

Total No. of Questions : 4]

SEAT No. :

PD-3045

[Total No. of Pages : 2

[6475]-101

M.Sc.

PHYSICS

**PHY501 MJ : Mathematical Methods for Physics
(2023 Pattern) (NEP 2020) (Semester - I) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) *Q. 1 is compulsory.*
- 2) *Attempt any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log table or non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Solve any four of the following :

[8]

i) If $u = \begin{pmatrix} 2 \\ 3 \\ 4 \end{pmatrix}$ & $v = \begin{pmatrix} 5 \\ -1 \\ 1 \end{pmatrix}$ then find their inner product.

ii) Define eigen value & eigen vector of a matrix.

iii) If $L\{f(t)\} = f(s) = \int_{t=0}^{t=\infty} f(t)e^{-st} dt$ then prove that $L(1) = \frac{1}{s}$

iv) What are Dirichlet's conditions for fourier series?

v) If $A = \begin{pmatrix} 2 & 1 \\ 7 & 4 \end{pmatrix}$, then find A^{-1}

b) Differentiate between Hermitian & symmetric matrices.

[3]

P.T.O.

- Q2) a) i)** Show that the vectors $(1,0,0), (1,1,0), (1,1,1)$ form a basis for $\mathbb{R}^3$ [4]
iii) Find the fourier coefficient a_0 if $f(x) = x+x^2$ for $-\pi < x < \pi$ [3]
b) Find the fourier sine transform of e^{-ax} [5]

- Q3) a)** Apply the Gram-Schmidt orthogonalisation process to find an orthogonal basis & then an orthonormal basis for the subspace u for $\mathbb{R}^4$ spanned by $V_1 = (1,1,1,1), v_2 = (1,2,4,5), v_3 = (1,-3,-4,-2)$ [7]
b) Find the fourier series expansion of the periodic function of period 2π .
 $f(x) = x^2, -\pi \leq x \leq \pi$. Hence, find the sum of the series
 $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots$ [5]

Q4) Solve any three of the following : [12]

- a)** Find the Laplace transform of $\cos^2 t$.
b) If the fourier transform of $f(t)$ & $g(t)$ be $F(w)$ & $G(w)$ respectively then show that

$$\int_{-\infty}^{\infty} F(w)G^*(w)dw = \int_{-\infty}^{\infty} f(t)g^*(t)dt$$

Where $G^*(w)$ is complex conjugate of $G(w)$ & $g^*(t)$ is complex conjugate of $g(t)$.

- c)** Prove that the product of two matrices.

$$A = \begin{bmatrix} \cos^2 \theta & \cos \theta \sin \theta \\ \cos \theta \sin \theta & \sin^2 \theta \end{bmatrix} \text{ \& } B = \begin{bmatrix} \cos^2 \phi & \cos \phi \sin \phi \\ \cos \phi \sin \phi & \sin^2 \phi \end{bmatrix}$$

is zero when θ & ϕ differ by an odd multiple of $\frac{\pi}{2}$

- d)** Prove that the matrix $\frac{1}{\sqrt{3}} \begin{bmatrix} 1 & 1+i \\ 1-i & -1 \end{bmatrix}$ is unitary.



[6475]-102

M.Sc. - I
PHYSICSPHY-502-MJ: Statistical Physics
(2023 Credit Pattern) (Semester - I) (NEP-2020) (2 Credit)

Time : 2 Hours]

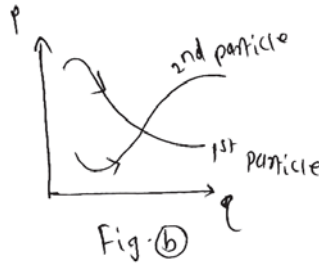
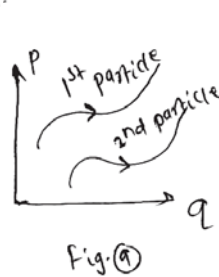
[Max. Marks : 35

Instructions to the candidates:

- 1) Q.1 is compulsory.
- 2) Attempt or solve any two questions form Q.2 to Q.4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of calculator and non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) a) Attempt any four of the following.

- i) What is microscopic and macroscopic state of a system? [2]
- ii) Which of the following is not a phase trajectory diagrams and why? [2]



- iii) Find the most probable state for the distribution of three particles in 2- cells. [2]
- iv) Explain the term phase space. [2]
- v) Write a short note on “Photongas”. [2]
- b) State and explain the postulate of equal a priori probability. [3]

Q2) a) i) On the basis of canonical distribution prove the law of paramagnetism. [4]

- ii) Explain the behaviour of density of states in phase space and show that density of states in phase space is given by

$$g(\epsilon) = \frac{V}{4\pi^2} \left(\frac{2m}{\hbar^2} \right)^{3/2} \cdot \epsilon^{1/2}. \quad [3]$$

- b) Explain Radiation pressure of a ideal photon gas. [5]

P.T.O.

- Q3)** a) Find the classical partition function for an ideal monoatomic gas of N - particles and calculate the average kinetic energy of the N - particles of ideal monoatomic gas. [7]
- b) The molar mass of Lithium is 0.00694 and its density is $0.53 \times 10^6 \text{ kg/m}^3$. Calculate the fermi-energy and fermi - temperature of electrons. [5]

Q4) Write the short note on any three of the following. [12]

- a) Gibbs paradox
- b) Quantum distribution function
- c) Physical significance of α
- d) Liouville's theorem.



Total No. of Questions : 4]

SEAT No. :

PD-3047

[Total No. of Pages : 2

[6475]-103

M.Sc.

PHYSICS

PHY - 503 - MJ : Classical Physics

(2023 Pattern) (NEP - 2020) (Semester - I) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) Q.1 is compulsory.
- 2) Attempt any two questions from Q.2 to Q.4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks
- 5) Use of log tables and non-programmable electronic calculator is allowed.
- 6) Neats diagrams must be drawn wherever necessary.

Q1) a) Attempt any four of the following : [8]

- i) What is meant by phase space?
- ii) State variational principle.
- iii) Give two examples of construcunts.
- iv) Write a note on generating function.
- v) Define cyclic coordinate. Give one example of it.

b) Prove that Poisson's Bracket obeys distributive law. [3]
 $[F, G + K] = [F, G] + [F, K]$

Q2) a) State and prove Jacobi's identify. [7]

b) Obtain Hamiltonian and Hamiltonian equation of motion for simple pendulum. [5]

Q3) a) i) Explain D' Alembert's principle. [4]

ii) Show that the transformation is canonical. [3]

$$P = \frac{1}{2}(p^2 + q^2), Q = \tan^{-1}\left(\frac{q}{p}\right)$$

b) Using variational principle explain Brachistochrone problem. [5]

P.T.O.

Q4) Attempt any three of the following :

[12]

- a) Discuss Legendre transformation.
- b) State and explain theorem on total energy.
- c) Write a note on Euler's equation.
- d) Explain :
 - i) degrees of freedom
 - ii) generalised co-ordinates



Total No. of Questions : 7]

SEAT No. :

PD-3048

[Total No. of Pages : 2

[6475]-104

M.Sc.

PHYSICS

PHY 504 MJ : Quantum Physics

(2023 Pattern) (Semester - I) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Q. No. 1 is compulsory.
- 2) Solve any five questions from Q.2 to Q.7.
- 3) Q. No. 2 to 7 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of logtables and non programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) Attempt any FIVE of the following :

[10]

- a) Write Pauli's spin matrices of S_y and S_z in spin half system.
- b) What are ladder operators?
- c) Write and discuss eigen equation of Hamiltonian operator.
- d) Define transition amplitude in time dependent perturbation system.
- e) Give physical significance of probability density of wave function.
- f) State Heisenberg's uncertainty principle.

Q2) a) Explain Hilbert space using bra and ket notations. Discuss properties of Hilbert space. **[7]**

b) Explain WKB approximation in classical and non classical region. **[5]**

Q3) a) Derive an expression for second order correction to energy of non degenerate time independent perturbation system. **[7]**

b) Obtain matrix representation of total angular momentum operator J in $j = \frac{1}{2}$ system. **[5]**

P.T.O.

