

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
I SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 101 –MATHEMATICAL METHODS OF PHYSICS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

SECTION – A
Answer ALL Questions

4x10 = 40

1. (a) Define a Fourier integral and prove that Fourier integral theorem

$$f(x) = \frac{1}{\pi} \int_0^{\infty} du \int_{-\infty}^{+\infty} \cos u(x-t) f(t) dt$$

Where $f(x)$ is real function and evaluate Fourier integrals for odd and even Functions

8

- (b) Find out Fourier integral of $f(x) = e^{-kx}$ for $x > 0$ and

2

$$f(-x) = f(x) (k > 0)$$

[OR]

- (c) Define Fourier series. Find the Fourier series expansion of a Triangular wave periodic function defined as:

$$y = 0 \text{ at } t = 0$$

$$y = a \text{ at } t = T/2$$

$$y = 0 \text{ at } t = T$$

8

- (d) Discuss briefly the role of Fourier series in mathematical physics.

2

2. (a) State Cayley-Hamilton theorem and show that it is satisfied by the matrix:

7

$$A = \begin{bmatrix} -11 & -10 & 6 \\ 5 & 4 & -5 \\ -20 & -20 & 4 \end{bmatrix}$$

- (b) Determine the eigen values and eigen functions of the matrix

3

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

[OR]

- (c) Diagonalise the matrices

10

$$(a) A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$$

$$(b) A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$$

3. (a) State and prove Cauchy residue theorem for a complex function? 6
 (b) Apply calculus of residues to show that $\int_0^{2\pi} \frac{d\theta}{a + b \cos\theta} = \frac{2\pi}{\sqrt{a^2 - b^2}}$,
 $a > b > 0$. 4
 [OR]
 (c) State and prove Cauchy's integral theorem $\oint_c f(z) dz = 0$ 8
 (d) Use Cauchy's integral theorem to evaluate the integral
 Where c is a simple closed curve $\oint_c \frac{dz}{z}$ 2
4. (a) Obtain the series solution of Legendre's differential equation
 $(1 - x^2) \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} + n(n + 1)y = 0$. 10
 [OR]
 (b) Show that $P_n(x)$ is the coefficient of z^n in the expansion of
 $[1 - 2xz + z^2]^{-1/2}$ in ascending powers of z . 8
 (d) If $P_n(x)$ is a solution of Legendre's differential equation then prove that
 $(n + 1)P_{n+1} = (2n + 1)xP_n - nP_{n-1}$. 2

SECTION – B

Answer Any FIVE Questions

5x4 = 20

5. Find the Laplace transforms of the functions

(i) $e^{at} \cos \omega t$ (ii) $e^{at} \sin \omega t$

6. Find the eigen values of the matrix

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & 9 \end{bmatrix}$$

7. What is the value of a for which $f(x, y) = 2x + 3(x^2 - y^2) + 2i(3xy + ay)$ is an analytic function of complex variable $z = x + iy$.

8. Prove that Beta function is symmetric and the relation between beta and gamma function?

9. Find the inverse laplace transform of $\frac{1}{s^2(s+1)}$.

10. Consider the three vectors $\vec{v}_1 = 2\hat{i} + 3\hat{k}$, $\vec{v}_2 = \hat{i} + 2\hat{j} + 2\hat{k}$,
 $\vec{v}_3 = 5\hat{i} + \hat{j} + a\hat{k}$, where \hat{i} , \hat{j} , \hat{k} are the standard unit vectors in a three-dimensional Euclidean space. These vectors will be linearly dependent, then the value of 'a' ?

11. Find the residues of $\frac{ze^{iz}}{z^4 + a^4}$ at its poles?

12. Consider the following ordinary differential equation

$$\frac{d^2x}{dt^2} + \frac{1}{x} \left(\frac{dx}{dt} \right)^2 - \frac{dx}{dt} = 0$$

With the boundary conditions $x(t = 0) = 0$ and $x(t = 1) = 1$.

Find out the value of $x(t)$ at $t = 2$.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
I SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 102 -CLASSICAL MECHANICS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

SECTION – A

Answer **ALL** Questions

4 x 10 = 40

1. (a) Explain holonomic and non-holonomic constraints with examples.
Obtain the Lagrange's equation of motion of a system in presence of non-conservative forces.

Or
- (b) What is Hamilton's Principle? Derive Lagrange's equation of motion for a conservative system from Hamilton's Principle.
2. (a) What is scattering cross section? Obtain the expression for scattering cross section in Rutherford experiment.

