where C is $|z|=\frac{3}{2}$, by residue theorem.

Or

(b) Find the Laurent series of the function $f(z)=\frac{z}{(z+1)(z+2)}$ about $z=-2$.

15. (a) Find the inverse Fourier Transform of $\bar{f}(p)=e^{-|p|y}$, where y belongs to $(-\infty,\infty)$.

Or

(b) Find the Fourier sine and cosine transform of the function x^{m-1}.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Verify the divergence theorem for $\overline{A} = 4x\hat{i} - 2y^2\hat{j} + z^2\hat{k}$ taken over the region bounded by $x^2 = y^2 = 4, z = 0$ and $z = 3$.

17. Calculate the trace of the real 4×4 matrix $U = e^A$, where $A = \begin{pmatrix} 0 & 0 & 0 & \frac{\pi}{4} \\ 0 & 0 & \frac{\pi}{4} & 0 \\ 0 & \frac{\pi}{4} & 0 & 0 \\ \frac{\pi}{4} & 0 & 0 & 0 \end{pmatrix}$.

18. Prove that eigen functions coming out from Strum-Liouville problem are orthogonal to each other.

19. State and prove Cauchy's integral formula.

20. Obtain half range cosine series for $f(x) = \begin{cases} kx & 0 \le x \le \frac{l}{2} \\ k(l-x) & \frac{l}{2} \le x \le l \end{cases}$. Hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots$

A–10389	Sub. Code
	4MPH1C2

M.Sc. DEGREE EXAMINATION, APRIL 2021 &
Supplementary/Improvement/Arrear Examinations

First Semester

Physics

CLASSICAL DYNAMICS AND RELATIVITY

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** questions.

1. List different kinds of constraints with one example for each.

2. State Noether's theorem.

3. Define central force. Write any two central forces you know.

4. State Virial theorem.

5. Differentiate between phase velocity and group velocity.

6. How do you determine an equilibrium point as stable or unstable?

7. The Poisson bracket $\{p, q\}_{q,p}$ value is _____

8. How do you check the given transformation is a canonical one?

9. Write Lorentz transformation.

10. Write the postulates of relativity.

Part B (5 × 5 = 25)

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

11. (a) Solve the equation of motion for the following Lagrangian $L=\left(\frac{1}{2}mq^2-\frac{1}{2}kq^2\right)$

Or

(b) Using the techniques of the calculus of variations, derive the Euler Lagrange's equations of motion from Hamilton's principle.

12. (a) Reduce the two body problem into equivalent one body problem and obtain the equation of motion for r in the case of central forces.

Or

(b) Obtain the expression for differential cross section in scattering in a central force.

13. (a) Describe the motion of a symmetrical top.

Or

(b) Derive the transformation matrix for the rotation in three dimensional space using Euler's angles.

14. (a) Derive the Hamilton's equation of motion using variational principle.

Or

(b) Obtain the Hamilton's equations of motion for a particle in Poisson bracket formalism.

15. (a) Two electrons, each of velocity 0.8 c, move towards each other. Find the relative velocity of one electron with respect to each other.

Or

(b) Derive the expression for mass energy equivalence.

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

Answer any **three** questions.

16. Derive Euler-Lagrange's equation from DAlembert's principle.

17. Derive the Kepler's laws for inverse square law of force.

18. Obtain normal modes of the free vibrations of a linear triatomic molecule.

19. Explain Hamilton-Jacobi formalism using simple harmonic oscillator.

20. Show that Maxwell equations are invariant under Lorentz transformation.

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A–10390	Sub. Code
	4MPH1C3

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

First Semester

Physics

ADVANCED ELECTRONICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** questions.

1. Why ordinary transistor is called bipolar?
2. What is pinch-of voltage in JFET?
3. Draw the schematic symbol of OP-AMP and list the different terminals.
4. Define slew rate.
5. What are advantages of TTL circuits?
6. For what applications permanent memories like ROMs are used?
7. What are different types of D/A converters?
8. List out the applications of astable multivibrator.
9. What are advantages of FM over AM?
10. What is tunnelling?