Q4) a) If A and B are adjoint operators then prove that [7]

i) $(AB)^\dagger = B^\dagger A^\dagger$

ii) $(A^\dagger)^\dagger = A$

b) State and prove variational method of approximation. [5]

Q5) a) Prove the following for orbital angular momentum operator: [7]

i) $[L_x, L_y] = i\hbar L_z$

ii) $[L^2, L_x] = 0$

iii) $[L_z, L_\pm] = \pm \hbar L_\pm$

b) Explain spin angular momentum operators in spin half system. Discuss eigen values and eigen spinors of S_z . [5]

Q6) a) Explain completeness and closure property in quantum mechanics. [7]

b) Calculate the first order correction to the allowed energies of infinite square well potential of width 'L' if perturbation of the system is $H' = V_0$ (constant). [5]

Q7) Attempt Any THREE of the following : [12]

a) Explain physical interpretation of

i) eigen value

ii) expansion coefficient

b) Discuss selection rule in time dependent perturbation system.

c) Explain Clebsch-Gordan coefficients.

d) Give postulates of quantum mechanics.

e) Write eigen equations of L^2 and L_z operators. Explain it.



Total No. of Questions : 4]

SEAT No. :

PD-3049

[Total No. of Pages : 2

[6475]-105

M.Sc. - I

PHYSICS

**PHY-510 MJ : Industrial Electronics
(2023 Pattern) (Semester - I) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) Q. 1 is compulsory.
- 2) Attempt / Solve any two questions from Q.2 to Q.4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Neat diagrams must be drawn wherever necessary.

Q1) a) Attempt any four of the following :

- i) State four digital characteristics of IOT. [2]
- ii) State trans receiver? [2]
- iii) What is microcontroller and microprocessors? [2]
- iv) What are principles of open source embedded platforms? [2]
- v) What was the first technology in the evolution of IOT? [2]
- b) Describe Technical Building blocks of IOT and its working? [3]

Q2) a) i) Describe types of communication models in IOT. [4]

iii) Describe zigbee and z wave IOT communication Technologies. [3]

- b) Write a programme, how to turn on, LED light with a push Button on an Arduino. [5]

P.T.O.

- Q3)** a) Describe physical design of IOT with its Issues and challenges. [7]
b) Write a program for LM35 Temperature sensor code for Arduino. [5]

Q4) Write a short note on any three of the following :

- a) Concept of GPIO in Atmega 328 based Arduino board. [4]
b) Digital communication. [4]
c) Interfacing of Atmega 328 based Arduino board with stepper motor for rotation of forward and reverse direction. [4]
d) Bluetooth. [4]



Total No. of Questions : 4]

SEAT No. :

PD-3050

[Total No. of Pages : 2

[6475]-106

M.Sc.

PHYSICS

**PHY - 511 - MJ : Computational Physics
(2023 Pattern) (Semester - I) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Attempt/solve any two questions from 2 to 4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks*
- 5) *Use of non-programmable calculator is allowed.*
- 6) *Neat diagrams/flow charts must be drawn wherever necessary.*

Q1) a) Attempt any four of the following :

- i) What is the purpose of IMPLICIT NONE statement. [2]
- ii) What is list directed input statement? Give example of it. [2]
- iii) What is a logical expression in fortran? [2]
- iv) What is monte - carlo simulation. [2]
- v) Define a pointer in fortran. [2]
- b) Write algorithm for Lagrange interpolation. [3]

Q2) a) i) What is Euler method to solve the differential equation. [4]

ii) Explain the difference between functions and subroutines with an example. [3]

b) Write a fortran program and draw a flow chart to calculate the sum of the first N natural numbers. [5]

Q3) a) Solve following simultaneous equations using Gauss elimination method.[7]

$$2x_1 + 3x_2 + 5x_3 = 23$$

$$3x_1 + 4x_2 + x_3 = 14$$

$$6x_1 + 7x_2 + 2x_3 = 26$$

b) Write a fortran program and draw flow chart to calculate the dot product of two vectors. [5]

P.T.O.

Q4) Attempt any three of the following :

- a) Explain the use of character strings in fortran with example. [4]
- b) Describe the structure of a fortran program. [4]
- c) Explain Gauss - seidal iterative method. [4]
- d) Write a short note on Weddle's rule. [4]



Total No. of Questions : 7]

SEAT No. :

PD3051

[Total No. of Pages : 2

[6475]-107

First Year M.Sc.

PHYSICS

PHY-512 MJ : Space Weather and Technology

(2023 Credit Pattern) (Semester - I) (NEP-2020)(4 - Credits) (Elective)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question 1 is compulsory.*
- 2) *Solve any five questions form Q.2 to Q.7.*
- 3) *Q.2 to Q.7 carry equal Marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculators is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five of the following.

- a) What is the sunspots? [2]
- b) What do you mean by Aurorae? [2]
- c) What are the geomagnetic activity indices? [2]
- d) Define solar flares. [2]
- e) Define the term mesosphere. [2]
- f) What is the earthis magnetosphere? [2]

Q2) a) Explain in detail magnetic storms and Aurorae. [7]

b) Explain the geomagnetic activity indices [5]

Q3) a) Explain with the neat diagram the structure of the sun. [7]

b) What is GPS? Explain the effect of space weather on GPS. [5]

Q4) a) Explain in details the composition morphology & general properties of ionosphere. [7]

b) Explain the propagation of coronal mass Ejections in the interplanetary medium. [5]

P.T.O.

- Q5)** a) What is satellite? Explain the effect of space weather on satellite. [6]
b) What is stratosphere? Explain the properties of stratosphere. [6]
- Q6)** a) Explain with neat diagram the Earth's magnetosphere. Explain the concept of Magnetopause. [6]
b) What is space weather? Explain any one application of space weather. [6]
- Q7)** Write short note on any three of following.
- a) Cosmic rays [4]
b) Remote sensing [4]
c) Electric and power grid [4]
d) Solar cycle [4]



Total No. of Questions : 4]

SEAT No. :

PD3052

[Total No. of Pages : 1

[6475]-108

First Year M.Sc.

PHYSICS

**PHY-513 MJ : Atmospheric Physics
(2023 Credit Pattern) (Semester - I) (2 - Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Attempt any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log table and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

- Q1)** a) Attempt any four of the following:
- i) What is the vorticity? [2]
 - ii) Define the hydrostatic balance. [2]
 - iii) What are the apparent forces? [2]
 - iv) Define the LIDARS. [2]
 - v) What are the launch vehicles? [2]
- b) What is the radiosonde? [3]
- Q2)** a) i) Explain the kinematics of the large-Scale horizontal flow. [4]
- ii) Write a short note on geostrophic wind. [3]
- b) Explain in detail of polar and stationery orbits. [5]
- Q3)** a) What is the Doppler radar? Explain in detail the working principle and application of Doppler radar. [7]
- b) Explain in details, the kinetic energy cycle. [5]
- Q4)** Write a short note on any three of following.
- a) Gradient wind [4]
 - b) Atmosphere as a Heat Engine [4]
 - c) Launch vehicles and space crafts [4]
 - d) MST Radar [4]



Total No. of Questions : 4]

SEAT No. :

PD3053

[Total No. of Pages : 1

[6475]-109

M.Sc. - I

PHYSICS

**PHY-514 - MJ : Communication Physics
(2023 Credit Pattern) (Semester - I) (NEP-2020)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Attempt any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any four of the following:

- i) Explain Band-Width. [2]
 - ii) Explain the different Noise in data transmission. [2]
 - iii) What is Hollerith code? [2]
 - iv) What is transmission path? [2]
 - v) What is the time duration of one bit if data rate is 400 bits/sec. [2]
- b) A 50 MHz Radar has a PRF of 5000 Hz, Average power of 30 KW and a pulse width of 3 micro sec. calculate the peak power of this radar. [3]

Q2) a) i) Describe Network organization. [4]

ii) Describe Bardot code. [3]

b) Describe three different codes used for data transmission and discuss their merits and demerits. [5]

Q3) a) Describe satellite communication system. [7]

b) Describe basic pulsed radar system. [5]

Q4) Write a short note on any three of the following.

- a) Distortion equalizer. [4]
- b) Different characteristics of data transmission. [4]
- c) ASCII code used in digital communication. [4]
- d) Radar range equation [4]



Total No. of Questions : 4]

SEAT No. :

PD3054

[Total No. of Pages : 2

[6475]-110

M.Sc. - I

PHYSICS

PHY 541 MN : RESEARCH METHODOLOGY

(2023 Credit Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Q.1 is Compulsory.*
- 2) *Attempt/solve any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log table & non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever neccessary.*

Q1) a) Solve any four of following: **[8]**

- i) What is research proposal? **[2]**
- ii) Write main component's & research paper. **[2]**
- iii) What do you mean by fundamental research? **[2]**
- iv) State the meaning of secondary data. **[2]**
- v) What is research methodology? **[2]**

b) Describe in details the tool's of data collection. **[3]**

Q2) a) i) Distinguish between survey and experiment. **[4]**

ii) Explain in details the significance of research report writing. **[3]**

b) What is research? Explain the characteristics of research. **[5]**

P.T.O.