Or
- (b) Derive Hamilton's Canonical Equations of motion. Give the significance of Hamiltonian.
3. (a) What are canonical equations? Derive generating functions F_1 and F_2 of canonical transformations

Or
- (b) What are Action-Angle variables? Obtain the frequency of linear harmonic oscillator by using Action-Angle variables.
4. (a) What is a symmetric top? Obtain the condition that a heavy symmetric top with its axis vertical may continue to spin in the same way for an indefinite period under the action of gravity.

Or
- (b) What is four-dimensional space? Explain covariant formulation of Lagrangian and Hamiltonian.

SECTION – B

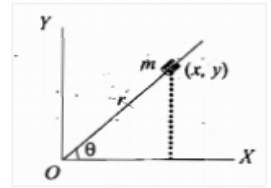
Answer **ANY FIVE** Questions

5 x 4 = 20

5. What is cyclic coordinate? Show that the angular momentum is conserved for a system of particles.

6. Reduce a two body central force problem to an equivalent one body problem.
7. Prove the Jacobi's Identity.
8. Obtain the expression relating the relativistic energy and momentum
 $E^2 = p^2 c^2 + m_0^2 c^4$.

9. A bead is sliding on a rod, which is rotating about a vertical axis with fixed velocity. Obtain its equation of motion.



10. A planet of mass m moves in the inverse square central force field of the Sun of mass M . If the semi-major and semi-minor axes of the orbit are a and b respectively. What is the total energy of the planet?

11. The Lagrangian of a system is given by

$$L = \frac{1}{2} m \dot{q}^2 + 2m \dot{q}^2 - k \left(\frac{5}{4} q_1^2 + 2q_2^2 - 2q_1 q_2 \right)$$

where m and k are positive constants. What are the frequencies of its normal modes?

12. A π - meson is of rest mass m_π decays into a μ - meson of rest mass m_μ and a neutrino of mass m_ν . Show that the total energy of μ - meson is

$$\frac{1}{2m_\pi} [m_\pi^2 + m_\mu^2 + m_\nu^2] c^2.$$

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
II SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 103 - INTRODUCTORY QUANTUM MECHANICS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hrs.

Max. Marks: 60

SECTION -A

Answer ALL Questions

4 x 10 = 40

1. a) Derive Schrodinger wave equation. Obtain an expression for Probability current density.
b) What are stationary states? Show that for stationary states probability current density is constant in time.

OR

- c) State and prove Ehrenfest's theorem.
- d) Write statistical ensemble averaging and Copenhagen interpretations of Quantum Mechanics.
2. a) Show that commuting operators have common Eigen functions.
b) Define Dirac Delta function and write its properties.

OR

- c) State the postulates of Quantum Mechanics.
- d) Write the properties of wave functions and Eigen values of such Operators.
3. a) State the properties of a well behaved wave function
b) Solve the Schrodinger equation for a linear harmonic oscillator and obtain eigen values.

OR

- c) Discuss the motion of a particle at a potential step for $E < V$ and $E > V$ conditions.
- d) Derive the wave equation in momentum space.
4. a) Show that L_x and L_z commute. Obtain Eigen values and Eigen functions for these operators.
b) Write Pauli spin matrices and discuss commutation relations among them

OR

- c) Write about Angular Momentum Matrices
- d) Explain various properties of Angular Momentum Operators M.Sc Physics ANUR

SECTION -B

Answer any FIVE Questions

5 x 4 = 20

5. Explain wave and particle duality of microscopic particles.
6. State Heisenberg's uncertainty principle and discuss its origin.
7. Obtain Eigen values of double well potential.
8. Show that Eigen functions belonging to different Eigen values are Orthogonal.
9. Discuss the principle of Superposition
10. Find the energy states of the one dimensional step barrier
11. Explain Unitary Transformations
12. Find Eigen values of J^2 and J_z

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
I SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 104 -ELECTRONIC DEVICES AND CIRCUITS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hrs.