Part B (5 × 5 = 25)

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

11. (a) Compare JFET with BJT.

Or

(b) What is TRIAC? Sketch its characteristics and describe its operation.

12. (a) Explain the operation of inverting and non-inverting operational amplifier.

Or

(b) Explain how first –order low-pass filter can be constructed using an operational amplifier.

13. (a) Explain charge coupled devices (CCD).

Or

(b) Implement up-down counter using flip-flop and explain its operations.

14. (a) Explain the working R-2R ladder type of D/A converter.

Or

(b) Draw sample and hold circuit and describe their operations.

15. (a) Derive the expression for the spectrum of FM wave.

Or

(b) Explain the working principles of Gunn diode.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

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

17. Explain the describe characteristics of an instrumentation amplifier with the help of a circuit diagram.

18. Explain in detail different classification of ROMs.

19. Explain the function of successive approximation method in A/D converter.

20. With a suitable schematic diagram, explain various parts and its operations of Reflex klystron oscillator.

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A–10391

Sub. Code
4MPH1C4

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

First Semester

Physics

SOLID STATE PHYSICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** the questions.

1. Define point group.

2. What is the difference between a Schottky defect and a Frenkel defect?

3. Define stress and strain.

4. What are phonons?

5. What is Mathiessen's rule?

6. What do you mean by Brillouin zone?

7. Explain the term electric susceptibility.

8. What is paramagnetism?

9. Explain the origin of Weiss molecular field in ferromagnetic materials.

10. What is flux quantization?

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

Answer **all** the questions.

11. (a) Deduce Bragg's law in reciprocal lattice. Show that the reciprocal lattice to bcc is fcc.

Or

(b) Briefly describe the crystal structures of *CsCl* and Diamond with suitable diagrams.

12. (a) Distinguish between group velocity and phase velocity of a wave and establish relation between them. In which case these two velocities are equal?

Or

(b) Write a short note on inelastic scattering of neutrons by phonons.

13. (a) What is Hall effect? Discuss its importance in characterizing a semiconductor material.

Or

(b) Give a brief account of de Hass Van Alphen effect.

14. (a) Establish Claussius-Mossotti relation.

Or

(b) Discuss quantum theory of diamagnetism.

15. (a) What is Antiferromagnetism? Give molecular field theory treatment of antiferromagnetism.

Or

(b) Obtain London's equations in superconductivity.

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

Answer any **three** questions.

16. Describe the rotating crystal method for the experimental determination of crystal structure.

17. Obtain the dispersion relation for a linear diatomic lattice and show that its vibrational spectrum consists of two branches, acoustical and optical.

18. Describe Kronig-Penny model of electrons moving in a periodic potential. How does it lead to the formation of forbidden energy gaps?

19. Describe the following

(a) Cooling by adiabatic demagnetization.

(b) Paramagnetic susceptibility of conduction electrons.

20. Discuss ac Josephson effect. Show that the current oscillates with frequency $w = \frac{2eV}{\hbar}$.

A–10392	Sub. Code
	4MPH1E1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

First Semester

Physics

Elective – NUMERICAL METHODS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** questions.

1. If $x = 0.9$, find $f|x| = 1/|1-x^2|$. If there is an error of +0.01 in x, comment on the error in computing $f(x)$.

2. Define absolute and relative errors with example.

3. What is the purpose of fitting a curve to a given data?

4. Define rate of convergence of an iteration method. What does it signify?

5. If $P[x]$ is an interpolating polynomial for the data $\{x_i, y_i\}$ then $y_i = P|x_i|$ not for all i (True / False) Justify.

6. Write an equation of the form $f(x) = 0$ to find $\sqrt[3]{11}$.

7. Find the number of roots of a polynomial of degree n.

8. Find the root and its multiplicity of an equation $|x - X_0|^m h(x) = 0$.

9. Why Simpson's method is better than trapezoidal method for numerical integration?

10. What is intermediate value theorem?

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

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

11. (a) Describe the method of least squares to fit a straight line for a given data.