- Q3)** a) i) What is literature review? State it's advantages. [4]
ii) Explain the concept of hypothesis. [3]
b) Describe the various method's of data collection and it's relative merits [5]
- Q4)** Write a short note on any three of the following: [12]
a) Quantitative and qualitative research. [4]
b) Important aspect's of questionnaires. [4]
c) Research ethics and plagiarism. [4]
d) Research problem. [4]

* * *

Total No. of Questions : 7]

SEAT No. :

PD-3055

[Total No. of Pages : 3

[6475]-201

M.Sc.

PHYSICS

PHY-551 MJ : Solid State Physics
(2023 Pattern)(Semester - II) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Q. 1 is compulsory.
- 2) Solve any five questions from Q.2 to Q.7.
- 3) Q.2 to Q.7 carry equal marks.
- 4) Use of log table and non programmable calculator is allowed.
- 5) Figures to the right indicate full marks.
- 6) Neat labelled diagrams must be drawn wherever necessary.

Given : Plancks constant $h = 6.626 \times 10^{-34}$ J.S.

Mass of electron $m_e = 9.1 \times 10^{-31}$ Kg.

Boltzman constant $K_B = 1.38 \times 10^{-23}$ J/K

Avogadro's number $A = 6.023 \times 10^{23}$ / mole

Permeability of free space $= 4\pi \times 10^{-7}$ Henry/M

Charge of electron $e = 1.6 \times 10^{-19}$ C

Permittivity of free space $= 8.85 \times 10^{-12}$ C²/Nm²

Bohr Magnetron $= 9.27 \times 10^{-24}$ Am²

Q1) Solve Any Five of the following :

- a) What do you mean by Brillouin zone? [2]
- b) The critical temperature T_c for mercury with isotopic mass 199.5 is 4.185 K. Calculate its critical temperature when its isotopic mass changes to 203.4 amu. [2]
- c) What is magnetization? Give its unit. [2]

P.T.O.

- d) What is crystal structure of material showing [110], [200] and [220] miller indices reflections in X-ray diffraction pattern. [2]
- e) Define unit cell and state lattice parameters restriction for orthrhombic unit cell. [2]
- f) Sketch one dimensional coulomb potential for a nearly free election moving in a periodic crystal with lattice constant a . [2]
- Q2) a)** State and prove Bloch theorem . [7]
- b) Estimate the order of the diamagnetic susceptibility of copper by assuming that only one electron per atom makes the contribution. The radius of the copper atom is $1\text{\AA}$ and the lattice parameter of FCC crystal structure of copper is $3.608\text{\AA}$. [5]
- Q3) a)** On the basis of band theory of solid distinguish between a metal, semiconductor and insulator. [7]
- b) Calculate the effective magneton number for Gd^{+3} having outer most electronic configuration ($4f^7 5s^2 5p^6$) [5]
- Q4) a)** Discuss the classical theory of diamagnetism and hence derive an expression for diamagnetic susceptibility. [7]
- b) A paramagnetic salt contains 10^{28} ions/ m^3 with magnetic moment of Bohr magneton. Calculate the paramagnetic susceptibility and magnetization produced in a uniform magnetic field of 10^6A/m at room temperature of 27°C . [5]
- Q5) a)** What is Ferromagnetism? Explain it in details with the help of Weiss molecular theory. [6]
- b) Show that entropy of a super conductor is less than the entropy of a normal conductor. [6]

- Q6)** a) Explain the BCS theory of superconductor. [6]
- b) What are type I and II super conductor? Show that super conductor is perfect diamagnet. [6]

Q7) Write short note on any Three of the following :

- a) Domain theory in ferromagnetism. [4]
- b) Bloch wall [4]
- c) Meissner effect [4]
- d) Dielectric behaviour in BaTiO_3 [4]



Total No. of Questions : 4]

SEAT No. :

PD-3056

[Total No. of Pages : 2

[6475]-202

M.Sc.

PHYSICS

PHY 552 MJ : Electrodynamics

(2023 Pattern) (Semester -II) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instruction to the candidates :

- 1) Q.1 is compulsory.
- 2) Attempt / Solve any two questions from Q.2 to Q.4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log table and non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) Attempt any four of the following: [8]

- a)
 - i) What are Lorentz and coulomb gauges? Write expression.
 - ii) State Faraday's law of electromagnetism.
 - iii) State Postulates of Einstein's theory of relativity.
 - iv) Explain the term multi pole moments.
 - v) Find the velocity at which the mass of the particle is double its rest mass.
- b) How fast does a light approach Earth if sent from a spaceship travelling at $0.500c$. [3]

Q2) a) i) Obtain an expression for electromagnetic field tensor. [4]

ii) Explain Min kowski's space-time diagram. [3]

- b) Derive an expression for potential at a point due to a small linear quadrupole. [5]

P.T.O.

- Q3)** a) Obtain Faraday's law of Induction in differential form for a stationary medium and show how it can be modified if the medium is moving. [7]
- b) Explain the term "Four Vector Potential". [5]

Q4) Attempt any three of the following. [12]

- a) Explain Michelson-Morley experiment with a neat diagram and hence derive formula for fringe shift.
- b) Prove that space time interval $x^2+y^2+z^2$ is not variant under Lorentz transformation while the combined space time interval $x^2+y^2+z^2-c^2t^2$ is Lorentz invariant.
- c) Write Maxwell's equations in differential and integral form.
- d) Describe Lorentz force on charged particle.



Total No. of Questions : 4]

SEAT No. :

PD-3057

[Total No. of Pages : 2

[6475]-203

M.Sc. (Part - I)

PHYSICS

PHY-553 MJ : Atomic and Molecular Physics

(2023 Pattern) (Semester - II) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) Q. 1 is compulsory.
- 2) Attempt / Solve any two questions from Q.2 to Q.4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of non-programmable calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) a) Attempt any four of the following :

- i) What is Hund's principle. Explain its significance. [2]
- ii) Calculate the total number of electrons in a shell if principal quantum number (n) is 4. [2]
- iii) What is molecular spectra hence state types of molecular spectra. [2]
- iv) What is Raman effect hence explain Stokes and anti-Stokes lines. [2]
- v) Explain infrared spectroscopy. [2]
- b) Give the physical significance of Lande's 'g' factor calculate it for 3D_3 . [3]

Q2) a) i) What do you mean by resonance hence explain the terms Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR). [4]

- iii) Find L, S and J values for spectroscopic term symbol 3P_2 and 1P_1 . [3]
- b) Explain Molecular Orbital (MO) method developed by Mulliken to describe the electronic structure of molecules. [5]

P.T.O.

- Q3)** a) Explain the principle, construction and working of Infrared spectrometer with the help of block diagram. [7]
- b) What is Paschen - Back effect hence illustrate it in the principal series of Lithium ($2p - 2s$) state using selection rule $\Delta(m_L + 2m_S) = 0, \pm 1$. [5]

Q4) Attempt any three of the following :

- a) State and explain Franck-Condon principle. [4]
- b) The vibrational structure of the absorption spectrum of O_2 becomes a continuum at 56876 cm^{-1} . If the upper electronic state dissociates into one ground state atom & one excited atom with excitation energy 15875 cm^{-1} . Estimate the dissociation energy of the ground state in cm^{-1} and K.J/mole. [4]
- c) Discuss the information derived from microwave spectroscopy in relation with molecular structure, dipole moment, atomic mass and nuclear quadrupole moment. [4]
- d) Discuss the sample handling techniques in Raman spectrum. Irradiation of carbon tetrachloride by $4358\text{\AA}$ radiation gives Raman lines at $4400\text{\AA}$. Calculate the Raman shift of the line in cm^{-1} . [4]



Total No. of Questions : 4]

SEAT No. :

PD-3058

[Total No. of Pages : 2

[6475]-204

M.Sc.