Max. Marks: 60

SECTION – A

Answer All Questions

4 × 10 = 40

1. a) Describe the forward and reverse bias characteristics of P-N Junction diode.
b) Explain the terms AC, DC resistances and Transition, diffusion capacitances.
OR
c) Explain the working principle of Full wave bridge rectifier.
d) Derive expressions for Efficiency, Ripple factor.
2. a) Explain the working, advantages and disadvantages of various transistor biasing techniques in CE configuration.
b) Describe how emitter follower circuit works.
OR
c) What are h-parameters. Obtain the h-parameters for CE configuration of transistor.
3. a) Describe the classification of power amplifiers.
b) Explain the working of Class-B Push-Pull amplifier.
OR
c) Explain the construction and working of JFET.
4. a) Explain the block diagram of operational amplifier.
b) Explain input offset voltage, input offset current, Bandwidth, slew rate and CMRR.
OR
c) Explain how negative feedback affects the bandwidth of an amplifier.
d) Describe the construction and working of Phase shift oscillator.

SECTION – B

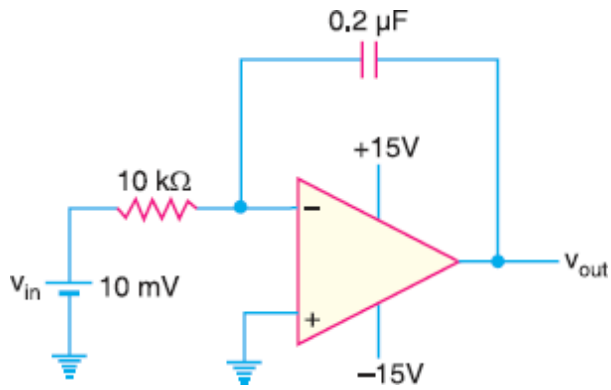
Answer Any Five Questions

5 × 4 = 20

5. Explain how a diode can be used as a wave form clipper with neat circuit diagrams.
6. Describe the current mirror circuit using a transistor.
7. Describe about Tunnel diode.
8. Explain how a 555 timer can be used as an astable multivibrator.
9. A half-wave rectifier is used to supply 50V d.c. to a resistive load of 800Ω. The diode has a resistance of 25Ω. Calculate the voltage required.
10. In a fixed bias configuration, find V_{BB} that just passes the transistor into saturation if $V_{CC} = 10V$, $\beta = 200$, $R_C = 2K\Omega$ and $R_B = 50K\Omega$.

11. A JFET has the following parameters: $I_{DSS} = 32\text{mA}$, $(off) = -8\text{V}$, $V_{GS} = -4.5\text{V}$. Find the value of drain current.

12. For the integrator circuit shown below, find out the saturation time.



GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
II SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 201 –STATISTICAL MECHANICS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

SECTION-A

Answer All Questions:
= 40 M

4x10

1. a) Explain the specification of the state of a system.

b) State and Explain the Liouville's Theorem.

(10 M)

(OR)

a) State and explain the basic postulates of Statistical Mechanics.

b) Explain the limiting behaviour of entropy in terms of ground state energy and temperature.

(10 M)

2. a) Derive the Gibbs canonical distribution.

b) Show that energy fluctuations in the canonical distribution is proportional to the specific heat.

(10 M)

(OR)

a) Derive the grand canonical distribution.

b) Calculate the fluctuations in the number of particles of a system in a grand canonical ensemble.

(10 M)

3. What is "Gibbs paradox"? Explain how it can be resolved.

(10 M)

(OR)

a) State and Prove Equi partition theorem.

b) Hence discuss the case of harmonic oscillator.

(10 M)

4. a) Derive the distribution functions for Maxwell- Boltzmann Statistics, Bose-Einstein

b) Statistics and Fermi - Dirac Statistics.
(10 M)

(OR)

a) Explain in detail about the "Bose- Einstein Condensation".
(10 M)

SECTION - B

Answer Any Five Questions.

5x4=20 M

5. Differentiate "Exact" and "inexact" differentials.
6. Derive the expression for entropy of a perfect gas in micro canonical ensemble.
7. Discuss about Einstein's model of specific heat of solids.
8. Write about "Brownian motion".
9. Explain the validity of the classical approximation in statistical mechanics.
10. Write a short note on "Thermionic Emission"
11. Discuss the Boltzmann limit of Boson and Fermion gases.
12. Discuss the properties of Partition function.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
II SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 202 –NUCLEAR AND PARTICLE PHYSICS
MODEL QUESTION PAPER
As Approved in the BOS meeting held on 15/11/2023for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

SECTION – A

Answer **ALL** Questions

4x10 = 40

1. a) What do you mean by mass defect and Binding energy of a nucleus? Draw a curve showing the variation of binding energy per nucleon against the mass number. Use the curve to explain the instability of light and heavy nuclei while stability of intermediate nuclei?

