This question paper contains **3** printed pages]

# NEPSST—1—2025

## FACULTY OF SCIENCE AND TECHNOLOGY

## M.Sc. (First Year) (First Semester) EXAMINATION

## APRIL/MAY, 2025

### (NEP 2020)

RESEARCH METHODOLOGY

Paper NEPRN-1001

**(Wednesday, 16-4-2025)**      **Time : 10.00 a.m. to 12.30 p.m.**

*Time—2½ Hours*      *Maximum Marks—60*

*N.B.* :— (*i*) Question No. **1** is compulsory.

    (*ii*) Of the remaining solve any *three* questions.

    (*iii*) Calculator and log table is allowed.

1. Attempt any *three* of the following :      15

    (*a*) Qualities of good research.

    (*b*) Features of good design.

    (*c*) ANOVA

    (*d*) Types of data.

2. (*a*) What is research ? Explain steps involved in research process.    8

    (*b*) Discuss interview as a technique of data collection.    7

P.T.O.

3. (*a*) Calculate the Mean, Median and Mode of the following data :  8

| Class Interval (CI) | Frequency (F) |
|---|---|
| 50–54 | 2 |
| 45–49 | 5 |
| 40–44 | 8 |
| 35–39 | 7 |
| 30–34 | 10 |
| 25–29 | 5 |
| 20–24 | 9 |
| 15–19 | 2 |
| 10–14 | 1 |
| 5–9 | 1 |

(*b*) What is hypothesis ? Give the characteristics of good research hypothesis.  7

4. (*a*) Describe non-probability and probability sampling.  8

(*b*) Calculate the Chi-square value of the following data :  7

| Excellent | Average | Poor | Total |
|---|---|---|---|
| 58 | 32 | 30 | 120 |

5. (*a*) Define case study. Give their components. 8

   (*b*) Explain extraneous variable. 7

6. Write short notes on : 15

   (*a*) Descriptive types of research

   (*b*) Non-parametric test

   (*c*) Primary data sources.

# NEPSST—86—2025

## FACULTY OF SCIENCE AND TECHNOLOGY

### M.Sc. (First Year) (First Semester) EXAMINATION

### APRIL/MAY, 2025

### (NEP)

### PHYSICS

### Paper SPHYC-401

### (Mathematical Methods in Physics)

**(Saturday, 19-4-2025)**         **Time : 10.00 a.m. to 1.00 p.m.**

*Time*—3 Hours                               *Maximum Marks*—80

*N.B.* :—   (*i*)   *All* questions carry equal marks.

        (*ii*)   Question **1** is compulsory.

        (*iii*)   Solve any *three* of the remaining five questions (Q. No. **2** to Q. No. **6**).

        (*iv*)   Figures to the right indicate full marks.

1.   Solve the following questions (each carries 5 marks) :        20

   (A)   Write a short note on Hermitian matrices

   (B)   Show that $\int_{-1}^{+1} P_n(x)\,dx = 0$ if $n \neq 0$

       and $\int_{-1}^{+1} P_n(x)\,dx = 2$, if $n = 0$ .

   (C)   Explain Fourier cosine transforms.

   (D)   State and prove residue theorem.

<div align="right">P.T.O.</div>

2. (1) Examine for linear dependence [1, 0, 2, 1], [3, 1, 2, 1], [4, 6, 2, 4], [–6, 0, – 3, – 4] and find the relation between them. 10

(2) Explain Gram Schmidt Orthonormalization Process for orthonormalizing a set of vectors in an inner product space. 10

3. (1) Derive Rodrigue's formula $P_n(x) = \dfrac{1}{2^n.n!} \dfrac{d^n}{dx^n}(x^2 - 1)^n$. 10

(2) Prove that $J_n(x)$ is the coefficient of $z^n$ in the expansion of $e^{\frac{x}{z}\left(z - \frac{1}{z}\right)}$.

10

4. (1) Find the Laplace transform of [4 cosh 2t sin 4t]. 10

(2) Find the Fourier transform of function $e^{ax^2}$, where $a > 0$. 10

5. (1) State and prove Taylor's theorem. 10

(2) Derive the necessary condition for $f(z)$ to be analytic. 10

6. Solve the following (Each question carries **5** marks) : 20

(a) Prove that the inverse of a matrix is unique.

(b) Prove that $xJ_n' = nJ^n - x J_{(n+1)}$.

(c) If $L\{f(t)\} = F(s)$, then $L[f(at)] = \dfrac{1}{2} F\left(\dfrac{s}{a}\right)$.

(d) Define the residue at a pole.

# NEPSST—182—2025

## FACULTY OF SCIENCE AND TECHNOLOGY

## M.Sc. (First Year) (First Semester) EXAMINATION

## APRIL/MAY, 2025

### (NEP-2020)

PHYSICS

Paper–SPHYC-402

(Classical Mechanics)

**(Tuesday, 22-4-2025)**          **Time : 10.00 a.m. to 1.00 p.m.**

*Time—3 Hours*          *Maximum Marks—80*

N.B. :—   (*i*)   *All* questions carry equal marks.

       (*ii*)   Question No. **1** is compulsory.

       (*iii*)   Solve any *three* of the remaining questions (Q. No. **2** to Q. No. **6**).

       (*iv*)   Figures to the right indicate full marks.

1.   Solve the following questions (Each question carries **5** marks) :     20

    (*a*)     Gallelian Transformation

    (*b*)     Jacobi Integral

    (*c*)     Kepler's laws of planetary motion

    (*d*)     Derive Normal frequencies of vibrations.

2. Solve the following questions (Each question carries **10** marks) : 20

   (*a*) Explain motion of charge particle in electromagnetic field.