Or

(b) Develop a method of least squares to fit the curve $y = \frac{a}{x} + b\sqrt{x}$ for a given data.

12. (a) Solve the equation $x = e^{-x}$ using Newton-Raphson method with error tolerance 10^{-5}.

Or

(b) Solve the following system of equations using Gauss elimination method.

$$x + y + z = 1,$$
$$4x + 3y - z = 6,$$
$$3x + 5y + 3z = 4$$

13. (a) Find an interpolating polynomial for the following data.

x	0	1	2	4	5	6
y	1	14	15	5	6	19

Or

(b) Write down the Newton-Gregory forward difference interpolation formula along with the table.

14. (a) Differentiate trapezoidal and Simpson methods of integration. Which method is expected to give more accurate result and why?

Or

(b) Obtain the three point formula for the second derivative of a function *f(x)*.

15. (a) Describe Euler method to solve the initial value problem $\frac{dy}{dx} = f|x, y|$.

Or

(b) If $\frac{dy}{dx} = x^2 - y$ with $y(0) = 1$, find $y(0.1)$, $y(0.2)$ using Runge-Kutta second order method.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Using the method least squares approximation, fit a straight line for the following data. Find the total error in the approximation.

x_i	1	1.1	1.3	1.5	1.9	2.1
y_i	1.9	1.96	2.18	2.45	2.9	3.3

17. Solve the equation $\cos x - xe^x = 0$ using Newton-Raphson method, to the accuracy of 5 decimal places. Write a C program to implement the same in computer.

18. Consider a spherical solid ball of radius *r*, submerged to a depth *d* in water. If ρ is the density of the solid, write an equation for the depth *d*. If *r* =10 cm and ρ = 0.638 gm/cm^3, find *d* upto 6 decimal places. Discuss your results in detail.

19. Since there is no analytical method, evaluate $\int_0^1 \frac{x^3}{e^x - 1}$ numerically with step size $h = 0.1$.

20. Solve the equation $y' = \exp(t - y)$ for $0 \le t \le 1$, $y(0) = 1$ with $h = 0.2$ using Runge-Kutta second order method. Compare the approximations for $y(0.2)$, $y(0.4)$ with that of the exact solution $y(t) = \ln(e^t + e - 1)$.

A–10393	Sub. Code
	4MPH2C1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Second Semester

Physics

MATHEMATICAL PHYSICS II

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** questions.

1. What does a Fourier transform do?

2. What is the initital condition for the determination of Laplace transform?

3. Define a parabolic partial differential equation. Give an example fort it.

4. How many independent variables are there in a partial differential equation?

5. Determine the number of independent components of an anti-symmetric tensor P_{ij} with indices i and j running from 1 to 5.

6. By elementary arguments show that the physical quantity strain cannot be a tensor.

7. What do you mean by permutation group?

8. Define cyclic group.

9. What are the singular points of the Legendre differential equation?

10. Write the characteristics of a normal curve.

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

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

11. (a) Find the cosine transform of a function of x which is unity for $0 < x < a$ and zero for $x \geq a$. What is the function whose cosine transform is $\sqrt{\frac{2}{\pi}} \frac{\sin ap}{p}$.

Or

(b) Find the inverse Laplace transform of $f(s) = \frac{1}{s(s+2)^3}$

12. (a) Solve the one-dimensional wave equation by any one of the methods.

Or

(b) Demonstrate the separation of variable method by considering a one dimensional partial differential equation.

13. (a) Show that every tensor can be expressed as the form of two tensors, one of which is symmetric and the other is skew-symmetric in a pair of covariant and contravariant indices.

Or

(b) Show that the velocity of a fluid at any point is a contravariant vector of rank one.

14. (a) What is meant by isomorphic and homomorphic groups? Demonstrate them with an example.

