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

NEPKR—01—2026

FACULTY OF SCIENCE AND TECHNOLOGY

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

APRIL/MAY, 2026

RESEARCH METHODOLOGY (Compulsory)

Paper NEPRM-1001

(Thursday, 16-4-2026) **Time : 10.00 a.m. to 12.00 noon**

Time—2 *Hours* *Maximum Marks*—45

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

(2) Solve any *two* questions from Q. No. **2** to Q. No. **5**.

(3) Calculator and log table is allowed.

1. Write notes on : 5×3=15

(*a*) Research motive

(*b*) Need of research design

(*c*) Coding processing operation

(*d*) Statistical techniques in research

(*e*) Variables.

P.T.O.

2. (*a*) Explain in detail various steps involved in research process. 8

(*b*) What is research hypothesis ? Give their characteristics. 7

3. (*a*) Give an account on good research design. 8

(*b*) Describe types of research. 7

4. (*a*) Calculate the mean, median and mode of the following data : 8

3, 6, 3, 7, 4, 3, 9.

(*b*) Describe interview method for the collection of primary data. 7

5. (*a*) Calculate the chi-square (χ^2) value of the following data : 8

Fully Agree	Not Sure	Not Agree	Total
102	108	28	238

(*b*) Write an essay on case study. 7

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

NEPKR—83—2026

FACULTY OF ARTS/SCIENCE

M.A./M.Sc. (First Year) (First Semester) EXAMINATION

APRIL/MAY, 2026

(NEP-2020 Pattern)

MATHEMATICS

Paper SMATC-401

(Algebra)

(Saturday, 18-4-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2½ *Hours* *Maximum Marks*—60

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

(2) Answer any *three* questions from Q. No. **2** to Q. No. **6**.

(3) Figures to the right indicate full marks.

1. Attempt the following questions : 15

(*a*) Prove that arbitrary intersection of subgroups of group G is also subgroup of G.

(*b*) Find all normal series of Z_9.

P.T.O.

(*c*) Find the non-isomorphic abelian groups of order 6.

(*d*) Find all ring homomorphism of ring of integers Z.

(*e*) Find all possible generators of Z_{25}.

2. Attempt the following questions : 15

(*a*) Prove that every infinite cyclic group is isomorphic to Z. 7

(*b*) State and prove first isomorphism theorem of group. 8

3. Attempt the following : 15

(*a*) Prove that every subgroup H of nilpotent group G is nilpotent. 7

(*b*) Prove that abelian group G has composition series iff G is finite group. 8

4. Attempt the following : 15

(*a*) Prove that there is no simple group of order 36. 7

(*b*) State and prove third Sylow theorem. 8

5. Attempt the following : 15

(*a*) If R is non-zero commutative ring with unity and M is ideal of R such that R/M is a field then prove that M is a maximal ideal of ring R. 7

(*b*) Prove that Every Euclidean domain is a PID. 8

6. Attempt any *three* of the following (**5** marks each) : 15

(*a*) If $f : G \to H$ is an injective group homomorphism from group G to group H, then prove that $\text{Ker}(f) = \{e\}$.

(*b*) Write down all the composition series for the S_3 group.

(*c*) The alternating group A_n is generated by the set of all 3-cycles in S_4.

(*d*) Prove that the ideal $(x^7 + x^3 + 1)$ in the polynomial ring Z/(2)[X] over Z/(2) is a prime ideal.

This question paper contains **4** printed pages]

NEPKR—183—2026

FACULTY OF SCIENCE AND TECHNOLOGY

M.A./M.Sc. (First Year) (First Semester) EXAMINATION

APRIL/MAY, 2026

(NEP 2020 Pattern)

MATHEMATICS

Paper SMATC-402

(Real Analysis)

(Tuesday, 21-4-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2½ *Hours* *Maximum Marks*—60

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

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

(*iii*) Answer any *three* questions from Q. No. **2** to Q. No. **6**.

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

1. Answer the following : 15

(*a*) Define Riemann Stieltjes integral.

(*b*) State the Weierstrass M-test for uniform convergence for series of function.

P.T.O.

(*c*) Write a short note on equicontinuous families of function.

(*d*) State inverse function theorem.