   (*b*) What are constraints ? Explain its types.

3. Solve the following questions (Each question carries **10** marks) : 20

   (*a*) Explain Gauge transformation from Lagrangian.

   (*b*) Explain kinetic energy in terms of generalized co-ordinates.

4. Solve the following questions (Each question carries **10** marks) : 20

   (*a*) Derive Hamiltonian equation of motion from Hamiltonian principle.

   (*b*) What is Poisson bracket ? Explain their properties in detail.

5. Solve the following questions (Each question carries **10** marks) : 20

   (*a*) Explain Euler's equation of motion for a rigid body.

   (*b*) Explain stable and unstable equilibrium in detail.

6. Write short notes on (Each question carries **5** marks) : 20

   (*a*) Conservative and non-conservative forces

   (*b*) Generalized momentum

   (*c*) Rutherford scattering

   (*d*) Normal coordinates.

This question paper contains **3** printed pages]

# NEPSST—306—2025

## FACULTY OF SCIENCE

**M.Sc. (NEP) (First Year) (First Semester) EXAMINATION**

**APRIL/MAY, 2025**

PHYSICS

(SPHYC-403)

**(Numerical Techniques and C-Programming)**

**(Thursday, 24-4-2025)**                                    **Time : 10.00 a.m. to 1.00 p.m.**

*Time—3 Hours*                                            *Maximum Marks—80*

*N.B.* :—  (*i*)    Q. No. **1** is compulsory.

    (*ii*)    Attempt any *three* questions from Q. Nos. **2** to **6**.

    (*iii*)    Each question carries equal marks.

    (*iv*)    Use of scientific calculator is allowed.

    (*v*)    Figures to the right indicate full marks.

1.    Solve any *two* of the following questions :                                    20

(*a*)    Explain Bisection method to obtain root of a polynomial equation.

(*b*)    Evaluate $\int_0^6 xe^{-0.5x}\,dx$ using the trapezoidal rule with 3 strips, to 3 decimal places.

(*c*)    Discuss the solution for the hyperbolic partial differential equation.

(*d*)    What are the advantages/disadvantages of compilers and interpreters over each other ?

P.T.O.

2. (*a*) Using the following data find the Newton's interpolating polynomial and also find the value of *y* at *x* = 5 : 10

| *x* | *y* |
|---|---|
| 0 | 7 |
| 10 | 18 |
| 20 | 32 |
| 30 | 48 |
| 40 | 85 |

(*b*) Find a real root of the equation $x^3 - 2x - 5 = 0$ by the method of false position correct to three decimal places. 10

3. (*a*) Using Euler's method solve the differential equation : 10

$$\frac{dy}{dx} = \log (x + y)$$ with initial condition that *y* = 1 at *x* = 0, find *y* at *x* = 0.2 and *y* = 0.5.

(*b*) Derive Newton Cotes formula and evaluate the integral : 10

$$\int_0^1 \frac{dx}{(1+x)}$$ divide the integral (0, 1) into six equal parts.

4. (*a*) Find inverse of the matrix : 10

$$A = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$$ by Gauss-Jordon method.

(b) Find the highest eigen value and corresponding eigen vectors of the following matrix : 10

$$A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

5. (a) What are random numbers ? How random numbers are generated in C programming ? 10

(b) What is an assignment statement ? Give general form of an assignment statement. Discuss build in and user defined function. 10

6. Write short notes on any *two* (each question carries 10 marks) : 20

(a) The principle of Least squares.

(b) Runge-Kutta method.

(c) Gauss-Seidal iteraction method.

(d) Executable and non-executable statements.

This question paper contains **2** printed pages]

## NEPSST—485—2025

### FACULTY OF SCIENCE

**M.Sc. (First Year) (First Semester) EXAMINATION**

**APRIL/MAY, 2025**

**(NEP 2020 Pattern)**

PHYSICS

SPHYE-401

(Electronic Devices)

**(Saturday, 26-4-2025)**                                                           **Time : 10.00 a.m. to 1.00 p.m.**

*Time—3 Hours*                                                                                 *Maximum Marks—60*

**N.B.** :—  (*i*)  *All* questions carry equal marks.

(*ii*)  Question No. **1** is compulsory.

(*iii*)  Solve any *three* of the remaining five questions (Q. No. **2** to Q. No. **6**)

(*iv*)  Figures to the right indicate full marks.

1.  Solve the following questions :                                                                    15

(*a*)  Explain structure of Field effect transistor.

(*b*)  Explain in brief about photodetectors.

(*c*)  With logic diagram and truth table explain R-S flip-flop.

P.T.O.

2. (*a*) Draw the structure of SCR and explain its working. 8

   (*b*) Describe the fundamental properties of a semiconductor and its types. 7

3. (*a*) How do photodiodes and phototransistors work ? Explain in detail.

   8

   (*b*) What are direct and indirect band gap semiconductors ? Explain difference between them. 7

4. (*a*) Explain Op-Amp as an adder and substractor. 8

   (*b*) With neat diagram explain how Op-Amp can be used as an inverting amplifier. 7

5. (*a*) What is logic ? Explain the operations of basic gates with its logic symbols and truth table. 8

   (*b*) Solve using binary rules :

   (*i*) $(1100)_2 + (1101)_2$ 7

   (*ii*) $(1010)_2 - (0100)_2$

6. Write short notes on : 15

   (*a*) Gunn Diode

   (*b*) Astable Multivibrator using IC555

   (*c*) 1 : 4 Demultiplexer

This question paper contains **2** printed pages]

# NEPSST—42—2025

## FACULTY OF SCIENCE

### M.Sc. (NEP) (First Year) (Second Semester) EXAMINATION

### APRIL/MAY, 2025

PHYSICS

SPHYC-451

(Quantum Mechanics)

**(Thursday, 17-4-2025)**                                   **Time : 10.00 a.m. to 1.00 p.m.**

*Time—3 Hours*                                               *Maximum Marks—80*

**N.B.** :— (*i*)   Question Number **1** is compulsory.

(*ii*)   Solve any *three* of the remaining five questions (Q. No. **2** to **6**).