Or

(b) Obtain the irreducible representation of C_{3v} point group and construct its character table.

15. (a) Show that by direct substitution $\frac{\sin x}{\sqrt{x}}$ satisfies the Bessel differential equation $x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - \frac{1}{4})y = 0.$

Or

(b) Calculate mean and standard deviation of Binomial distribution.

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

Answer any **three** questions.

16. With the help of Laplace transform solve the differential equation $t^2 \frac{d^2x}{dt^2} + \frac{dx}{dt} + 4tx = 0$ subject to $x(0) = 3$ and $\dot{x}(0) = 0.$

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

18. Discuss the application of tensor analysis to the dynamics of a particle.

19. State and prove Schur's lemma.

20. Prove the $\int_{-1}^{1} P_n(x)P_m(x)dx = \frac{2}{2n+1}\delta_{nm}$ where P_n and P_m are Legendre polynomials. Verify the above relation explicitly by considering the polynomials $P_2(x)$ and $P_1(x)$.

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A–10394	Sub. Code
	4MPH2C2

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Second Semester

Physics

ELECTROMAGNETIC THEORY

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. State Coulomb's law.

2. Write the expression for electric field of a continuous line and volume charge distribution.

3. Define Lorentz force law

4. Compare electrostatics and magnetostatics.

5. Define Poyniting vector.

6. Recall Coulomb's gauge.

7. State Snell's law of refraction.

8. How will you define group velocity?

9. Write down the significance of retarded potential.

10. Point out the fundamentals of Thomson scattering.

Part B (5 × 5 = 25)

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

11. (a) Comment on the divergence of electric filed using Gauss's law.

Or

(b) Deduce Laplace equation in one dimension.

12. (a) State Biot-Savart law and relate it to Ampere's law.

Or

(b) Write a short note on magnetostatic boundary conditions.

13. (a) With aid of Faraday's experiment, explain laws of electromagnetic induction.

Or

(b) Discuss about the Lorentz gauge and invariance.

14. (a) Analyze the condition for total internal reflection.

Or

(b) Describe the TM modes in Propagation of electromagnetic waves in rectangular wave guides.

15. (a) Derive Jefimenko's equations.

Or

(b) Compare normal and anomalous dispersion.

Part C (3 × 10 = 30)

Answer any **Three** questions.

16. Explain electrodynamics of a charged particle in an electric field.

17. Obtain an expression for the magnetic vector potential and magnetic induction due to a current carrying element.

18. Discuss the formulation of Maxwell's equation. Also write the significance of displacement current.

19. Derive the plane electromagnetic waves in an isotropic medium.

20. Elaborate electric dipole radiation.

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A–9842	Sub. Code
	4MPH2E1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &
Supplementary/Improvement/Arrear Examinations

Second Semester

Physics

Elective-NANO SCIENCE

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. List out some of the important features of deBroglie wavelength.

2. Define enthalpy and entropy.

3. State the principle of electrodeposition.

4. List out the disadvantages of CVD.

5. How CNTs types can be classified?

6. Mention any three applications of carbon nanotubes?

7. Discuss the applications of photonic crystals.

8. Define photonic bandgap.

9. What is nanoelectronics?

10. List out the applications of MEMS device.

Part B (5 × 5 = 25)

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

11. (a) Briefly explain about atomic structure.

Or

(b) Explain the size dependent effects in nanoscale systems with suitable illustrations.

12. (a) Describe the kinetics of sol-gel process.

Or

(b) What are the advantages of high energy ball milling processes? Explain.

13. (a) Write a short note on self-assembled monolayers.

Or

(b) Explain about the physico-chemical properties of CNTs.

14. (a) Give a brief note on reflectance, transmission, polarization and radiation.

Or

(b) Briefly discuss about new low cost energy efficient windows.

15. (a) Give a brief account on quantum electronic devices.

Or

(b) What is meant Docoherence? How it affects the quantum computation?