PHYSICS

PHY - 554 - MJ : Basic Electronics
(2023 Pattern) (2 Credits) (Semester - II)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) Q.1 is compulsory.
- 2) Attempt/solve any two questions from 2 to 4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log table and non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) a) Attempt any four of the following :

- i) What are the basic components of PLL? [2]
- ii) What is the role of an op-amp in a function generator? [2]
- iii) What is a precision rectifier? [2]
- iv) Draw the basic circuit diagram of voltage regulator using the IC723.[2]
- v) What is the function of the control voltage in a VCO? [2]
- b) Draw block diagram of voltage controlled oscillator. [3]

Q2) a) i) Explain the operation and V-I characteristics of TRIAC. [4]

ii) Explain the working of SCR. Draw it's V-I characteristics. [3]

b) What is PLL? Draw its block diagram. Explain its working. Define the terms lock range and capture range. [5]

Q3) a) Determine the free-running frequency f_0 , the lock range f_1 and the capture range f_1 Given :- $V = 12\text{V}$ $R_1 = 15\text{ k}\Omega$, $c_1 = 0.01\text{ }\mu\text{f}$ $c_2 = 10\mu\text{f}$. [7]

b) Explain the working of astable multivibrator using IC741. Draw it's waveform derive the formula for frequency. [5]

P.T.O.

Q4) Write a short note on any three of following :

[12]

- a) SMPS
- b) DC-CD converter
- c) Instrumentation amplifier
- d) Timer IC555 as a FSK generator



Total No. of Questions : 4]

SEAT No. :

PD-3059

[Total No. of Pages : 2

[6475]-205

M.Sc.

PHYSICS

**PHY - 560 - MJ : Fiber Optics and Photonics
(2023 Pattern) (2 Credits) (Semester - II) (NEP - 2020)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Attempt/solve any two questions from 2 to 4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any FOUR of the following : **[8]**

- i) What is the basic of Fibre optics?
- ii) What is the acceptance angle?
- iii) What are the applications of numerical aperture?
- iv) What is a skew ray?
- v) What are different Fiber Losses?
- vi) Where are directional couplers used?

b) How to measure Dispersion Losses? Explain. **[3]**

Q2) a) Answer the following questions.

- i) Describe various classification of fiber. **[4]**
- ii) What are different Fabrication Techniques? **[3]**

b) What is Grating in Photonics Technology? Explain Fiber Grating. **[5]**

Q3) a) Answer the following questions.

- i) What is optical fiber and its types? **[4]**
- ii) Describe Fabry-Perot Filters. **[3]**

b) Explain Plasma- activated chemical vapor deposition. **[5]**

P.T.O.

Q4) Attempt any THREE of the following :

[12]

- a) Explain Coherent Optical Fibre Communication Systems.
- b) Explain Materials or Impurity Fiber Losses.
- c) What is a meridional ray?
- d) Explain the principle of Isolators and Circulators.
- e) What is the principle of numerical aperture?
- f) What is graded-index fibre?



Total No. of Questions : 4]

SEAT No. :

PD-3060

[Total No. of Pages : 2

[6475]-206

M.Sc. (Part - I)

PHYSICS

**PHY - 561 MJ : Experimental Techniques for Material
Characterization**

(2023 Pattern) (Semester - II) (2 Credits) (Elective)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) Q. no. is compulsory.
- 2) Attempt/Solve any two questions from Q.2 to Q.4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log tables and non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) a) Solve any four of the following :

- i) How does elemental analysis (EDS) works? [2]
- ii) What do you mean by lattice parameter? [2]
- iii) Write down the properties of X-Rays. [2]
- iv) What do you mean by hall effect? [2]
- v) Write down the principle of Electron Spin Resonance (ESR) spectroscopy. [2]

b) Calculate the distance between two lattice planes which give first order diffraction at an angle of 26.42° with molybdenum X-Rays of wavelength $0.71\text{\AA}$ [3]

Q2) a) i) With the help of Suitable diagram, describe the resistivity measurement by four probe method. [4]

ii) Why UV-visible spectroscopy is important for material characterization? [3]

b) State and prove the Bragg's Law of Diffraction. [5]

P.T.O.

- Q3)** a) Describe the principle, construction, working and applications of Transmission electron microscopy. [7]
- b) In XRD, peak width at half maxima is 0.35° and it's bragg's angle is 24° . Calculate the crystallite size (wavelength of the source is $1.5406\text{\AA}$) [5]

Q4) Write a short note on any three of the following :

- a) Fourier Transform Infrared spectroscopy (FTIR). [4]
- b) Advantages and Disadvantages of XPS. [4]
- c) Hall effect. [4]
- d) Photoluminescence spectroscopy. [4]



Total No. of Questions : 4]

SEAT No. :

PD-3061

[Total No. of Pages : 2

[6475]-207

M.Sc.

PHYSICS

PHY-562-MJ : Industrial Physics

(2023 Pattern) (Semester -II) (2 Credits) (Elective)

Time : 2 Hours]

[Max. Marks : 35

Instruction to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Attempt any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Neat diagrams must be drawn whenever necessary.*

Q1) a) Attempt any four of the following :

- i) Define nucleus [2]
- ii) Define solar cell [2]
- iii) What is particle accelerator? [2]
- iv) Define binding energy. [2]
- v) Define industrial vacuum. [2]
- b) What are the principles of radiation detectors? [3]

- Q2)** a) i) Explain the function of solar cell. [4]
- ii) What are the essential elements of scientific report? [3]
- b) Explain the function of vacuum pumps. [5]

P.T.O.

- Q3)** a) i) What are the medical applications of particle accelerator? [4]
ii) What are the scaling techniques in vacuum? [3]
b) Write a short note on work ethics in industry. [5]

Q4) Write notes on any three of the following:

- a) Vacuum leak detection [4]
b) Safety culture in industry [4]
c) Radiation monitoring equipment [4]
d) P-n junction diode [4]



Total No. of Questions : 4]

SEAT No. :

PD-3062

[Total No. of Pages : 2

[6475]-208

M.Sc. - I

PHYSICS

**PHY - 563 - MJ : Semiconductor Technology (Elective)
(2023 Pattern) (Semester - II) (NEP - 2020) (2 Credit)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Attempt any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log table and non programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any Four of the following :

- i) What do you mean by conductivity and mobility of charge carriers? [2]
- ii) Find the room temperature resistivity of n type silicon doped with 10^{16} phosphorous atoms/cm³. ($\mu_n - 1300$ cm²/V-s) [2]
- iii) What is basic difference between Schottky barrier diode and p-n junction diode. [2]
- iv) What is tunneling effect in semiconductor? [2]
- v) What is junction breakdown in p-n junction? [2]

b) Draw schematic band diagram, Fermi-Dirac distribution and carrier concentration for intrinsic, n-type and p-type semiconductor at thermal equilibrium. [3]

Q2) a) i) Using Fermi-Dirac distribution function, explain energy band structures for intrinsic and extrinsic semiconductors. [4]

ii) What is Hall effect? Obtain an expression for Hall voltage across semiconductor slab. [3]

b) Derive Shockley diode equation and draw I-V characteristics of diode. [5]

P.T.O.

Q3) a) Obtain the following relation for capacitance in p-n junction :

$$C_j = \frac{A}{2} \left[\frac{2q\epsilon}{V_o - V} Nd \right]^{\frac{1}{2}} \quad [7]$$

b) Show that net recombination rate at carriers is proportional to excess minority carrier concentration in semiconductor at thermal equilibrium,

$$\text{ie. } U = \frac{p_n - p_{no}}{\tau_c} . \quad [5]$$

Q4) Attempt any three of the following : [12]

- a) Derive continuity equation for semiconducting material. [4]
- b) Explain formation of Schottky barrier by contacting n-type semiconductor with metal having larger or smaller work function. [4]
- c) Derive an expression for total current density in semiconductor material. [4]
- d) For a silicon linearly graded junction with a impurity gradient of 10^{20} cm^{-4} , the depletion layer width is $0.5 \mu\text{m}$. Calculate the maximum field and built-in voltage ($T = 300\text{K}$) (Semiconductor permittivity, $\epsilon_s = 0.119 \epsilon_o$). [4]



Total No. of Questions : 4]

SEAT No. :

PD-3063

[Total No. of Pages : 2

[6475]-209

M.Sc.

PHYSICS

PHY-564 MJ : Laser Physics

(2023 Pattern) (Semester - II) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) Q. 1 is compulsory.
- 2) Attempt / Solve any two equations from Q.2 to Q.4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log tables and non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) a) Attempt any four of the following :

- i) Give two type of solid state laser. [2]
- ii) Define metastable state. [2]
- iii) What do you mean by pumping? [2]
- iv) Define term life time of the state. [2]
- v) What is beam divergence? [2]
- b) Calculate the wave length frequency of CO₂ beam having energy difference between two state as 0.117eV. [3]

Q2) a) i) Explain the principle and working of semiconductor diode laser. [4]

- ii) Calculate intensity of a He-Ne laser beam having emissive power 1mw and wavelength 6328×10^{-10} m. [3]

b) Explain the principle and working of Ruby laser. [5]

P.T.O.