(*iii*)   *All* questions carry equal marks.

(*iv*)   Figures to the right indicate full marks.

1.   Solve the following questions (each question carries **5** marks) :          20

(*a*)   Discuss any *two* postulates of quantum mechanics.

(*b*)   Show that :

(*i*)   $[J_z, J_+] = \hbar J_+$

(*ii*)   $[J_+, J_-] = 2\hbar J_z$

P.T.O.

(c) Describe the time independent perturbation theory for non-dgenerate case in first order.

(d) Explain the Laboratory reference frame.

2. (a) Derive an expression for the time dependent Schrodinger equation.

10

(b) Describe the Unitary Transformation in detail. 10

3. (a) What are the Ladder operators ? Find the commutation relation of $J_z$ with J and J. 10

(b) Discuss the reflection invariance and parity. 10

4. (a) Outline W.K.B. method for one-dimensional case and derive the connection formulate. 10

(b) Explain the sudden approximation with reference to time dependent perturbation theory. 10

5. (a) Explain Born approximation in detail. 10

(b) Discuss the symmetric and anti-symmetric wave functions. 10

6. Write short notes on (Each question carries **5** marks) : 20

(a) Ket and Bra notations

(b) Orbital angular momentum

(c) Fermi Golden rule

(d) Differential scattering cross-section.

# NEPSST—134—2025

## FACULTY OF SCIENCE

### M.Sc. (First Year) (Second Semester) EXAMINATION

### APRIL/MAY, 2025

PHYSICS

Paper–SPHYC-452

(Statistical Mechanics)

**(Monday, 21-4-2025)**  **Time : 10.00 a.m. to 1.00 p.m.**

*Time—3 Hours*  *Maximum Marks—*80

*N.B.* :— (*i*) Each question carries equal marks.

(*ii*) Figures to the right indicate full marks.

(*iii*) *First* question is compulsory.

(*iv*) Solve any *three* of the remaining five questions (Q. No. **2** to Q. No. **6**).

1. Solve the following questions (any *two*) :  20

(*i*) Define partition function and derive it for a system represented by a grand canconical ensemble.

(*ii*) Pauli's theory of para magnetism.

(*iii*) Discuss the phenomenon of Bose-Einstein condensation.

(*iv*) Give brief account on Brownian motion.

P.T.O.

2. (*a*) Define partition function and derive it for a system represented by a canonical ensemble. 10

(*b*) Derive M-B distribution formula and evaluate $\alpha$ and $\beta$. 10

3. (*a*) What are Fermions ? Derive the Fermi-Dirac distribution formula. Discuss *one* application for this distribution. 10

(*b*) Show that electron gas in a White Dwarf Star is strongly degenerate and relativistic in nature. 10

4. (*a*) Explain the phenomenon of B-E condensation using B-E distribution law at $T < T_0$. 10

(*b*) Derive B-E distribution law for the distribution of particle obeying B-E statistics. 10

5. (*a*) Derive the Fokker-Plank equation. 10

(*b*) Discuss Landau's theory of phase transition. 10

6. Write short notes on (any *two*) : 20

(*a*) Microcananical ensemble

(*b*) Density matrix

(*c*) Phonon statistics

(*d*) Fluctuations and transport phenonmena.

This question paper contains **3** printed pages]

# NEPSST—231—2025

## FACULTY OF SCIENCE

**M.Sc. (First Year) (Second Semester) EXAMINATION**

**APRIL/MAY, 2025**

**(NEP-2020)**

PHYSICS

Paper SPHYC-453

(Condensed Matter Physics–I)

**(Wednesday, 23-4-2025)**          **Time : 10.00 a.m. to 1.00 p.m.**

*Time—Three Hours*          *Maximum Marks—80*

N.B. :—   (*i*)   Question No. **1** is compulsory.

      (*ii*)   Solve any *three* of the remaining 5 questions (Q. Nos. **2** to **6**).

     (*iii*)   *All* questions carry equal marks.

     (*iv*)   Figures to the right indicate full marks.

1.     Solve the following questions (Each questions **5** marks) :       20

   (*a*)     What is Bravais Lattices ? Discuss Bravais lattice in two-dimensions. Write down symmetry operations in which each is invariant.

(b) How are Brillouin zones constructed ? Describe and sketch the first Brillouin zones of bcc and fcc lattice.

(c) Distinguish between a metal, a semiconductor, and an insulator on the basis of their energy band structure.

(d) What is the Fermi surface and how does it relate to the properties of metals ?

2. Answer the following (Each sub-questions **10** marks) :　　　　20

(a) Explain the crystal structure of diamond. In diamond crystal what is the number of nearest neighbors, the number of stoms per unit cell and packing fraction ?

(b) Describe a hexagonal closed-packed structure (hcp). Calculate its packing fraction.

3. Answer the following (Each sub-questions **10** marks) :　　　　20

(a) What is Bragg's law ? Explain X-ray diffraction with its applications.

(b) Describe the powder method for X-ray diffraction.

4. Answer the following (Each sub-questions **10** marks) :　　　　20

(a) State and prove Bloch theorem. Discuss its importance in the band theory.