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. (a) What is nanotechnology? Explain its types. (5)

(b) Discuss about the limitations of optical lithography in top-down approaches. (5)

17. (a) List out the advantages of nanomaterials over bulk counterparts. (4)

(b) With neat diagram describe chemical vapour deposition process of nanomaterials preparation. (6)

18. (a) Describe in detail the purification process of carbon nanotubes. (5)

(b) Outline the structure of DNA and RNA and its significance. (5)

19. (a) Write short note on nano holes and photons. (5)

(b) Discuss the basics of photo generated charge carriers. (5)

20. (a) Give a brief account on quantum information. (5)

(b) Explain the fabrication process of MEMS. (5)

A–10198	Sub. Code
	4MPH2C3

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement / Arrear Examinations

Second Semester

Physics

THERMODYNAMICS AND STATISTICAL PHYSICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Give an example where heat transfer takes place from a lower temperature to a higher temperature. Does this example violate the second law of thermodynamics?

2. Define first order phase transition.

3. Point out which physical quantity is transported in the case of conductivity and diffusivity of gas.

4. What do you mean by fluctuation? How it is measured?

5. State any two limitations of Maxwell-Boltzmann statistics.

6. Obtain the expression for the partition function for a system of distinguishable particles distributed in three non-degenerate states having energy 0, E and $3E$. The system is in thermal equilibrium at temperature T and the degeneracy of each state is g.

7. State any two differences between Bose-Einstein statistics and Fermi-Dirac statistics.

8. Sketch the Fermi-Dirac distribution function at $T = 0$ and $T \neq 0$.

9. The total energy E of an ideal non-relativistic Fermi gas in three dimensions is given by $E \propto \frac{N^{\frac{5}{3}}}{V^{\frac{2}{3}}}$, where N is the number of particles and V is the volume of the gas. Obtain the equation of state.

10. What is the physical explanation of the behaviour of the chemical potential μ and fugacity $z = e^{\beta\mu}$ in the general expression of Bose-Einstein or Fermi-Dirac distribution function as temperature goes to zero?

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

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

11. (a) Derive Ehrenfest equations which are suitable to describe second-order phase transition.

Or

(b) Obtain Maxwell's thermodynamics relations.

12. (a) Obtain the expression for probability of one-dimensional random walk.

Or

(b) Deduce the equation of continuity from Boltzmann transport equation.

13. (a) State and prove Liouville theorem.

Or

(b) Assuming the energy distribution law for an ideal gas obeying Maxwell Boltzmann distribution, calcultate the total internal energy and specific heat of the given gas.

14. (a) Give some important differences between the classical and quantum statistics.

Or

(b) Two indistinguishable Boson and Fermion particles have to be adjusted in a state whose degeneracy is three. How many ways the particles can be adjusted?

15. (a) Discuss Einstein's model of specific heat of solids.

Or

(b) Write down the important properties of liquid Helium II.

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

Answer any **three** questions.

16. What are the critical constants of a gas? Calculate the values of these constants in terms of the constants of the Van der Waals equation.

17. What do you understand by mean free path? Derive expression for it.

18. Derive an expression for canonical distribution and canonical partition function of a system in quantum statistics.

19. Obtain equation of state of an ideal Fermi gas at absolute zero temperature.

20. Discuss Planck's theory of black body radiation. Show that this reduces to Wien's formula for small wavelengths and Rayleigh-Jeans law for large wavelengths.

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A–10199

Sub. Code
4MPH2E3

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Second Semester

Physics

Elective — COMMUNICATION ELECTRONICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all the** questions.

1. What is noise figure?

2. Define power gain of an antenna.

3. Give the principle of Amplitude Shift Keying.

4. What are the basic operations involved in PCM?

5. List out the important uses of CW radar.

6. What is Gunn effect?

7. Give some applications of optical fiber communication system.

8. What are optical fiber losses?

9. What is satellite link?

10. Give the performance criteria of cellular phones.

Part B (5 × 5 = 25)

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

11. (a) Compare and contrast the significant features of AM, FM and PM.