(*e*) Let $f : \mathrm{R}^2 \to \mathrm{R}^2$ be defined by the equation $f(x, y) = (e^x \cos y, e^x \sin y)$. Calculate D$f$ and $|\mathrm{D}f|$.

2. Answer the following : 15

If γ' is continuous on $[a, b]$, then prove that γ is rectifiable and $\wedge(\gamma) = \int_a^b |\gamma'(t)|\, dt$.

Also, if $f(x) = 0$ for all irrational x, $f(x) = 1$ for all rational x, show that $f \notin \mathbf{R}(\alpha)$ on $[a, b]$ for any $a < b$.

3. Answer the following : 15

Suppose $f_n \to f$ uniformly on a set E in a metric space. Let x be a limit point of E and suppose that :

$$\lim_{t \to x} f_n(t) = \mathrm{A}_n, \quad n = 1, 2, 3, \ldots\ldots\ldots$$

Then show that $\{\mathrm{A}_n\}$ converges and $\lim_{t \to x} f(t) = \lim_{t \to x} \mathrm{A}_n$

For $m = 1, 2, 3, \ldots\ldots\ldots$, $n = 1, 2, \ldots\ldots\ldots$, let $\mathrm{S}_{mn} = \dfrac{m}{m+n}$

Show that :

$$\lim_{n \to \infty} \lim_{m \to \infty} \mathrm{S}_{mn} \neq \lim_{m \to \infty} \lim_{n \to \infty} \mathrm{S}_{mn}.$$

4. Answer the following : 15

Suppose the series $\sum a_n x^n$ and $\sum b_n x^n$ converge in the segment S = (–R, R). Let E be the set of all $x \in S$ at which :

$$\sum_{n=0}^{\infty} a_n x^n = \sum_{n=0}^{\infty} b_n x^n$$

If E has a limit point in S, then prove that $a_n = b_n$ for $n = 0, 1, 2 \ldots\ldots$ hence holds for all $x \in S$.

5. Answer the following : 15

Let A be opened in R^n, let $f : A \to R^n$, let $f(\bar{b}) = \bar{a}$. Suppose that g maps a neighborhood of $\bar{b}$ into R^n that $g(\bar{b}) = \bar{a}$ and $g(f(\bar{x})) = \bar{x}$ for all $\bar{x}$ in a neighborhood of $\bar{a}$. If f is differentiable at $\bar{a}$ and if g is differentiable at $\bar{b}$, then prove that :

$$Dg(\bar{b}) = [Df(x)]^{-1}.$$

Let $f : R^2 \to R^2$ be defined by the equation :

$$f(x, y) = (e^x \cos y, e^x \sin y),$$

(*i*) Show that f is one to one on the set A consisting of all (x, y) with $0 < y < 2\pi$.

(*ii*) What is the set B = F(A) ?

If g is the inverse function, find $D_g(0, 1)$.

P.T.O.

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

(*a*) State and prove fundamental theorem of Calculus.

(*b*) Let $f_n(x) = n^2 x(1-x^2)^n$, $0 \le x \le 1$ and n = 1, 2, 3, ... Show that :

$$\lim_{n\to\infty}\left[\int_0^1 f_n(x)\,dx\right] \neq \int_0^1 \left[\lim_{n\to\infty} f_n(x)\right] dx .$$

(*c*) State the Stone-Weierstrass theorem.

(*d*) Define $f : \mathrm{R}^2 \to \mathrm{R}$ by setting $f(\bar{0}) = \bar{0}$ and $f(x, y) = \dfrac{x^2}{x^4 + y^2}$ if $f(x, y) \neq \bar{0}$. Show that all directional derivative of f exist to $\bar{0}$ but that f is not differentiable at $\bar{0}$.

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

NEPKR—310—2026

FACULTY OF SCIENCE AND TECHNOLOGY

M.A./M.Sc. (First Year) (First Semester) EXAMINATION

APRIL/MAY, 2026

MATHEMATICS

Paper–SMATC-403

(Complex Analysis)

(Thursday, 23-4-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2½ Hours *Maximum Marks*—60

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

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

(*iii*) Answer any *three* from Q. No. **2** to Q. No. **6**.

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

1. Answer the following : 15

(*a*) Find all the values of $i^{\frac{1}{2}}$.

(*b*) Show that the function $u(x, y) = e^{-x}$, cos y is harmonic.