(OR)

b) Derive an Expression for the electric Quadrupole moment of a nucleus?

2. a) What are magic numbers and Explain Shell model?

(OR)

b) Explain Fermi's theory of beta decay? Derive an expression for the transition probability of a beta particle?

3. a) Discuss various types of nuclear reactions and conservation laws? Obtain an expression for Q- value in a nuclear reaction?

(OR)

b) Explain construction and working of a Gas filled detector with neat diagram?

4. a) Explain construction and working of Cyclotron?

(OR)

b) Explain Construction and working of a Linear accelerator?

SECTION -B

Answer Any **FIVE** Questions

5 X 4 =20

(Solve **at least** 2 problems is mandatory)

5. Discuss briefly the nature and characteristics of Nuclear forces?

6. What is a mass parabola and briefly explain how you can predict the stable isobar from a mass parabola?

7. What is the importance of Pauli's Neutrino Hypothesis?
8. Obtain the four factor formula for controlled fission reaction?
9. What are the differences between Nuclear fission and Fusion reactions?
10. Explain briefly the classification of elementary particles?
11. Calculate the Binding energy per nucleon in $^{12}_6\text{C}$, given that
 $m_p = 1.007825 \text{ u}$, $m_n = 1.008665 \text{ u}$, mass of carbon nucleus $M = 12.000 \text{ u}$
12. Use the shell model to predict the ground state angular momenta and parities of
 $^{27}_{13}\text{Al}$, $^{33}_{16}\text{S}$

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
II SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 203 –ATOMIC AND MOLECULAR PHYSICS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

SECTION – A

Answer **ALL** Questions

4x10 = 40

1. a) Derive an expression for spin- orbit interaction energy? Draw the fine structure of H_{α} -line?

(OR)

b) What is the importance of coupling schemes in multi electron atoms? Distinguish between L-S and J-J couplings for two valance electron atoms. Find the spectral terms (using L-S coupling) for two electrons in $3p3d$ state?

2. a) Distinguish between the spectra of hydrogen and sodium atoms. What makes the two spectra look so different even though both belong to the single valance electron system?

(OR)

b) What is anomalous Zeeman Effect? Derive an expression for the magnetic interaction energy for a single valance electron atom placed in a magnetic field?

3. a) What is stark effect? Discuss the weak field stark effect and strong field stark effect in hydrogen?

(OR)

b) Discuss the rotational spectrum of the diatomic molecule treated as rigid – rotator. Derive the expressions for rotational Term values and also wave number for the rotational lines.

4. a) Discuss the vibrational spectrum of the diatomic molecule treated as harmonic oscillator. Derive the expressions for vibrational Term values and also wave number for the vibrational lines? **(OR)**

b) What is Raman Effect? Explain the quantum theory of Raman Effect?

SECTION -B

Answer Any FIVE Questions

5 X 4

=20

(Solve **at least 2** problems is mandatory)

5. What is Raman Effect? Explain the quantum theory of Raman Effect?

6. Discuss how Pauli's exclusion principle is connected with symmetry of the wave function?

7. State and explain Lande interval Rule?

8. State "mutual exclusion principle" and explain its importance to determine molecular structure

9. If the wavelength of the first line of the Lyman series of hydrogen is 1215\AA calculate the wavelength of the second line of the series and the series limit

10. Determine the possible terms of a one-electron atom corresponding to $n=3$ and compute the angle between \vec{l} & \vec{s} vectors for the term ${}^2D_{5/2}$.

11. If the doublet splitting of the first excited state $2\text{}^2P_{3/2} - 2\text{}^2P_{1/2}$ of He^+ is 5.84 cm^{-1} . Calculate the corresponding separation for H.

12. Write the spectral term for d^2 electron configuration.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
II SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 204 –ELECTRODYNAMICS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours		Max. Marks: 60
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SECTION-A

Answer ALL Questions

4 x 10 = 40

M

1. Write down Laplace equations in Spherical coordinate system and obtain its solution?

(OR)

State Ampere circuital law and how it was modified to include the electric displacement vector (D)?

2. Obtain Maxwell's equations in differential and integral forms and explain their physical significance. State and prove Poynting's theorem

(OR)

Explain the behavior of electromagnetic waves in free space and non-conducting isotropic medium.

3. Obtain Lienard-Wiechert Potentials for a moving charge. Derive the electric and magnetic fields from these potentials.

(OR)

Discuss about the radiation damping and obtain an expression for Abraham-Lorentz formula.