Or

(b) What is noise? What are various forms and sources of noise?

12. (a) Draw ASK, FSK and PSK signal to transmit data streams – 111000111.

Or

(b) Compare the performance of PCM system and DM system.

13. (a) Draw the block diagram of MTI radar system and explain its working.

Or

(b) Describe the Gunn mode and limited space charge accumulation mode in case of Gunn diode.

14. (a) Discuss different scattering losses that occur in fiber at the operating wave length.

Or

(b) Give an account of different types of splices.

15. (a) Write a note on Telemetry.

Or

(b) Explain the concept of cell cluster and write its advantages.

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. What is an antenna array? With a suitable sketch, describe a typical antenna array for long distance broad casting.

17. Write a note on (a) time-division multiplexing and (b) frequency-division multiplexing.

18. Describe the principle of operations behind the use of a radar for measuring target range, velocity and location.

19. Draw the schematic diagram of a general optical communications system and explain each part of it.

20. What are the important systems necessary for a geosynchronous satellite? Explain them.

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A–10200	Sub. Code
	4MPH3C1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary / Improvement / Arrear Examinations

Third Semester

Physics

QUANTUM MECHANICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Prove that the operator $i\frac{d}{dx}$ is Hermitian.

2. Find the eigenfunction of the operator $\frac{d^2}{dx^2}+\frac{2}{x}\frac{d}{dx}$.

3. A harmonic oscillator is in the ground state. Where is the probability density maximum?

4. Explain the terms symmetric and antisymmetric wavefunctions.

5. Why the hydrogen atom in the ground state does not show a first order Stark effect?

6. Explain Fermi's golden rule.

7. Define differential scattering cross section and total cross section.

8. What are ladder operators? Why are they called so?

9. Give the physical significance of Dirac's α-matrix.

10. Dirac particle has spin $\frac{1}{2}$. Explain it.

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

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

11. (a) Derive the equation of continuity for probability.

Or

(b) Outline the postulates of quantum mechanics.

12. (a) Write the Schrödinger equation and obtain the wavefunctions in different regions of a square well with finite depth.

Or

(b) Show that the zero point energy of $\frac{1}{2}\hbar w$ of a linear harmonic oscillator is a manifestation of the uncertainty principle.

13. (a) A harmonic oscillator of natural frequency w is placed in a small external potential $\frac{1}{2}bx$. Calculate the change in the energy in first order correction.

Or

(b) Write a short note on adiabatic approximation.

14. (a) What are Clebsh-Gordon coefficients? Mention their properties and selection rules.

Or

(b) State the matrices that represent the x, y, z, components of the spin angular momentum vector S and obtain their eigenvalues and eigenvectors.

15. (a) Derive Dirac's relativistic wave equation.

Or

(b) Show that the probability density and current density defined for Dirac equation satisfy the continuity equation.

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

Answer any **three** questions.

16. State and prove Ehrenfest theorem.

17. Formulate Schrodinger equation for a rigid rotator with a free axis. Find its eigenvalues and eigenfunctions.

18. Develop time-dependent perturbation theory for a constant perturbation acting for a short interval of time.

19. Give the theory of Born approximation in scattering calculations and obtain the condition of validity of Born approximation.

20. Show that Dirac's theory automatically endows the spinning motion of the electron.

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A–10395

Sub. Code
4MPH3C2

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Third Semester

Physics

ATOMIC AND MOLECULAR PHYSICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** questions.

1. Define Fine structure.
2. State the Hund's rule.
3. When does Zeeman effect takes place?
4. What is meant by population inversion?
5. Give examples for symmetric top molecule.
6. Mention the salient feature of the infrared spectroscopy.
7. Write down the selection rule for Raman effect.
8. State Franck-Condon principle.
9. Define Chemical shift
10. What do you understand from 'g' factor?

Part B (5 × 5 = 25)

Answer **all** the questions.