(b) Explain Kronig-Penney Model.

5.      Answer the following (Each sub-questions **10** marks) :          20

     (*a*)      What are Brillouin zones ? Explain Brillouin zone in two-dimensions and three-dimensions.

     (*b*)      What is Fermi Level ? Discuss experimental techniques used to determine it.

6.      Write short notes on (Each question **5** marks) :          20

     (*a*)      Explain the concept of Miller indices.

     (*b*)      Discuss the properties of reciprocal lattice.

     (*c*)      What is meant by effective mass of an electron ? Explain in detail.

     (*d*)      What are key characteristics of Fermi surface ?

This question paper contains **2** printed pages]

# NEPSST—413—2025

## FACULTY OF SCIENCE AND TECHNOLOGY

## M.Sc. (First Year) (Second Semester) EXAMINATION

## APRIL/MAY, 2025

### (NEP-2020)

PHYSICS

Paper–SPHYE-451

(Atomic and Molecular Physics)

**(Friday, 25-4-2025)**                                    **Time : 10.00 a.m. to 1.00 p.m.**

*Time—3 Hours*                                              *Maximum Marks—60*

N.B. :—   (i)   *All* questions carry equal marks.

(ii)   Question No. **1** is compulsory.

(iii)   Solve any *three* of the remaining five questions Q. No. **2** to Q. No. **6**).

(iv)   Figures to the right indicate full marks.

1.   Solve the following questions (each question carries **5** marks) :          15

(a)   Explain the vector atom model and its significance in atomic spectra.

(b)   Describe the coupling schemes in divalent atoms.

(c)   What are the selection rules for rotational spectra of diatomic molecules ?

P.T.O.

2. (*a*) Discuss the different series in alkali spectra. 8

(*b*) Explain L-S coupling and j-j coupling. 7

3. (*a*) Explain the rigid rotator model. How it does differ from the non-rigid rotator model in microwave spectroscopy of diatomic molecules. 8

(*b*) How are inter-atomic distance determined using isotopic substitution in polyatomic molecules ? 7

4. (*a*) Discuss the anharmonic oscillator model in vibrational spectroscopy of diatomic molecules. 8

(*b*) Explain the P, Q and R branches in the vibrational spectra of polyatomic molecules. 7

5. (*a*) Explain the quantum theory of the Raman Effect and its significance in molecular spectroscopy. 8

(*b*) Discuss the Raman spectra of symmetric top molecules. 7

6. Write short notes (Each question carries **5** marks) : 15

(*a*) Spectroscopic terms and notations

(*b*) Dissociation energy and dissociation product

(*c*) Rule of mutual exclusion.

# NEPSST—18—2025

## FACULTY OF SCIENCE

### M.Sc. (Second Year) (Third Semester) EXAMINATION

### APRIL/MAY, 2025

### (NEP 2020)

PHYSICS

Paper SPHYC501

(Electrodynamics)

**(Wednesday, 16-4-2025)**                    **Time : 2.00 p.m. to 5.00 p.m.**

*Time*—3 Hours                                        *Maximum Marks*—80

N.B. :—   (*i*)   *All* questions carry equal marks.

(*ii*)   Question No. **1** is compulsory.

(*iii*)   Solve any *three* of the remaining five questions (Question No. **2** to **6**).

(*iv*)   Figures to the right indicate full marks.

1.   Solve the following questions (Each question carries **5** marks) :        20

(*a*)   Explain the concept of radiation pressure.

(*b*)   Discuss the Brewster's angle.

(*c*)   What do you mean by retarded potential ?

(*d*)   Explain Galilean transformation.

P.T.O.

2. (*a*) Derive an expressions for the equation of continuity. 10

   (*b*) State and explain Poynting's theorem. 10

3. (*a*) Derive an expression for Fressnel's equation in the case when vector E is parallel to the plane of incident on the basis of Reflection & Refraction from metallic surface. 10

   (*b*) Discuss the wave in hollow conductors. 10

4. (*a*) Derive the Lienard radiation formula by using Larmor formula. 10

   (*b*) Describe the field due to oscillating electric dipole. 10

5. (*a*) Explain the length contraction and time dialation of special theory of relativity. 10

   (*b*) Explain in detail the 4-vector in electrodynamics. 10

6. Write short notes on (each question carries **5** mark) : 20

   (*a*) Lorentz gauge

   (*b*) Total internal reflection

   (*c*) Retarded potential

   (*d*) 4-current.

# NEPSST—87—2025

## FACULTY OF SCIENCE

**M.Sc. (Second Year) (Third Semester) EXAMINATION**

**APRIL/MAY, 2025**

PHYSICS

Paper SPHYC-502

(Nuclear and Particle Physics)

**(Saturday, 19-4-2025)**          **Time : 2.00 p.m. to 5.00 p.m.**

*Time*—3 Hours          *Maximum Marks*—80

*N.B.* :— (1)    Question No. **1** is compulsory.

       (2)    Attempt any *three* questions from Question. Nos. **2** to **6**.

       (3)    *All* questions carry equal marks.

       (4)    Symbols have their usual meaning in the subject.

1.    Solve the following questions :          20

   (*a*)    Explain mirror nuclei with suitable examples.

   (*b*)    Write a short note on pair production.

   (*c*)    Write a short note on Meson theory of nuclear forces.

   (*d*)    Explain fusion process.

                         P.T.O.