4. Explain the covariance of Maxwell field equations in terms of 4-vectors.

(OR)

(a) Define electromagnetic field tensor.

(b) Obtain Lorentz transformations of electric and magnetic fields.

SECTION-B

Answer any FIVE Questions

5 x 4 =

20 M

5. Derive Laplace's and Poisson's equation from Gauss law.

6. State and prove Faraday's of electromagnetic induction.

7. The vector potential (A) and scalar potential (ϕ) in a certain region of space are given to be $A = \frac{\alpha t}{2} (x\hat{j} - y\hat{i})$, $\phi = \frac{1}{4}\alpha(x^2 - y^2)$ where α is constant. Find the electric and magnetic fields corresponding to these potentials?

Obtain the expressions for electromagnetic vector and scalar potentials.

8. A non-relativistic particle of mass 'm' and charge 'e' moving with velocity v and acceleration a emits radiation of intensity (I_1). what is the intensity (I_2) of the radiation emitted by a particle of mass 'm/2', charge '2e', velocity 'v/2' and acceleration '2a'?
9. Discuss about Cherenkov radiation.
10. Write about the occurrence of plasma.

11. What is Lorentz Condition in covariant form?

12. Explain about the wave guides.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
III SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 301 –NUMERICAL ANALYSIS & FORTRAN
MODEL QUESTION PAPER
As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

SECTION – A

Answer ALL Questions

4x10 = 40

1. (a) Describe Fixed point method to find the roots of polynomial equations. Show that it has linear convergence. 10
[OR]
(b) Use Gauss Elimination and Gauss Jordan methods to solve the following system of equations: $6x + y + z = 20$, $x + 4y - z = 6$, $x - y + 5z = 7$ 10
2. (a) Use Simpson's 3/8 rule to evaluate $\int_0^1 (\exp -x^2) dx$ with $h = 0.125$. 10
[OR]
(b) Calculate $y(2)$, where $y(1) = 2$, $\frac{dy}{dx} = 3x^2 + 1$ using Euler's method for $h = 0.5$ and $h = 0.25$. 10
3. (a) What are various Mathematical and Logical operators available in FORTRAN? 10
[OR]
(b) Write a note on Free and Open Source Software. 10
4. (a) Distinguish between Functions and Subroutines in FORTRAN? 10
[OR]
(b) Write a note on FORMAT statement in FORTRAN. 10

SECTION – B

Answer Any FIVE Questions by choosing at least TWO problems

5x4 = 20M

5. What are round off and truncation errors? Explain.
6. Find the root of $x^3 - 2x - 5 = 0$ with $x_0 = 2$ using Newton Raphson method to 6 decimals.
7. Explain Trapezoidal rule for numerical integration.
8. Use Simpson 1/3 rule to evaluate $\int_{-2}^4 (1 - x - 4x^3 + 2x^5)$ with $n = 12$.
9. What is the difference between Real*4, Real*8, Real*16?
10. What is the output of the following integer p; real q;
i) p=5.0/2 ii) q=5/2 iii) p=5.0/2.0
iv) p=5/2 v) p=5/2.0 vi) q=5.0/2
11. What is call by name and call by reference? Give examples.
12. Explain the format statement FORMAT (2(A5, 4x, F6.3, 4x, I2)).

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
III SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 302 – SOLID STATE PHYSICS
MODEL QUESTION PAPER
As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

PART – A

Answer **all** Question

Each question carries **10** marks

4x10 = 40 Marks

1. (a) Explain the different fundamental types of two dimensional lattices.
(b) Discuss briefly the seven systems of crystals in three dimensional lattices.
(OR)
(c) Obtain an expression for scattered wave amplitude.
(d) Show that the reciprocal lattice of fcc is bcc.
2. (a) Discuss the vibrations of atoms in the mono atomic lattices.
(b) Arrive at the expressions for phase velocity and group velocity for the elastic waves.
(OR)
(c) State and Explain Hall effect. What is the significance of it?
(d) Explain how Hall Effect is used to determine the sign of charge carriers.
3. (a) Explain the motion of electron in a periodic potential using Kronig – Penny model.
(b) Explain briefly the crystal momentum of an electron.
(OR)
(c) Derive an approximate solution near a zone boundary for crystal momentum of an electron.
(d) Based on the band theory of solids, explain the nature of conductors, Semi-conductors and insulators.
4. (a) What is superconductivity?
(b) Discuss in detail the BCS theory of superconductivity.
(OR)
(c) Derive London equations, and account for high frequency effects on superconductors.
(d) State and explain Meissner effect.