- Q3)** a) Explain with the help of an appropriate energy level diagram, How stimulated emission results from electron impact pumping in He-Ne gas laser. [7]
- b) What are the Einstein's coefficients? Discuss in detail. [5]

Q4) Write a short note on any three of the following : [3 × 4 = 12]

- a) Energy level diagram of ruby laser.
- b) Threshold pump power
- c) Line broadening mechanisms
- d) Properties of laser.



Total No. of Questions : 7]

SEAT No. :

PD-3064

[Total No. of Pages : 2

[6475]-301

M.Sc.

PHYSICS

PHY 601 MJ : Nuclear Physics

(2023 Pattern) (Semester - III) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q. 1 is compulsory.*
- 2) *Solve any five questions from Q.2 to Q.7.*
- 3) *Q.2 to Q.7 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagram must be drawn wherever necessary.*

Q1) Solve Any Five of the following :

- a) State the law of radioactive disintegration. [2]
- b) List the main components of nuclear reactor. [2]
- c) Give the examples of even parity & odd parity of quarks. [2]
- d) What is semi-empirical mass formula? [2]
- e) What is magic number? [2]
- f) State any two achievements of shell model. [2]

Q2) a) What are Leptons? Name any three Leptons and their anti particles. Discuss the properties of Leptons. [7]

b) Discuss principle, construction and working of cyclotron. [5]

Q3) a) Describe the Fermi gas model and obtain the expression for Fermi energy. [7]

b) Describe classification of elementary particles. [5]

P.T.O.

- Q4) a)** Explain construction and working of microtron accelerometer. Show that minimum time period for first orbit (π) is two times the period of R.F oscillator. [7]
- b)** State different conservation laws in nuclear reaction. [5]
- Q5) a)** Derive semi-empirical binding energy formula with the help of volume energy, surface energy, coulomb energy, asymmetric energy and pairing energy. [6]
- b)** What is radioactivity? Explain Geiger-Nuttel law. [6]
- Q6) a)** Describe any method for measuring nuclear size. The radius of $_{29}\text{Cu}^{64}$ is measured to be $4.8 \times 10^{-13} \text{cm}$. Find radius of $_{12}\text{Mg}^{27}$. [6]
- b)** Which of the following reaction are allowed or forbidden under the conservation of strangeness, conservation of baryon number, and conservation of charge. [6]
- i) $\pi^+ + n \rightarrow \Lambda^0 + k^+$
- ii) $\pi^- + p \rightarrow \pi^0 + \Lambda^0$
- Q7) Write short note on Any Three of following :** [12]
- a) Shell Model
- b) Fission chain reaction
- c) Electric quadrapole moment of nuclei
- d) Power reactor



Total No. of Questions : 7]

SEAT No. :

[Total No. of Pages : 2

PD3065

[6475]-302

M.Sc. - II

PHYSICS

**PHY-602-MJ: Fundamental Physics of Thin Films
(2023 Credit Pattern) (Semester - III) (NEP-2020) (Credit - 4)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Attempt any five questions form Q.2 to Q.7.*
- 3) *Q. 2 to Q.7 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five questions of the following.

- a) What is Atomistic model? [2]
- b) Define condensation. [2]
- c) Write the advantages of sputtering. [2]
- d) Write the applications of thin films. (any four) [2]
- e) Compare thin and thick films. [2]
- f) Define steps involved in Dip coating. [2]

Q2) a) Explain the principle, construction and working of UV-Visible spectroscopy. [7]

- b) Explain principle and chemical reactions involoved in chemical Bath Deposition (CBD). [5]

Q3) a) Explain in details various stages of thin film growth. [7]

- b) Explain Nucleation and it's types. [5]

Q4) a) Explain Dip coating and spin coating with its advantages and disadvantages. [7]

- b) Explain photolithograph in detail. [5]

P.T.O.

- Q5)** a) Explain chemical vapour deposition method. Give various chemical reactions involved in it. [6]
b) Explain different optical constants in thin films. [6]
- Q6)** a) Explain in detail Stranski-Krastanov model of thin film formation. [6]
b) Explain Mechanical properties of thin films. [6]
- Q7)** Write a short notes on the following. (any three)
- a) SILAR method [4]
b) X-ray photoelectron spectroscopy (XPS) [4]
c) Influence of individual factors on Nucleation process [4]
d) Interference method of film thickness measurement [4]



Total No. of Questions : 7]

SEAT No. :

PD3066

[Total No. of Pages : 2

[6475]-303

M.Sc. - II

PHYSICS

**PHY-603-MJ: Fundamental Biophysics
(2023 Credit Pattern) (Semester - III) (NEP-2020) (4 Credit)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Attempt any five questions form Q.2 to Q.7.*
- 3) *Q. 2 to Q.7 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five questions of the following.

- a) What is MRI. [2]
- b) Define Biophysis. [2]
- c) What is a neuron. [2]
- d) What is the main component of protoplasm? [2]
- e) What is Ramchandran plot. [2]
- f) What are prokaryotic organism. [2]

Q2) a) Describe the role of phosphate groups in the formation of the nucleic acid backbone. [7]

b) State and explain structure and properties of RNA. [5]

Q3) a) With diagram explain different components of animal cell. [7]

b) Describe various forms of protein structure. [5]

Q4) a) Explain components, properties and functions of cytoskeleton in eukaryotic cells. [7]

b) Explain in details Hodking-Kartz experiment. [5]

P.T.O.

- Q5)** a) Explain α and β -helix in proteins and difference between them. [6]
b) Explain the role of sodium (Na^+) and potassium (K^+) ions contributes to the rising and falling phases of the action potential. [6]
- Q6)** a) Describe structure and function of neuron with neat diagram. [6]
b) Discuss computed Tomography (CT) with neat label diagram. [6]
- Q7)** Write a short notes on any Three of the following.
- a) Structure of plant cell [4]
b) Positron Emission Tomography (PET) [4]
c) Types of DNA [4]
d) Applications of Liposomes in biology and medicine [4]



Total No. of Questions : 7]

SEAT No. :

[Total No. of Pages : 2

PD3067

[6475]-304

M.Sc. - II

PHYSICS

**PHY-604-MJ: Fundamental Astronomy and Astrophysics
(2023 Credit Pattern) (Semester - III) (NEP-2020) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Q.1 is compulsory.
- 2) Attempt any five questions from Q.2 to Q.7.
- 3) Q. 2 to Q.7 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log tables and non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) Solve any five questions of the following.

- a) What are the Meteorites? [2]
- b) Define the redshifts. [2]
- c) What are the comets? [2]
- d) Explain the Chandrasekhar limit. [2]
- e) What causes the seasons on earth? [2]
- f) Define the cosmology. [2]

Q2) a) What are the kepler's law? Explain kepler's three laws of planetary motion and describe how each law contributes to our understanding of the motion of planets around the sun. [7]

- b) What are the planetary rings? Explain the formation and evolution of planetary rings around gas giants. [5]

Q3) a) What are the Terrestrial and Giant planets? Explain the processes involved in the formation of terrestrial and giant planets in the early solar system.[7]

- b) What is the Moon? With neat diagram explain the phases of the moon.[5]

Q4) a) What is the redshift? How can redshift be used to determine the expansion of universe? [7]

- b) Explain the concept of habitable zone and the key factors that determine its location around a star. [5]

P.T.O.

- Q5)** a) Explain the formation of white dwarfs and the importance of the chandrasekhar limit in determining their maximum mass. [6]
b) Explain the concept of expanding Universe. How does the cosmic microwave background provide evidence for this expansion? [6]
- Q6)** a) What are the planetary nebulae? Explain in detail the formation of planetary nebulae. [6]
b) Discuss the concept of accelerating Universe. What is the evidence for this acceleration? [6]
- Q7)** Write short note on any three of the following.
- a) Formation of solar system [4]
 - b) Asteroids [4]
 - c) White Dwarfs [4]
 - d) Dark Matter [4]



Total No. of Questions : 7]

SEAT No. :

PD3068

[Total No. of Pages : 2

[6475]-305

M.Sc. - II

PHYSICS

**PHY-605-MJ: Fundamental Energy Physics
(2023 Credit Pattern) (Semester - III) (NEP-2020)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Solve any five questions form Q.2 to Q.7.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logtable and non-programmable electronic calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Q1) Attempt any five of the following.