(*c*) Evaluate $\int_C \frac{e^{z^2}}{z+2}\, dz$ where C : $|z| = 3$.

P.T.O.

(*d*) Expand, the function $f(z) = \frac{1}{z^z + 1}$ in Laurent's series valid in the deleted neighborhood of $z = i$.

(*e*) Find all the values of $\sin^{-1}(0)$.

2. Answer the following : 15

Define Cross ratio. Prove that the exponential function $f(z) = e^z$ is periodic function with purely imaginary period $2\pi i$. Also show the following :

(*i*) $\sin 2z = 2 \sin z . \cos z$

(*ii*) $\sin\left(\frac{\pi}{2} + z\right) = \cos z$.

3. Answer the following : 15

Prove that the necessary condition for the differentiability of the function $f(z)$ at a point $z = a$ is that $f_{\bar{z}} = 0$ at $z = a$. Find all the values of a, b and c such that the function, $f(z) = a(x^2 + y^2) + ibxy + c$ is an entire function. 15

4. Answer the following : 15

State and prove Taylor's Theorem. Expand the function $f(z) = \log(1 + z)$ in Maclurin's series about $z = 0$, valid in the neighborhood $|z| < 1$.

5. Answer the following : 15

State and prove Casorati-Weierstrass theorem. Find the Principal Part of the Laurent's expresion for the function $f(z) = \frac{z}{z^2 + 4}$ valid in the neighborhood of $z = 2i$.

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

(*a*) Find all the values of $e^z = 5 + 5i$.

(*b*) Find the length of the curve C : $z(t) = e^{2it}\left(0 \le t \le \frac{\pi}{2}\right)$.

(*c*) Evaluate :

$$\int_C \frac{z - 3\cos z}{(z - \pi/2)^2}\, dz \quad \text{where, C : } |z| = 2$$

(*d*) Find [Res : $f(z)$; $z = 1$] for the function $f(z) = \frac{z^4 - z^3 + 17z + 12}{(z-1)^3}$. Also evaluate $\int_C f(z)dz$.

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

NEPKR—502—2026

FACULTY OF SCIENCE

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

APRIL/MAY, 2026

(NEP-2020)

MATHEMATICS

Paper SMATE-401(A)

(Ordinary Differential Equations)

(Saturday, 25-4-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2½ *Hours* *Maximum Marks*—60

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

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

(3) Answer any *three* questions from Q. No. **2** to Q. No. **6**.

(4) Figures to the right indicate full marks.

1. Answer the following : 15

(*a*) Solve :

$$y''' - 3y' + 2y = 0.$$

P.T.O.

(*b*) Verify that $\phi_1(x) = x^3$ $(x > 0)$ satisfies the equation $x^2y'' - 7xy' + 15y = 0$ and find the second independent solution.

(*c*) Solve :

$$x^2y'' + 2xy' - 6y = 0 \text{ for } x > 0.$$

(*d*) Solve :

$$2xydx + (x^2 + 3y^2)dy = 0.$$

(*e*) Solve :

$$y^{(3)} - 4y' = 0.$$

2. Prove that every solution ψ of $L(y) = b(x)$ on I is $\psi = \psi_p + c_1\phi_1 + c_2\phi_2$, where ψ_p is particular solution. Where ϕ_1, ϕ_2 are two linearly independent solutions of $L(y) = 0$ and c_1, c_2 are constants. 15

3. ϕ_1, ϕ_2, ..., ϕ_n be n solutions of $L(y) = 0$ on an interval I, and x_0 be any point I then prove that : 15

$$W(\phi_1, \phi_2, ..., \phi_n)(x) = \exp\left[-\int_{x_0}^{x} a_1(t)dt\right] W(\phi_1, \phi_2, ..., \phi_n)(x_0).$$

4. Find two solutions of Euler's equation. 15

5. Prove that $M(x, y) + N(x, y)\, y' = 0$ is exact on some rectangle R if and only if : 15

$$\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}.$$

6. Answer any *three* of the following : 15

(*a*) Solve :

$$y'' - y' - 2y = e^{-x}.$$

(*b*) Solve :

$$y''' - y' = x.$$

(*c*) Solve :

$$x^2y'' + \frac{3}{2}xy' + xy = 0.$$

(*d*) Solve :

$$y' = xy,\ y(0) = 1.$$

This question paper contains **4** printed pages]

NEPKR—42—2026

FACULTY OF ARTS/SCIENCE

M.A./M.Sc. (First Year) (Second Semester) EXAMINATION

APRIL/MAY, 2026

(NEP-2020 Pattern)

MATHEMATICS

Paper SMATC-451

(Linear Algebra)

(Friday, 17-4-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2½ *Hours* *Maximum Marks*—60

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

(2) Answer any *three* questions from Q. No. **2** to Q. No. **6**.