2. (*a*) Discuss the semi-empirical mass formula for a nucleus and explain the different terms in it. 10

   (*b*) Explain mass defect and binding energy. 10

3. (*a*) Explain principle, construction and working of G.M. counter in detail. 10

   (*b*) Explain classification of elementary particles in detail. 10

4. (*a*) Write down the shell model configuration and assign the spin and parties to ground state of the nuclei : $_{28}Fe^{57}$, $_{30}Zn^{67}$, $_{21}Sc^{41}$. 10

   (*b*) Explain collective model in detail. 10

5. (*a*) What are allowed and forbidden $\beta$ transition ? Discuss Fermi and Gamow-Teller selection rules for various transitions in $\beta$ decay. 10

   (*b*) Discuss the C-N cycle. 10

6. Write short notes on the following : 20

   (*a*) Nuclear dipole moment

   (*b*) Quark theory

   (*c*) Spin orbital coupling

   (*d*) Angular momentum and parity.

This question paper contains **2** printed pages]

# NEPSST—184—2025

## FACULTY OF SCIENCE AND TECHNOLOGY

**M.Sc. (Second Year) (Third Semester) EXAMINATION**

**APRIL/MAY, 2025**

**(NEP-2020)**

PHYSICS

Paper–SPHYC-503

(Fiber Optics and Lasers–I)

**(Tuesday, 22-4-2025)**            **Time : 2.00 p.m. to 5.00 p.m.**

*Time*—3 Hours                       *Maximum Marks*—80

N.B. :—   (*i*)    Question No. **1** is compulsory.

         (*ii*)    Attempt any *three* questions form Question Nos. **2** to **6**.

         (*iii*)    *All* questions carry equal marks.

         (*iv*)    Symbols have their usual meaning in the subject.

1.     Solve the following questions :                          20

     (*a*)     Explain the propagation of light in an optical fiber by TIR (Total Internal Reflection Phenomenon)

     (*b*)     Describe the vapour phase deposition technique of a fiber fabrication

     (*c*)     Write a note on directionality and intensity of LASER light

     (*d*)     Give the applications of LASER in medical field.

                                                           P.T.O.

2. (*a*) What is NA (Numerical Aperture) of a fiber ? Calculate NA of a fiber if refractive index of the core and cladding is 1.55 and 1.50 respectively. 10

   (*b*) Explain different types of losses in an optical fiber. 10

3. (*a*) Explain in detail the modified chemical vapour deposition technique. 10

   (*b*) Describe the fiber drawing technique in detail. 10

4. (*a*) Explain the principle of working of He-Ne LASER. 10

   (*b*) Prove that Einstein's relation $A_{nm} / B_{nm} = \hbar \omega^3 h_m / \Pi^2 C$. 10

5. (*a*) Write a note on the applications of LASER in machining. 10

   (*b*) How is LASER used in medical surgery ? 10

6. Write short notes on the following : 20

   (*a*) Acceptance angle

   (*b*) Plasma activated CVD

   (*c*) Population inversion

   (*d*) Lasers in communication.

# NEPSST—183—2025

## FACULTY OF SCIENCE

## M.Sc. (Second Year) (Third Semester) EXAMINATION

## APRIL/MAY, 2025

PHYSICS

Paper–SPHYC-503 A

(Electronics-I : Microwave Devices)

**(Tuesday, 22-4-2025)**　　　　　　　　　　**Time : 2.00 p.m. to 5.00 p.m.**

*Time—3 Hours*　　　　　　　　　　　　　　　*Maximum Marks—80*

N.B. :— (i)  *All* questions carry equal marks.

　　　(ii)  Question No. **1** is compulsory.

　　　(iii)  Solve any *three* of the remaining five questions (Q. No. **2** to Q. No. **6**).

　　　(iv)  Figures to the right indicate full marks.

1.  Solve the following questions :　　　　　　　　　　　　　　20

(a)  Discuss microwave advantages and applications.

(b)  Explain in brief HBT.

(c)  What is microwave attenuator ? Explain it.

(d)  Discuss maximum unambiguous range of Radar.

　　　　　　　　　　　　　　　　　　　　　　　　　　　　P.T.O.

2. (*a*) Discuss distribution parameters in case of two conductor transmission line. Establish transmission line equation. 10

   (*b*) Explain the use of quarter and half wavelength lines in detail. 10

3. (*a*) Explain construction and working of Magnetron. 10

   (*b*) Describe construction of TRAPATT diode and explain its principle of operation. 10

4. (*a*) With a neat diagram give structure of two hole directional coupler and explain its operation of working. 10

   (*b*) Explain construction and working of circulator. 10

5. (*a*) Draw the block diagram of Radar and explain operation of each block. 10

   (*b*) With a neat diagram explain CW Doppler Radar. 10

6. Write short notes on : 20

   (*a*) Smith chart

   (*b*) Two-cavity Klystron

   (*c*) Waveguide Termination

   (*d*) Radar antennas.

This question paper contains **2** printed pages]

# NEPSST—307—2025

## FACULTY OF SCIENCE

### M.Sc. (Second Year) (Third Semester) EXAMINATION

### APRIL/MAY, 2025

PHYSICS

Paper SPHYE-501

(Astrophysics–I)

**(Thursday, 24-4-2025)**      **Time : 2.00 p.m. to 5.00 p.m.**

*Time—Three Hours*      *Maximum Marks—60*

*N.B.* :— (*i*)   Question No. **1** is compulsory.

     (*ii*)   Solve any *three* of the remaining 5 questions (Q. Nos. **2** to **6**).

     (*iii*)   *All* questions carry equal marks.

     (*iv*)   Figures to the right indicate full marks.

1.   Solve the following questions (Each question carries **5** marks) :      15

     (*a*)   Write a note on distance measurement in astronomy using stellar parallax method.

     (*b*)   Explain emission coefficient in radiative transfer.

     (*c*)   Solar limb darkening.