- a) Give at least two characteristics of sun. [2]
- b) What are green house gases? [2]
- c) What is the use of pyrliometer? [2]
- d) Define sensible heat storage. [2]
- e) What do you mean by renewable energy? [2]
- f) What is mean by conservation of energy? [2]

- Q2)** a) i) Explain the fourier low and Stefans-Boltzman relation. [4]
ii) Explain the difference between beam, diffuse, and global radiation? [3]
- b) Describe with neat diagram, the Hydro storage system. [5]

- Q3)** a) What is solar pond? Explain it's principle & working with neat diagram.[7]
b) Write down the difference between conductive & convective heat transfer. [5]

- Q4)** a) i) Write a short note on convectional & non-convectional energy sources. [4]
ii) Explain solar active and passive systems. [3]
- b) Explain with neat diagram, the structure of sun. [5]

P.T.O.

- Q5)** a) Explain construction, working principle of sun shine recorder with neat diagram. [6]
b) What is fossil fuels? What are impact of excessive use of fossil fuels.[6]
- Q6)** a) Explain the working principle and construction of pyranometer with neat diagram. [6]
b) Explain 1st and 2nd law of thermodynamics & gives real life example of each. [6]
- Q7)** Write short notes on any three of the following.
- a) Solar active and passive systems [4]
 - b) Solar green house [4]
 - c) Energy crisis [4]
 - d) Extra - terrestrial solar radiation [4]



Total No. of Questions : 4]

SEAT No. :

PD-3069

[Total No. of Pages : 2

[6475]-306

M.Sc. - II

PHYSICS

**PHY - 606 - MJ : Physics of Nanomaterials
(2023 Pattern) (2 Credits) (Semester - III)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Attempt/solve any two questions from 2 to 4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any FOUR of the following :

- i) What is Bottom-up approach? [2]
- ii) What is the main benefit of sol-gel processing? [2]
- iii) Enlist the various structure of nanotubes. [2]
- iv) What is the principle behind the hydrothermal method? [2]
- v) What is the role of microorganisms in biological synthesis? [2]
- b) Draw a neat labelled diagram of Physical Vapour Deposition. [3]

Q2) a) i) What is the mechanism at hydrothermal method. [4]

ii) Calculate the optical energy band gap of wave length 380 nm. [3]

b) Describe synthesis of nanomaterials using sol-gel method. [5]

Q3) a) Describe step by step chemical bath Deposition method with suitable diagram. [7]

b) Write a note on carbon nanotubes and their types. [5]

P.T.O.

Q4) Write a short note on any three of following.

[3 × 4 = 12]

- a) Catalytic Properties
- b) Photonic Properties
- c) Biomedical Application
- d) Grapheme



Total No. of Questions : 4]

SEAT No. :

PD-3070

[Total No. of Pages : 2

[6475]-307

M.Sc.

PHYSICS

**PHY-610 MJ : Physics of Diagnostic Instruments
(2023 Pattern) (NEP 2020) (Semester - III) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Solve any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Solve any Four of the following :

- i) What are the uses of skin electron therapy? [2]
- ii) What are the methods of blood flow measurement? [2]
- iii) What is Doppler ultrasound? [2]
- iv) What are effect of too much of high LET radiation therapy? [2]
- v) What information does the ECG give about patient? [2]
- b) State the working principle of x-rays in fractured bone treatment. [3]

Q2) a) i) Distinguish between IGRT and SBRT. [4]

ii) Why EEG is important test? What conclusions can be drawn after this test? [3]

b) Explain the working principle of MRI scan. [5]

P.T.O.

- Q3) a)** Which therapy used for the treatment of tumours on the skin surface?
Explain the working principle of it with schematic diagram. [7]
- b)** An electromagnetic flow meter is used to measure the blood flow in a vessel. The diameter of vessel is 15 mm and the flux density across the electrode is 1.571 mm. If the output voltage for a particular flow rate is 1.5 mv then the flow rate in mm^3/s is? [5]

Q4) Write a short note on any Three of the following :

- a) High LET radiation therapy. [4]
- b) EMG [4]
- c) CT scan [4]
- d) Bio potential electrodes. [4]



Total No. of Questions : 4]

SEAT No. :

PD-3071

[Total No. of Pages : 2

[6475]-308

M.Sc.

PHYSICS

**PHY - 611 - MJ : Radiation Physics
(2023 Pattern) (2 Credits) (Semester - III)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Attempt/solve any two questions from 2 to 4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any Four of the following :

- i) What is Ionizing and Non-Ionizing Radiation? [2]
- ii) Gives the List of types of Neutrons [2]
- iii) Write down the principles of CT scan [2]
- iv) Define Radiology [2]
- v) What do you mean by Thermoluminescence? [2]
- b) Write a note on materials used for shielding of Neutrons. [3]

Q2) a) i) What is Radiation protection? Explain the three methods of Radiation control in detail. [4]

ii) How COBALT - 60 is used in radiotherapy? [3]

b) What is Radiation? Describe the Gamma Ray's Interaction with matter in detail. [5]

Q3) a) Describe the principle, working and uses of x-Ray Radiography. [7]

b) Define the terms : Roentgen, Becquerel, Gray, sievert and Absorbed Dose. [5]

P.T.O.

Q4) Write a short note on any three of following :

- a) Radiation Associated Risk [4]
- b) G-M counter [4]
- c) Computational Simulation - Monte carlo codes [4]
- d) Organic and Inorganic scintillators [4]



Total No. of Questions : 4]

SEAT No. :

PD-3072

[Total No. of Pages : 2

[6475]-309

M.Sc.

PHYSICS

PHY-612MJ : Physics of Data Science
(2023 Pattern) (2 Credits) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) Q.1 is compulsory.
- 2) Attempt / Solve any two questions from Q.2 to Q.4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log-tables and non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) a) Attempt any four of the following :

- i) What are benifits of data preparation? [2]
- ii) What is machine learning? [2]
- iii) What is model evaluation? [2]
- iv) What is a primary goal of data visualization? [2]
- v) Explain "if" and "elif" statements in python? [2]

b) Implement a recursive function of python to calculate the factorial of given number. [3]

Q2) a) i) Explain the importance of setting goal in data science project. [4]
ii) Explain the concept of nested loops and provide an example to illustrate their use. [3]

b) What is unsupervised machine learning? Explain the different types of unsupervised machine learning with suitable example. [5]

Q3) a) Explain convolutional Neural network in deep learning. [7]

b) What is supervised machine learning? Explain different types of supervised machine learning with suitable example. [5]

P.T.O.

Q4) Write short note on any three of the following :

- a) Describe the key characteristics of data science. [4]
- b) Discuss the advantages and disadvantages of linear regression. [4]
- c) Describe the architecture of deep feed forward network. [4]
- d) Describe the primary purposes and application of numpy and scikit python libraries. [4]



Total No. of Questions : 4]

SEAT No. :

PD-3073

[Total No. of Pages : 2

[6475]-310

M.Sc.

PHYSICS

**PHY-613 MJ : Basic Industrial Instrumentation
(2023 Pattern) (Semester - III) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates :

- 1) *Q. 1 is compulsory.*
- 2) *Attempt / Solve any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator are allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any four of the following : **[8]**

- i) Write generalized mathematical model equation and interpret it for first order instruments.
 - ii) What are signal conditioners?
 - iii) What is seebeck effect?
 - iv) Draw block diagram of single channel data acquisition system.
 - v) A resistance strain gauge with a gauge factor of 2 is cemented to a steel member, which is subjected to a strain of 1×10^{-6} . If original resistance value of gauge is 130Ω , calculate change in resistance.
- b) Draw a circuit diagram of sample and hold circuit, explain its working. **[3]**

P.T.O.

- Q2) a) i)** The power radiated from a hot piece of metal was measured by radiation pyrometer and the temperature was determined as 820°C assuming surface emissivity of 0.75. Later it was found that the accurate value of emissivity was 0.69. Find the error in temperature determination. **[4]**
- ii)** Explain step input response of first order instrument with suitable graphs. **[3]**
- b)** Draw block diagram of microcontroller based data acquisition system and explain it in details. **[5]**
- Q3) a)** Explain in detail the use of microprocessor in improving fuel efficiency of petrol engine. **[7]**
- b)** Explain principle, construction and working of Linear Variable Displacement Transformer (LVDT). **[5]**
- Q4) Attempt any three of the following :** **[12]**
- a)** What is strain gauge? Obtain an expression of gauge factor for strain gauges. **[4]**
- b)** Draw block diagram of generalized data acquisition system and Explain it in details. **[4]**
- c)** Explain total radiation type of optical pyrometer with suitable ray diagram. **[4]**
- d)** Write a note on 'Hall effect sensors'. **[4]**



Total No. of Questions : 7]

SEAT No. :

PD-3074

[Total No. of Pages : 2

[6475]-401

M.Sc.