11. (a) Explain the hydrogen atom spectrum.

Or

(b) Discuss about the arrangement of atoms in the periodic table.

12. (a) Describe the stark effect and its significance.

Or

(b) Distinguish between spontaneous emission and stimulated emission.

13. (a) What is a non-rigid rotator? How does it account for rotational spectroscopy?

Or

(b) Write down the importance of diatomic vibrating rotator in the context of infrared spectroscopy.

14. (a) Explain the quantum theory of Raman effect.

Or

(b) Write notes on (i) Dissociation energy and (ii) Dissociated products

15. (a) Elaborate the classical description of nuclear magnetic resonance.

Or

(b) Describe the construction and working of an ESR spectrometer.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain with necessary theory, the Stern-Gerlach experiment.

17. Discuss the Heitler London theory of hydrogen molecule in detail.

18. Describe the microwave spectroscopy of asymmetric top molecules.

19. Explain the rotational fine structure of electronic vibration transitions.

20. Describe the double coil method of NMR spectroscopy.

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A–10201	Sub. Code
	4MPH3C3

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Third Semester

Physics

NUCLEAR AND PARTICLE PHYSICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. In what way binding energy varies with mass number?

2. Comment on the Yukawa potential.

3. List the various modes of beta decay.

4. State the basic principle of particle detector.

5. Compare cyclotron and synchrocyclotron.

6. What is cold fusion?

7. Define any two direct reactions.

8. Draw the energy level diagram of compound nucleus.

9. How will you define strangeness?

10. Based on the law of conservation of Baryon number, which of the following reaction is allowed?

(a) $\pi^- + p \rightarrow \pi^0 + n + \pi^- + \pi^+$

(b) $p + p' \rightarrow p + p + p'$

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

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

11. (a) List out the various energies that contribute in the semi-empirical mass formula.

Or

(b) Write a short note on ground state of deuteron.

12. (a) Analysis the term internal conversion.

Or

(b) How does a scintillation counter works?

13. (a) Brief out the functions of betatron.

Or

(b) Elucidate the working of power type reactor.

14. (a) Elaborate various conversation laws that govern the nuclear reactions.

Or

(b) Derive the Q-equation in nuclear kinematics.

15. (a) Classify elementary particles.

Or

(b) Give a short note on symmetries of charge, parity and time reversal.

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

Answer any **three** questions.

16. By defining the nature of nuclear force, give a detailed note on Yukawa's Meson theory.

17. Derive an expression for the transmissivity of alpha particle through barrier using Gamow's theory.

18. List the characteristics of nuclear fission. Illustrate Bohr-Wheeler's theory of nuclear fission.

19. Define nuclear cross section. Also derive Breit-Wigner dispersion one level formula for spinless nuclei.

20. Describe in detail the quark theory.

A–9843	Sub. Code
	4MPH3E1

M.Sc. DEGREE EXAMINATION, APRIL 2021 &
Supplementary/Improvement/Arrear Examinations

Third Semester

Physics

Elective-ENERGY PHYSICS AND ENVIRONMENTAL SCIENCE

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Point out the reasons for energy crisis faced by the world.
2. Define hydrostatic equilibrium.
3. Why is the solar radiation reaching the earth than outside the atmosphere is varying?
4. State the principle of compound parabolic concentrator collectors.
5. What is biogas?
6. Point out the advantages of concentrating collectors.
7. Comment on the adverse effects of depletion of fossil fuels.
8. Mention the various types of solar cells.
9. List out the factors that create air pollution.
10. State heat island effect.

Part B (5 × 5 = 25)

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

11. (a) Elaborate stratification and stability of atmosphere.

Or

(b) Write short notes on the bio-mass as renewable energy source.

12. (a) Analyse the term transmittance-absorbance product of solar collector.

Or

(b) How does a pyranometer works?

13. (a) Brief out the functions of high temperature collectors.

Or

(b) Elucidate the working of solar air heater and its applications.