2.   (*a*)   Explain Geocentric Universe in detail.      8

     (*b*)   Explain the characteristics of CCDs.      7

               P.T.O.

3. (*a*) What do you mean by black body ? Obtain Planck's Black body radiation law. 8

(*b*) Derive an expression for Compton scattering. 7

4. (*a*) What is H-R diagram ? Discuss its salient features. 8

(*b*) Define the terms intensity, flux, colour index, stellar temperature and luminosity. How are flux, intensity and luminosity relate one another ? 7

5. (*a*) Explain the Jean's criteria for star formation. 8

(*b*) Explain the concept of electron degeneracy pressure and hence obtain Chandrasekhar mass-radius relation for white dwarfs. 7

6. Write short notes on (each question carries **5** marks) : 15

(*a*) 21-cm line and its importance in astronomy

(*b*) Thermal Bremsstrahlung

(*c*) Supernova and supernova remnants.

## NEPSST—308—2025

### FACULTY OF SCIENCE

**M.Sc. (Third Semester) EXAMINATION**

**APRIL/MAY, 2025**

**(NEP-2020 Pattern)**

PHYSICS

Paper SPHYE-501

(Material Science—I)

**(Thursday, 24-4-2025)**            **Time : 2.00 p.m. to 5.00 p.m.**

*Time*—3 Hours                                    *Maximum Marks*—80

N.B. :— (1)  *All* questions carry equal marks.

   (2)  Question No. **1** is compulsory.

   (3)  Solve any *three* of the remaining five questions (Q. Nos. **2** to **6**).

   (4)  Figures to the right indicate full marks.

1. (*a*) Discuss the Fe-Fe3C phase diagram and its applications in steel manufacturing.    5

   (*b*) Explain steady-state diffusion and its significance in material processing.    5

   (*c*) Explain the working principle of a rotary pump and its application in vacuum systems.    5

   (*d*) Explain vapour phase epitaxy technique.    5

   P.T.O.

2. (*a*) Explain the invariant reactions in the Silver-Copper binary system. 10

(*b*) Describe in detail the copper nickel system. 10

3. (*a*) Describe the factors that affect diffusion in solids. 10

(*b*) Explain the Freundlich adsorption isotherm and its significance in adsorption processes. 10

4. (*a*) Discuss the working of a Turbo molecular pump and its role in vacuum technology. 10

(*b*) Describe the electron-beam deposition technique used in thin film fabrication. 10

5. (*a*) Explain the flux growth method for crystal growth and its applications. 10

(*b*) Discuss the steps involved in nucleation during the crystallization process. 10

6. Write short notes on the following :

(*a*) Effect of pressure on phase diagrams 5

(*b*) Hydrothermal technique of crystal growth 5

(*c*) Physical vapor deposition (PVD) for thin film deposition 5

(*d*) Physical and chemical adsorption. 5

# NEPSST—309—2025

## FACULTY OF SCIENCE

### M.Sc. (Second Year) (Third Semester) EXAMINATION

### APRIL/MAY, 2025

PHYSICS

Paper SPHYE-501

(Nano Physics)

**(Thursday, 24-4-2025)**        **Time : 2.00 p.m. to 5.00 p.m.**

*Time*—3 Hours        *Maximum Marks*—80

*N.B.* :— (1) *All* questions carry equal marks.

(2) Question No. **1** is compulsory.

(3) Solve any *three* of the remaining five questions (Q. Nos. **2** to **6**).

(4) Figures to the right indicate full marks.

1. Solve the following questions (Each question carries **5** marks) :    20

   (*a*) Explain mesoporous and microspores nanomaterials.

   (*b*) Explain the electrical conductivity of nanomaterials.

   (*c*) Discuss the principle and application of sol-gel method.

   (*d*) Explain two probe resistivity technique.

2. Solve the following questions (Each sub-question carries **10** marks) :    20

   (*a*) Explain zero-dimensional and one-dimensional nanostructure.

   (*b*) Discuss carbon fullerences and carbon nanotubes.

                                        P.T.O.

3. Solve the following questions (Each sub-question carries **10** marks) : 20

   (*a*) Explain the magnetic properties of nanomaterials.

   (*b*) What is surface plasmon resonance in metal nanoparticles ? Explain in detail.

4. Solve the following questions (Each sub-question carries **10** marks) : 20

   (*a*) Discuss chemical bath deposition, including its mechanism and synthesis method.

   (*b*) What is spray pyrolysis techniques ? Describe the deposition mechanisms involved in it.

5. Solve the following questions (Each sub-question carries carries **10** marks) : 20

   (*a*) What are the principles of AFM ? Explain its working mechanism.

   (*b*) What is the use of Fourier Transformed infrared spectroscopy (FTIR) and how does it work ?

6. Write short notes on (Each question carries **5** marks) : 20

   (*a*) Core shell structures

   (*b*) Ferroelectrics

   (*c*) Hydrothermal method

   (*d*) Vibrating Sample Magnetometer (VSM).

# NEPSST—43—2025

## FACULTY OF SCIENCE AND TECHNOLOGY

### M.Sc. (Second Year) (Fourth Semester) EXAMINATION

### APRIL/MAY, 2025

### (NEP 2020)

### RESEARCH AND PUBLICATION ETHICS

### NEPPE-1002

**(Thursday, 17-4-2025)**  **Time : 2.00 p.m. to 4.00 p.m.**

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*Time—2 Hours*  *Maximum Marks—40*

**N.B.** :— (*i*)  Question Number **1** is compulsory.

(*ii*)  Solve any *three* questions of the remaining.