PHYSICS

PHY 651 MJ : Advanced Functional Materials

(2023 Pattern) (Semester -IV) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Solve any five questions from Q.2 to Q.7.*
- 3) *Q.2 to Q.7 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log table and non-programmable electronic calculator is allowed.*
- 6) *Neat diagram must be drawn wherever necessary.*

Q1) Solve any Five of the following:

- a) Sketch the chemical structure of polypyrrole. [2]
- b) What is smart coating window? [2]
- c) What do you mean by pervoskite solar cells. [2]
- d) How does pH affect the drug release from hybrid mesoporous silica nanoparticles (MSNs)? [2]
- e) Enlist the types of polymeric membranes. [2]
- f) Define photochromatic nanoparticles. [2]

Q2) a) Describe the sources of Carbon-based nanomaterials obtained from waste. [7]

- b) Distinguish between the Lithium-ion-batteries and Sodium-ion-batteries. [5]

P.T.O.

- Q3)** a) Draw a schematic representation of an organic photo-voltaic (OPV) solar cell and explain its structure with their working mechanism. [7]
- b) What are magnetorheological (MR) Fluids and how do they work? [5]
- Q4)** a) What is supercapacitor? Compare the electrochemical performance of RuO_2 and MnO_2 as electrode material. [7]
- b) What are the challenges associated with TiO_2 photocatalytic materials in environmental applications? [5]
- Q5)** a) Write down the applications of conducting polymers in organic electronics. [6]
- b) How does NaFePO_4 function in sodium ion batteries? [6]
- Q6)** a) What is Advanced Functional materials? Enlist the types of sustainable energy materials. [6]
- b) Describe the thermo chromic behavior of $\text{Ge}_{20}\text{Te}_{80}$ in smart windows. [6]
- Q7)** Write a short note on any three of the following:
- a) Extrinsically conducting polymer. [4]
- b) Fuel cell materials. [4]
- c) Photochromic nanoparticles. [4]
- d) Mechanism of ZnO materials for photocatalysis. [4]



Total No. of Questions : 7]

SEAT No. :

PD-3075

[Total No. of Pages : 2

[6475]-402

M.Sc.

PHYSICS

**PHY-652MJ : Advanced Physics for Thin Films
(2023 Pattern) (Semester - IV) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) *Q. 1 is compulsory.*
- 2) *Solve any five equations from Q.2 to Q.7.*
- 3) *Q.2 to Q.7 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non programmable electronics calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five of the following :

- a) What is the role of diodes in thin-film electronics? [2]
- b) What does CIGS stand for in solar cells? [2]
- c) Define magnetic domains and domain walls. [2]
- d) What is superconductivity in thin films? [2]
- e) Why are silver thin film used for antimicrobial applications? [2]
- f) What are thin-film solar cells? [2]

Q2) a) Explain the construction and working of dye-sensitized solar cell (DSSC). [7]

b) Explain the role of thin film in magnetic storage devices. [5]

Q3) a) Discuss in detail the properties and applications of superconducting thin films. [7]

b) Discuss the principle and applications of Charge Coupled Devices (CCDs). [5]

P.T.O.

- Q4)** a) Discuss the electrical behaviour of metal films and their applications in modern electronics. [7]
b) Explain how gas sensors detect harmful gases in the environment. [5]
- Q5)** a) How do Infrared (IR) sensors work, and where are they used? [6]
b) Explain the mechanism of Electrofax in detail. [6]
- Q6)** a) How are thin films used in microwave devices in detail? [6]
b) Explain how thin-film strain gauges are used for stress and pressure measurements. [6]
- Q7)** Solve any three of the following :
- a) How do electrochromic displays work? [4]
b) What is the working principle of Thin-Film Transistor (TFT)? [4]
c) What is a photothermal device and how does it work? [4]
d) What is the role of optical sensors in modern applications? [4]



Total No. of Questions : 7]

SEAT No. :

PD-3076

[Total No. of Pages : 2

[6475]-403

M.Sc.

PHYSICS

PHY-653 MJ : Advanced Biophysics

(2023 Pattern) (NEP 2020) (Semester - IV) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Q. 1 is compulsory.
- 2) Solve any five questions from Q.2 to Q.7.
- 3) Q.2 to Q.7 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Neat diagrams must be drawn wherever necessary.

Q1) Solve any five of the following :

- a) Explain principle of IR spectroscopy in brief. [2]
- b) What are the different types of microscopy. [2]
- c) What is the principle of fluorescence microscopy. [2]
- d) What is the advantage of using Raman Spectroscopy for disease diagnosis? [2]
- e) What are the different statistical methods used in biostatistics? [2]
- f) What is the difference between fluorescence and phosphorescence? [2]

Q2) a) Describe principle and working of UV-Visible spectroscopy with neat labelled diagram. [7]

- b) Describe the advantages and limitations of using GC and HPLC in analyzing biological samples. [5]

P.T.O.

- Q3)** a) Explain the principle and working of Raman spectroscopy with neat labelled diagram. [7]
b) Explain principle and applications of polarization microscopy. [5]
- Q4)** a) Explain principle and instrumentation of mass spectroscopy. [7]
b) Describe principle and applications of microscopy in biology. [5]
- Q5)** a) Describe the principle of MALDI-TOF and explain how it is used to analyze biomolecules. [6]
b) Explain the interaction of radiation with cells and biological systems. [6]
- Q6)** a) Explain principle and working of NMR. [6]
b) Explain applications of X-Ray crystallography in biology. [6]
- Q7) Write short note on any three of the following :**
- a) Chemiluminescence [4]
b) Scanning Electron Microscopy (SEM) [4]
c) Chi-Square test [4]
d) Atomic Absorption Spectroscopy (AAS) [4]



Total No. of Questions : 7]

SEAT No. :

PD-3077

[Total No. of Pages : 2

[6475]-404

M.Sc.

PHYSICS

**PHY-654MJ : Advanced Astronomy and Astrophysics
(2023 Pattern) (Semester - IV) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) *Q.1 is compulsory.*
- 2) *Solve any five questions from Q.2 to Q.7.*
- 3) *Q.2 to Q.7 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five of the following :

- a) Name two space-based telescopes used for astronomical research. [2]
- b) What are neutrinos and how are they detected in astronomy. [2]
- c) Define Flux and Luminosity in astrophysics. [2]
- d) Name two methods used for root finding in numerical analysis. [2]
- e) State the Cauchy-Riemann conditions for analyticity. [2]
- f) Define inner product in vector spaces. [2]

- Q2) a)** Discuss the role of gravitational waves, neutrinos and cosmic rays in modern astrophysics. [7]
- b) Compare the advantages and disadvantages of ground-based and space-based telescopes. [5]

- Q3) a)** Explain the Lorentz transformations and their applications in relativistic astrophysics. [7]
- b) Discuss the role of special relativity in astrophysical radiation. [5]

P.T.O.

- Q4)** a) Explain how N-Body methods and gravitational simulations are used in astrophysical research. [7]
b) Explain the Fourier Transform and its applications in astrophysics. [5]
- Q5)** a) Discuss Green's function method in solving non homogenous differential equations with an example. [6]
b) How do you evaluate definite integrals using residue theorem? [6]
- Q6)** a) Discuss the multi-wavelength view of astrophysical objects. [6]
b) Explain the properties of unitary and orthogonal matrices with examples. [6]
- Q7)** Solve any three of the following :
- a) What are the major challenges in detecting dark energy? [4]
b) Describe the role of Virtual Observatories (VO) in modern astronomy.[4]
c) Discuss Thomson Scattering and its importance. [4]
d) What is a contour integral, and where is it used? [4]



Total No. of Questions : 5]

SEAT No. :

PD-3078

[Total No. of Pages : 2

[6475]-405

M.Sc.