PART – B

Answer any **FIVE** questions, choosing **at least two problems**.

Each carries **4** marks

5 x 4 = 20 Marks.

5. Explain the structure of Sodium Chloride.
6. What are phonons? Describe their properties.
7. State and explain Bloch theorem. .
8. What are SQUIDS? Mention their applications.
9. In a crystal whose primitives are 1.2\AA , 1.8\AA and 2\AA . A plane (231) cuts an intercept of 1.2\AA , on x – axis. Find the corresponding intercepts on the Y and Z axes.
10. Find the lowest energy of an electron confined to move in a one dimensional potential box of width 0.5\AA .
11. Explain briefly the crystal momentum of an electron.
12. At what temperature is $H_c(T) = 0.1H_c(0)$ for a material having $T_c = 7.2\text{K}$.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
III SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 401 – ADVANCED QUANTUM MECHANICS
MODEL QUESTION PAPER
As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

SECTION – A

Answer ALL Questions

4x10 = 40

1. (a) Explain the Pauli's exclusion principle in the case of a two particle system. 10
- OR
- (b) Illustrate the Heitler-London treatment of H₂ molecule. 10
2. (a) Discuss the time dependent perturbation theory and obtain the expression for the probability of transition to a state. 10
- OR
- (b) Apply Variation technique to find the ground state energy of He atom 10
3. (a) Explain Born Approximation. 10
- OR
- (b) Discuss the partial wave analysis of scattering by spherically symmetric potentials. 10
4. (a) Derive Klein-Gordon equation for a free particle and write its inadequacies. 10
- OR
- (b) Write about Dirac relativistic principle. Obtain the free particle solution of Dirac's relativistic equation. 10

SECTION – B

Answer Any FIVE Questions by choosing at least TWO problems

5x4 = 20

5. State and explain the principle of in-distinguishability of identical particles.
6. Write about the validity of W.K.B. approximation method.
7. Derive the relation between differential scattering cross section and scattering amplitude.
8. Explain the Dirac's concept of negative energy states.
9. Prove that either totally symmetric function or totally anti-symmetric function is

simultaneous Eigen function of all exchange operators.

10. Determine the energy levels for a particle of mass m in the potential $V(x) = \alpha|x|$, in the WKB approximation

$$\sqrt{2m} \int_a^b \sqrt{E - V(x)} dx = (n + \frac{1}{2})\hbar\pi$$

where a, b are the turning points and $n = 0, 1, 2, \dots$

11. Consider the potential

$$V(\vec{r}) = \sum_i V_0 a^3 \delta^{(3)}(\vec{r} - \vec{r}_i)$$

where \vec{r}_i are the position vectors of the vertices of a cube of length 'a' centered at the origin and V_0 is a constant. If $V_0 a^2 \ll \frac{\hbar^2}{m}$, then find the total scattering cross-section in the low energy limit.

12. Prove that

$$(\vec{\alpha} \cdot \mathbf{B})(\vec{\alpha} \cdot \mathbf{C}) = \mathbf{B} \cdot \mathbf{C} + i\sigma'(\mathbf{B} \times \mathbf{C})$$

where \mathbf{B} and \mathbf{C} commute with $\vec{\alpha}$ but not necessarily with each other.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
III SEMESTER- II M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 304 – DIGITAL, COMMUNICATION ELECTRONICS & MICROPROCESSOR
MODEL QUESTION PAPER
As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60 M

SECTION – A

Answer ALL Questions

4x10 = 40M

- 1 (a) Explain the working of EX-OR gate with neat logic diagram. Show that a combination of EX-OR gates can be used as a parity generator and checker. 10
[OR]
- (b) Bring out the working of a 3 to 8 line Decoder with neat sketch. 10
- 2 (a) With a neat sketch, illustrate the working of a 4-bit asynchronous counter. 10
[OR]
- (b) Describe the Digital Ramp Analog to Digital conversion method with neat sketch. 10
- 3 (a) Explain in detail the frequency spectrum for sinusoidal FM. Arrive at an equation of average power in sinusoidal FM 10
(b) Explain what is meant by FM Radio detection.
[OR]
- (b) Explain the classification of Instruction set of 8085 microprocessor with suitable examples. 10
- 4 (a) Draw the block diagram of 8255 PPI and explain its functioning. Discuss different modes of 8255 PPI operation. 10
[OR]
- (b) Explain the functioning of 8253 programmable interval timer with neat sketch. 10