1. Write notes on :  5×2=10

(*a*)  Nature of philosophy

(*b*)  Research integrity

(*c*)  Importance of publication ethics

(*d*)  Characteristics to call a journal open

(*e*)  *h*-index.

P.T.O.

2.    (*a*)    Define philosophy. Explain its branches.           5×2=10

     (*b*)    What do you mean by fabrication, falsification and plagiarism (FFP).

3.    (*a*)    Define publication ethics. Write the importance of publication ethics.

                                                          5×2=10

     (*b*)    Describe SHERPA/ROMEO online resource and list three variant of text.

4.    (*a*)    What is predatory journal ? List the common characteristics of it.

                                                          5×2=10

     (*b*)    What is impact factor ? How does it calculate ? Explain it with a suitable example.

5.    (*a*)    What is plagiarism ? Give their types.          2×5=10

     (*b*)    Describe in detail SNIP and SJR.

6.    Write short notes on :                          4×2.5=10

     (*a*)    Moral philosophy

     (*b*)    Duplicate publication

     (*c*)    Principle of transparency

     (*d*)    Turnitin.

This question paper contains **3** printed pages]

# NEPSST—135—2025

## FACULTY OF SCIENCE

**M.Sc. (Second Year) (Fourth Semester) EXAMINATION**

**APRIL/MAY, 2025**

PHYSICS

Paper SPHYC551

(Energy Studies)

**(Monday, 21-4-2025)**                                    **Time : 2.00 p.m. to 5.00 p.m.**

*Time—Three Hours*                                                      *Maximum Marks—80*

N.B. :—   (*i*)   *All* questions carry equal marks.

      (*ii*)   Question No. **1** is compulsory.

      (*iii*)   Solve any *three* of the remaining five questions (Q. No. **2** to Q. No. **6**).

      (*iv*)   Figures to the right indicate full marks.

1.    Solve the following questions (Each question **5** marks) :       20

(*a*)    Explain the working principle of photovoltaic technology.

(*b*)    Discuss the advantages and disadvantages of Barrage and Non-Barrage Tidal Systems.

                                                 P.T.O.

(c) Discuss the concept of mini and micro-hydropower systems.

(d) Explain the importance of energy conservation legislation in reducing national energy consumption and promoting sustainability.

2. Solve the following questions (Each sub-question **10** marks) : 20

(a) Explain solar radiation in detail.

(b) Explain the difference between conventional and non-conventional energy sources. Discuss the advantages and disadvantages of each.

3. Solve the following questions (Each sub-question **10** marks) : 20

(a) Discuss the different types of wave energy devices, such as oscillating water columns, point absorbers, and overtopping devices. How do these devices convert wave motion into usable energy ?

(b) Explain the construction and working principle of a non-barrage tidal power system.

4. Solve the following questions (Each sub-question **10** marks) : 20

(a) Explain the process of converting biomass into energy. Discuss the different conversion methods and their respective advantages and disadvantages.

(b) Explain the basic working principle of geothermal energy. Discuss how it can be used for both direct heating and electricity generation.

5. Solve the following questions (Each sub-question **10** marks) : 20

   (*a*) Discuss the importance of energy exploitation, conservation and management.

   (*b*) Explain the management of natural resources.

6. Write short notes (Each sub-question **5** marks) : 20

   (*a*) Silicon solar cell

   (*b*) Fuel cell

   (*c*) Water turbine

   (*d*) Conservation of natural resources.

# NEPSST—233—2025

## FACULTY OF SCIENCE AND TECHNOLOGY

**M.Sc. (NEP) (Second Year) (Fourth Semester) EXAMINATION**

**APRIL/MAY, 2025**

PHYSICS

Paper SPHYC-552

(Fiber Optics and Lasers–II)

**(Wednesday, 23-4-2025)**          **Time : 2.00 p.m. to 5.00 p.m.**

*Time—Three Hours*          *Maximum Marks*—80

N.B. :—    (*i*)    Question No. **1** is compulsory.

        (*ii*)    Solve any *three* of the remaining 5 questions (Q. Nos. 2 to 6).

      (*iii*)    *All* questions carry equal marks.

      (*iv*)    Figures to the right indicate full marks.

1.    Solve the following questions (each question carries **5** marks) :      20

     (*a*)    Write a note on Edge Emitting LEDS.

     (*b*)    P-N Junction Photodiode.

     (*c*)    Explain Non-linear Scattering Losses.

     (*d*)    Write a note on Core Fiber diameter measurements.

                                        P.T.O.

2. (*a*) Explain the detail index guided injection laser structure. 10

   (*b*) Discuss structure and characteristics of double heterojunction LED. 10

3. (*a*) Discuss on construction and working principle of PN photodiodes. 10

   (*b*) Explain silicon reach through Avalanche photodiodes. 10

4. (*a*) Write a note on non-linear scattering losses and its types. 10

   (*b*) Explain dispersion and its types in detail. 10

5. (*a*) Explain fiber refractive index profile measurement. 10

   (*b*) Explain fiber cutoff wavelength measurement. 10

6. Solve the following (each question carries **5** marks) : 20

   (*a*) LED characteristics

   (*b*) Photodiodes and its types

   (*c*) Attenuation

   (*d*) Optical return loss in optical fibers.

# NEPSST—232—2025

## FACULTY OF SCIENCE

### M.Sc. (Second Year) (Fourth Semester) EXAMINATION

### APRIL/MAY, 2025

### (NEP-2020 Pattern)

PHYSICS

Paper–SPHYC-552A

(Electronics II : Microwave Measurements, Systems and Applications)

**(Wednesday, 23-4-2025)**      **Time : 2.00 p.m. to 5.00 p.m.**

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*Time—3 Hours*      *Maximum Marks—80*

N.B. :—   (*i*)   *All* questions carry equal marks.