PHYSICS

**PHY-655-MJ: Advanced Energy Physics
(2023 Pattern) (Semester - IV) (NEP-2020) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidate:

- 1) *Q. 1 is compulsory.*
- 2) *Q. 2 to 7 carry equal marks.*
- 3) *Solve any five questions from Q. 2 to Q. 7.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five of the following :

- a) Explain the basic working principle of solar cell? [2]
- b) What is anaerobic bioconversion? [2]
- c) What are the sources of hydrogen? [2]
- d) What is biomass? [2]
- e) What is selective coating? [2]
- f) What is Geothermal energy? [2]

Q2) Solve the following

- a) What is fuel cell? Explain its principle, construction and application. [7]
- b) Explain the various hydrogen production method. [5]

P.T.O.

- Q3)** a) i) Explain a water pump as application of SPV system. [4]
ii) List out the different factors which affects the power of wind. [3]
b) Explain with neat diagram, domestic hot water system i.e.flat plate collector system. [5]

Q4) Solve the following

- a) What are the different properties of biomass? How it converts into useful form of energy. [7]
b) Explain the working of solar Dryer with a suitable diagram. [5]

Q5) Solve the following

- a) Explain the basic principal of wind energy conversion. [6]
b) Explain with neat block diagram, a solar photovoltaic (spv) system designing. [6]

Q6) Solve the following

- a) State the different types of solar cooker. Explain any one of them with a suitable diagram. [6]
b) Explain the aerobic and anaerobic bio-conversion process. [6]

Q7) Write a short note on any three of the following:

- a) Solar still [4]
b) Methods of production of Hydrogen. [4]
c) Limitations of Wind Energy Conversions. [4]
d) Biomass Gasifier and it's type. [4]



Total No. of Questions : 4]

SEAT No. :

PD3079

[6475]-406

[Total No. of Pages : 2

M.Sc.-II

PHYSICS

**PHY-660-MJ : Energy Storage Devices
(2023 Credit Pattern) (Semester - IV) (NEP-2020)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Attempt/solve any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicates full marks.*
- 5) *Use of logarithmic tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any four of the following.

- i) Define energy storage and its importance. [2]
- ii) Define energy storage. [2]
- iii) Define a battery. [2]
- iv) Name two type of fuel cells. [2]
- v) Define thermal runaway in battery system. [2]
- b) Explain the working principle of a battery. [3]

Q2) a) i) Explain the major difference between batteries and super capacitors. [4]

ii) What are the challenges in recycling lithiumion batteries? [3]

b) What are the challenges and advancements in energy storage technologies? [5]

P.T.O.

Q3) a) Explain the working principle of different battery types and compare their performance. **[7]**

b) Explain the advantages and challenges of fast-charging solution for EVs. **[5]**

Q4) Write a short note on any three of the following.

a) Hybrid electrochemical supercapacitors. **[4]**

b) Recycling of Batteries from EVs. **[4]**

c) Type of fuel cells. **[4]**

d) Lead-acid battery. **[4]**



Total No. of Questions : 4]

SEAT No. :

PD3080

[6475]-407

[Total No. of Pages : 2

S.Y.M.Sc.

PHYSICS

**PHY-661-MJ : Data Interpretation and Analysis
(2023 Credit Pattern) (Semester - IV) (NEP-2020) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Attempt any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figure to right indicates full marks.*
- 5) *Use of logarithmic tables and non-programmable calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any four of the following.

- i) Describe structured data and its characteristics. [2]
 - ii) What is the purpose of measures of variability. [2]
 - iii) What is the primary goal of effective data visualization? [2]
 - iv) What is P-value? [2]
 - v) Give the names of three types of ANOVA. [2]
- b) A data set contains the following values 2, 4, 6, 8, 10. Calculate the mean, median and mode of the dataset. [3]

Q2) a) i) Describe the key characteristics to be focused for effective presentation of data analysis results. [4]

ii) Explain the concept of data cleaning and its various technique. [3]

b) Explain concept of measures of shapes and describe different types.[5]

P.T.O.

- Q3)** a) Explain the concept of cluster analysis and its purpose in identifying patterns and relationships in a dataset. Describe the different types of cluster analysis, including hierarchical and non-hierarchical clustering. **[7]**
- b) Explain the concept of data visualization and its importance in understanding and communicating data insights. Describe different types of data visualization tools available including statistical softwares, data visualization platforms and programming languages. **[5]**

Q4) Write a short note on any three of the following.

- a) Factor analysis. **[4]**
- b) Different methods for handling missing data. **[4]**
- c) Chart types for effective data visualization. **[4]**
- d) Cluster analysis method and its types. **[4]**



Total No. of Questions : 7]

SEAT No. :

PD3081

[6475]-408

[Total No. of Pages : 2

M.Sc.-II

PHYSICS

PHY-662-MJ : Ocean Physics

(2023 Credit Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.1 is compulsory.*
- 2) *Solve any five questions from Q.2 to Q.7.*
- 3) *Figures to the right indicates full marks.*
- 4) *Q.2 to Q.7 carry equal marks.*
- 5) *Use of logarithmic tables and non-programmable calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any Five of the following.

- a) Define sound propagation in sea water. [2]
- b) Define physical oceanography. [2]
- c) What is ocean optics? [2]
- d) What is under water acoustics? [2]
- e) Define acoustic impedance. [2]
- f) What is remote sensing in oceanography? [2]

Q2) a) Explain how wind stress contributes to oceanic circulation patterns and climate regulation? [7]

- b) Derive the basic form of the acoustic wave equation and describe its physical meaning. [5]

P.T.O.

- Q3)** a) Explain how sound wave are used for underwater communication and navigation? [7]
b) Explain the process of tsunami formation and propagation. [5]
- Q4)** a) Explain how light penetration varies with depth and its effects on marine life? [7]
b) Differentiate between wind-generated waves and tsunamis. [5]
- Q5)** a) Discuss how the acoustic wave equation is applied in sonar and underwater exploration? [6]
b) Describe the factor affecting sound transmission in seawater. [6]
- Q6)** a) Briefly explain the contributions of modern technology to the development of physical oceanography. [6]
b) Describe the process of back scattering of light by particles in the ocean. [6]
- Q7)** Solve any three of the following.
- a) Explain how pressure gradients contribute to ocean circulation. [4]
b) Briefly explain the role of pressure and density in the acoustic wave equation. [4]
c) Explain the role of solar radiation in ocean optics. [4]
d) Describe how satellite sensors measure ocean color. [4]



Total No. of Questions : 4]

SEAT No. :

PD3082

[Total No. of Pages : 2

[6475]-409

S.Y. M.Sc.

PHYSICS

**PHY-663-MJ : Advanced Industrial Instrumentation
(2023 Credit Pattern) (NEP 2020) (Semester - IV) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Q. No. 1 is compulsory.*
- 2) *Attempt/Solve any two questions from Q.2 to Q.4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Neat diagrams must be drawn wherever necessary.*

- Q1)** a) Attempt any four of the following : [8]
- i) What is Servomechanism? [2]
 - ii) What are narrative statements in ladder programming. [2]
 - iii) Define 'transient regulation'. [2]
 - iv) Define 'Neutral Zone' in two position controller mode. [2]
 - v) Write the answer of the following MATLAB command : [2]
`>>A = [10: -1: 4; ones (1, 7); line space (0, 10, 7)]`
- b) State and explain process characteristics in process control system in details. [3]
- Q2)** a) i) Explain control system objectives in process control systems. [4]
ii) What do you mean by discrete state process control? [3]
- b) Write a commands in MATLAB to create 6×6 matrix in which middle two rows and columns are 1's (ones) and the rest of all are 0's(zeros).[5]
- Q3)** a) Draw circuit diagram for proportional integrate mode controller and explain it's response to the changes in error with time. [7]
- b) The elevator platform used to move object up and down. The global objective is that when up button is pushed, the platform carries something to the up position and when down button is pushed, the platform carries something to the down position. Use M_1 , M_2 , LS_1 , LS_2 and swithes PB_1 to PB_4 hardware specifications to define the equipments have used in the elevator. Write the narrative statements and draw a ladder diagram to implement these control functions. [5]

P.T.O.

Q4) Attempt any three of the following : **[12]**

- a) Explain programmable logic controller's (PLC's) operation with suitable diagram. **[4]**
- b) Explain action of relay sequence using suitable example. **[4]**
- c) A liquid level control system linearly convert's a displacement of 2 to 3mA in to a 4 to 20 mA control signal. A relay (serves) as the two position to open or close an inlet valve. The relay closes at 12mA and opens at 10mA find(a) the relation between displacement level & current(b) the neutral zone or displacement gap in meters. **[4]**
- d) What is derivative mode? Draw a practical circuit diagram using Op-amp and explain it. **[4]**