SECTION – B

Answer Any FIVE Questions by choosing at least TWO problems

5x4 = 20 M

5. Draw the logic circuits and truth tables for the expression $(A+B)(A+C)$ and $(A+BC)$.
What did you understand?
6. Discuss the functioning of digital comparator.
7. With a neat circuit diagram, explain the Ladder type D/A converter.
8. How do the flip-flops can be used for frequency division and counting?
9. Give a brief account on delta modulation
10. How do the flags of 8085 microprocessor change during the addition of two 8-bit Numbers 56 H and 78 H.

11. Write about DAC 0800.

12. Write the control word for the following configuration of the ports of Intel 8255 for mode2 operation.

Port A – Bidirectional

Mode of Port A – Mode 2

Port B – Output

Mode of Port B – Mode 1

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
III SEMESTER- II M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 303 –LASERS & NON - LINEAR OPTICS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60M

SECTION – A

Answer ALL Questions

4x10 =40M

1. (a) Obtain the condition for Steady state inversion in a three level LASER system using rate equations? 10
[OR]
(c) Explain light amplification and obtained relation between Einstein A and B coefficients 10
2. (a) Explain Natural broadening and arrive an expression for Full width at half maximum due to radiative decay of atoms. 10
[OR]
(b) Explain the methods of Mode locking and Q switching in lasers. 10
3. (a) Explain various optical modes and configurations. Evaluate an expression for the modes of polarization in the case of a graded index fiber. 10
[OR]
(b) Compare the characteristics of step index and graded index Optical fiber. 10
4. (a) What is hologram? Explain recording, reconstruction of hologram 10
[OR]
(b) Explain Fourier transformation spectroscopy. 10

SECTION – B

Answer Any FIVE Questions

5x4 = 20

5. Write a short note on Nd: YAG Laser.
6. Find the relative population of two states in a ruby laser that produces a light beam of wavelength 6943\AA at 300K AND 500K.
7. Explain about Q-Switching.

8. Using Paraxial approximation, arrive at matrices for translation and reflection through homogeneous medium.
9. Explain what is meant by pulse broadening in optical fibres.
10. Consider a multimode silica fiber that has a core refractive index $n_1 = 1.480$ and a cladding index $n_2 = 1.460$. Find (a) Critical angle
(b) The numerical aperture and
(c) The acceptance angle.
11. Write about Acoustics holography microscopy?
12. Explain Fringe contrast variation.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
III SEMESTER- II M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 402– PROPERTIES AND CHARACTERIZATION OF MATERIALS
MODEL QUESTION PAPER
As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

Section A

Answer **All** the following Questions

4 X10 = 40 M

1. Derive an expression for Thermal expansion based on an harmonic interactions
Or
Describe the production of color centres in crystals.
2. Explain Weiss molecular field theory of ferromagnetism.
Or
Explain the construction and working of Scanning Electron Microscope with a neat diagram.
3. Explain the principle, construction and working of ESR Spectrometer with a neat diagram.
Or
Describe the principle of Mossbauer spectroscopy and explain the hyperfine interaction using Mossbauer Effect.
4. What is Curie temperature? Explain the determination of Curie temperature of a specimen in the laboratory
Or
Describe the fundamentals of IR Spectroscopy.
Explain the principle of Infra-red spectroscopy

Section-B

Answer any **FIVE** of the following questions

5 X 4=20 M

5. State and explain Frenkel effect.
6. State and explain Fick's law of diffusion
7. Mention the applications of Ferrites.
8. Mention the applications of Transmission electron Microscope.
9. Write a note on Larmors precession.
10. Mention the applications of Mossbauer spectroscopy.
11. Mention the applications of infrared spectroscopy.
12. What is Saturation Magnetization.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
III SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 403 – THEORY AND PHYSICS OF NANOMATERIALS
MODEL QUESTION PAPER

As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

SECTION – A

Answer ALL Questions

4x10 = 40 M

1. Explain Structural, thermal and optical properties of nanomaterials.
Discuss about the size and reduction of dimensionality in nanomaterials.

[OR]

Briefly explain mechanical and magnetic properties of nanomaterials.
Write about the chemical properties of nanomaterials.

2. Explain the discovery and variation of bucky balls and bucky tubes.
Write the applications of Fullerenes.

[OR]

Explain the synthesis of nanomaterials using Sol-gel and Ball milling method.
Write the applications of Fullerenes.