      (*ii*)   Question No. **1** is compulsory.

      (*iii*)   Solve any *three* of the remaining five questions Q. No. **2** to Q. No. **6**.

      (*iv*)   Figures to the right indicate full marks.

1.   Solve the following questions (each question carries **5** marks) :      20

   (*a*)   What is Lens Antenna ? Explain in short.

   (*b*)   Discuss in brief attenuation measurement.

   (*c*)   Describe planar resistor film.

   (*d*)   Explain heating mechanism in microwave.

2. (*a*) Discuss working of Slot antenna with suitable diagram. 10

   (*b*) Show that parabolic reflecting antenna is highly direction. Discuss beam width and gain of such antenna. 10

3. (*a*) What are different methods of Power measurement in microwave ? Explain in detail Bolometer method for it. 10

   (*b*) With suitable set up explain the dielectric constant measurement. 10

4. (*a*) Discuss fabrication technique for hybrid integrated circuit. 10

   (*b*) What are thin film devices ? Explain in detail planar Inductor film. 10

5. (*a*) Draw the block diagram of Time Domain Reflectometry technique and explain it. 10

   (*b*) Discuss LOS microwave system for communication. 10

6. Write short notes on (Each question carries **5** marks) : 20

   (*a*) H-Plane Horn antenna

   (*b*) Microwave bench general measurement setup

   (*c*) MMIC

   (*d*) Satellite Communication.

# NEPSST—417—2025

## FACULTY OF SCIENCE AND TECHNOLOGY

### M.Sc. (Second Year) (Fourth Semester) EXAMINATION

### APRIL/MAY, 2025

### (NEP-2020)

### PHYSICS

### Paper SPHYE-551

### (Electronics Instrumentation)

| (Friday, 25-4-2025) | Time : 2.00 p.m. to 5.00 p.m. |
|---|---|

*Time*—3 *Hours*                                          *Maximum Marks*—80

N.B. :—   (*i*)   *All* questions carry equal marks.

       (*ii*)   Q. No. **1** is compulsory.

      (*iii*)   Solve any *three* of the remaining five questions (Q. No. 2 to Q. No. 6).

     (*iv*)   Figures to the right indicate the full marks.

1.   Solve the following questions (each question carries **5** marks) :          20

(*a*)   Explain the importance of measurements.

(*b*)   Describe the classification of transducers.

(*c*)   Discuss the lock in amplifier.

(*d*)   Explain the basic elements of data acquisition system.

P.T.O.

2. Solve the following questions (each question carries **10** marks) : 20

   (*a*) Describe in detail generalized measurement systems. 10

   (*b*) Define the error and explain the types of errors. 10

3. Solve the following questions (each question carries **10** marks) : 20

   (*a*) With the help of net block digram, explain the resistive transducer.

   10

   (*b*) Explain the capacitive transducer in detail. 10

4. Solve the following questions (each question carries **10** marks) : 20

   (*a*) Describe automation in digital instruments with net diagram. 10

   (*b*) Discuss in detail the digital frequency meter (DFM). 10

5. Solve the following questions (each question carries **10** marks) : 20

   (*a*) Describe the strip chart recorder in detail. 10

   (*b*) Draw and discuss sample and hold circuit. 10

6. Write short notes on (**5** marks each) : 20

   (*a*) Purpose of instrumentation

   (*b*) Optical transducer

   (*c*) Q meter

   (*d*) X-Y recorder.

This question paper contains **2** printed pages]

# NEPSST—416—2025

## FACULTY OF SCIENCE

### M.Sc. (Second Year) (Fourth Semester) EXAMINATION

### APRIL/MAY, 2025

PHYSICS

Paper SPHYE-551

(Material Science-II)

**(Friday, 25-4-2025)**        **Time : 2.00 p.m. to 5.00 p.m.**

*Time*—3 *Hours*        *Maximum Marks*—80

N.B. :—   (*i*)   *All* questions carry equal marks.

     (*ii*)   Question No. **1** is compulsory.

     (*iii*)   Solve any *three* of the remaining five questions (Q. No. 2 to Q. No. 6).

     (*iv*)   Figures to the right indicate full marks.

1.   Solve the following questions :        20

   (*a*)   What are the applications of metallic nanoparticles in various industries and how to their unique properties make them suitable for these applications ?

   (*b*)   Describe the structure of ceramics.

   (*c*)   Explain the concept of copolymers and the different types of copolymers.

   (*d*)   Explain Atomic Absorption Spectroscopy (AAS).

                                          P.T.O.

2. (*a*) Explain the classification of nanomaterials along with their properties and applications.                                                       10

   (*b*) Explain synthesis methods of metallic nanoparticles and its applications.

                                                                                10

3. (*a*) Explain Griffith's theory of ceramics in detail. How does it describe the relationship between cracks and the fracture of ceramics ?       10

   (*b*) Describe the structure of silicates in ceramics.                      10

4. (*a*) What are elastomers ? Explain their unique properties and applications.

                                                                                10

   (*b*) Discuss the different types of polymers, their properties and their applications in textiles and other industries.                          10

5. (*a*) Explain working mechanism of Scanning Electron Microscopy (SEM) with its applications.                                                       10

   (*b*) Explain in detail X-ray photo electron spectroscopy (XPS).           10

6. Write short notes on :                                                       20

   (*a*) Semiconducting nanoparticles

   (*b*) Phase diagram $SiO_2.Al_2O_3$

   (*c*) Degree of polymerization

   (*d*) Atomic Force Microscopy (AFM).