14. (a) How is hydrogen used for electricity generation?

Or

(b) Mention the various types, components and applications of fuel cells.

15. (a) Explain the causes of global warming and its side effects.

Or

(b) What are the causes and effects of ozone depletion?

Part C

(3 × 10 = 30)

Answer any **three** questions.

16. State and explain Raynold's transport theorem. Also write a note on variation of temperature, pressure and density with height.

17. Discuss the flat-plate solar collector in detail with its advantages.

18. Explain the classification of Biogas plants.

19. Elaborate the principle and applications of solar photovolatics.

20. Describe the sources, purification and control devices of air pollution.

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A–10396	Sub. Code
	4MPH3E2

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Third Semester

Physics

Elective – MEDICAL PHYSICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** questions.

1. Which is the prime site for the exchange of gases in our body?

2. Mention the main parts involved in initiating a pressure gradient between the lungs and the atmosphere during normal respiration.

3. Why sound wave is called a longitudinal wave?

4. What is the audible range of the average human ear?

5. How the light is measured and give the unit of its measurement?

6. Explain the function of Retina.

7. Define fluoroscopy.

8. What are the dose units used in Radiation therapy?

9. Define Bernoulli's principle.

10. Give any three differences between an artery and vein.

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

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

11. (a) Explain about the volume relationships of the lungs.

Or

(b) Discuss the electric signals from the heart.

12. (a) Briefly discuss about physiological effects of ultrasound in therapy.

Or

(b) Describe the working of an human ear.

13. (a) Point out the applications of UV and infra -red in medicine.

Or

(b) What is Chromatic aberration and how it can be resolved?

14. (a) Write a short note on the production of x rays.

Or

(b) What are the principles of radiation therapy?

15. (a) Enumerate the differences between blood and lymph.

Or

(b) Write a note on the function of heart sound.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. What are the different methods of producing a charge on a body? Explain them in brief.

17. Discuss in detail the working of a sonar and explain its applications.

18. Elucidate the applications of light in medicine.

19. Discuss in detail about the radiotherapy planning.

20. Describe about the Cardiovascular system and it's function.

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A–10397

Sub. Code
4MPH3E3

M.Sc. DEGREE EXAMINATION, APRIL 2021 &

Supplementary/Improvement/Arrear Examinations

Third Semester

Physics

ELECTIVE–MICROPROCESSORS AND MICRO CONTROLLERS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

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

Answer **all** questions.

1. Define stack.

2. Why data bus is bi-directional?

3. What is baud rate?

4. List out the features of 8259.

5. How does 8051 differentiate the external and internal program memory?

6. Give the difference between microprocessor and micro-controller.

7. Give any two data transfer instruction in 8051 microcontroller.

8. List out the rotate instruction in 8051 microcontroller.

9. What is the use of A/D converter?

10. Give the formula for pressure measurement.

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

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

11. (a) Write any assembly language program for multiplication of two 8 bit numbers by the process of repeated addition.

Or

(b) Describe the pin diagram of 8085.

12. (a) Explain various modes of operations of 8253A programmable internal timer.

Or

(b) Explain how keyboards are interfaced to the 8085 microprocessor.

13. (a) Explain different serial communication modes of operations of 8051.

Or

(b) Explain the interrupt structure of 8051 microcontroller.

14. (a) Write a 8051 ALP to find the average of N numbers.

Or

(b) List out the arithmetic instructions available in 8051 microcontroller and explain them.

15. (a) With an neat diagram explain how a micro controller is used to measure temperature.

Or

(b) With a necessary circuit diagram, discuss the interfacing of a 8051 microcontroller to DAC.

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

Answer any **three** questions.

16. With a suitable example, explain various types of 8085 instructions.

17. Explain the architecture of 8251 IC in detail.

18. Draw and explain the architecture of 8051.

19. List out the various addressing modes used in 8051 and explain them with an example.

20. Enumerate the interfacing of 8051 microcontroller to stepper motor.

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