3. What is the theory of electric charge and enhancements in carbon tubes?
Write about Shell theory.

[OR]

Describe about single walled nanotubes.
Explain Elasticity and Tensile strength of carbon nanotubes.

4. How do you synthesis SWNT and MWNT using Arc discharge method
Explain what is plasma enhanced CVD

[OR]

Explain various methods of purification of carbon nano tubes.

SECTION – B

Answer Any FIVE Questions

5x4=20

5. Discuss the importance of surface to volume ratio in nanomaterials.
6. Explain the chemical activity of nanomaterials.
7. Briefly describe fullerenes and their structure.
8. Write a short note on Composites and Dendrimers.
9. Write a short note on modeling and analysis of Carbon nano tubes using thick shell theory.
10. Explain the various properties of nanotubes.
11. Explain Magnetic Purification of Carbon nano tubes.
12. Explain root growth mechanism of carbon nano tubes.

GOVERNMENT COLLEGE (A): RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
IV SEMESTER- M.Sc. PHYSICS
(Effective from 2019-20 Admitted Batch)
PHY 404 – RESEARCH APTITUDE AND DATA ANALYSIS
MODEL QUESTION PAPER
As Approved in the BOS meeting held on 15/11/2023 for the acad. Year 2023-2034

Time: 3 Hours

Max. Marks: 60

SECTION – A

Answer ALL Questions
= 40 Marks

4 x 10

1 (a) What is meant by Research? Explain briefly, various steps involved in Research Process.

(b) [OR]

What is Scientific Method? Explain Scientific Method with neat flow chart and mention its postulates.

2 (a) Define Confidence Interval. Describe Confidence Interval for a single sample population mean a small sample.

A random sample of 350 male college students were asked for the number of units they were taking. The mean was 12.3 units, with a standard deviation of 2.50 units. Construct a 90% confidence interval for the mean number of units taken by a male college student.

(b) [OR]

What is Hypothesis Test? Mention the steps involved in Hypothesis Test.

A physician claims that 13.6% of all pregnant female smoke during their pregnancy. A random sample of 400 pregnant women revealed that 60 of them are smoking while pregnant. Test the physician's claim at the 0.05 level of significance

3 (a) Write about Chi – Square test.

Mars Inc. claims that plain M&Ms are made in the following percentages.

<i>Color</i>	<i>Brown</i>	<i>Yellow</i>	<i>Red</i>	<i>Orange</i>	<i>Green</i>	<i>Blue</i>
Percentage	30%	20%	20%	10%	10%	10%

A random sample of 55 plain M&M candies had the following breakdown by colours.

<i>Color</i>	<i>Brown</i>	<i>Yellow</i>	<i>Red</i>	<i>Orange</i>	<i>Green</i>	<i>Blue</i>
Number	20	15	3	4	5	8

At the 0.05 level of significance, test the claim that Mars Inc.'s claimed percentage breakdown of colours is correct.

[OR]

- (b) Write about Random and Systematic errors? Discuss the common sources of errors occurring in the physics laboratory measurement

- 4 (a) Describe two MATLAB arguments / functions related to each of the following variable with examples
(i) Vector Variables (ii) Matrix Variables (iii) Character Variables (iv) Numbers and (ii) Complex Numbers

[OR]

- (b) Write a MATLAB program for Euler's method used in solving ordinary differential equations.

SECTION – B

Answer Any **FIVE** Questions
= **20 M**

5 x 4

5. Explain Experimental research design.
6. Write about Research Ethics and Plagiarism Policies.
7. Write about the mean and standard deviation of Poisson distribution.
During a typical hour fishing at a lake, a fisher can expect to catch 3 fish. Find the probability that a fisher catches exactly 2 fish in his first hour fishing.
8. Here are the ages of ten randomly selected women at a college orientation. Find the coefficient of skewness for these data.
18 25 31 19 22 21 19 25 18 27
9. Fit a second degree polynomial to the data points (x, y) given by (0,1), (1, 6) and (2,17).
10. Define precision and accuracy. Explain their measurement with an example each.

11.Explain MATLAB arguments (i) $a./b$ and $a.\backslash b$ (ii) A/B and $A\backslash B$ with examples.

Where a and b are vectors and A and B are matrices.

12.Write a MATLAB program to plot $y = 4\sin x + 3\cos x$, for x in the interval 0 to 4π .