(3) Figures to the right indicate full marks.

1. Attempt the following (**3** marks each) : 15

(*a*) Prove that arbitrary intersection of subspaces of vector space V is also subspace of V.

(*b*) Prove that $W_1 = \{(a_1, a_2, a_3) \in R^3 : a_1 = 3a_2$ and $a_3 = -a_2\}$ be the subspace of R3.

P.T.O.

(*c*) If V and W are vector spaces of same dimension n, and let $T : V \to W$ be linear such that T is one-to-one then prove that $N(T) = \{0\}$.

(*d*) If V be an inner product space such that $\|Y\| = 7$, $\|X + Y\| = 6$ and $\|X - Y\| = 8$, then find $\|X\|$.

(*e*) If M be a square upper triangular matrix with non-zero diagonal entries, then prove that the columns of M are linearly independent.

2. Attempt the following : 15

(*a*) Let V be a vector space and let $S1 \subseteq S2 \subseteq V$. If S1 is linearly dependent, then S2 is linearly dependent. 7

(*b*) If V be the finite dimensional vector space over F and let A and B be the subspaces of V, then prove that $\dim(A + B) = \dim(A) + \dim(B) - \dim(A \cap B)$. 8

3. Attempt the following : 15

(*a*) Let V be a finite dimensional vector space over F, then prove that if $T \varepsilon L(V)$ is an one-one linear operator, then prove that T is onto. 7

(*b*) State and prove dimension theorem. 8

4. Attempt the following : 15

(*a*) Prove that rank of any matrix equals the maximum number of its linearly independent columns. 7

(*b*) Let $T : V \to W$ and $U : W \to Z$ be linear transformations on finite-dimensional vector spaces V, W and Z, then prove that $\text{rank}(UT) \leq \text{rank}(U)$. 8

5. Attempt the following : 15

(*a*) Let V be an inner product space over F and if X, Y are any two vectors of V, then prove that $\|X + Y\| \leq \|X\| + \|Y\|$. 7

(*b*) If V be an inner product space, and let S be an orthogonal subset of V consisting of non-zero vectors, then prove that S is linearly independent. 8

6. Attempt any *three* of the following (**5** marks each) : 15

(*a*) Let V be a vector space and S a subset that generates V. If β is a maximal linearly independent subset of S, then prove that β is a basis for V.

P.T.O.

(*b*) Let V, W and Z be vector spaces over the same field F. If $T : V \to W$ and $U : W \to Z$ are linear then prove that $UT : V \to Z$ is linear.

(*c*) Prove that characteristic polynomial of any diagonalizable linear operator T on vector space V is splits over field F.

(*d*) Let B = {$w1$ = (1, 0, 1, 0), $w2$ = (1, 1, 1, 1), $w3$ = (0, 1, 2, 1)} is linearly independent, then use the Gram-Schmidt process to compute the orthogonal vectors $v1$, $v2$ and $v3$ and then normalize these.

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

NEPKR—134—2026

FACULTY OF SCIENCE AND TECHNOLOGY

M.A./M.Sc. (First Year) (Second Semester) EXAMINATION

APRIL/MAY, 2026

(NEP-2020)

MATHEMATICS

Paper SMATC-452

(Measure and Integration Theory)

(Monday, 20-4-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2½ *Hours* *Maximum Marks*—60

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

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

(3) Answer any *three* questions from Q. No. **2** to Q. No. **6**.

(4) Figures to the right indicate full marks.

1. Answer the following : 15

(*a*) Show that the set [0, 1] is uncountable.

P.T.O.

(*b*) Give an example to show that, $D^+ (f + g) \neq D^+ f + D^+ g$.

(*c*) Prove that, every measure is a signed measure.

(*d*) State Radon-Nikodym theorem.

(*e*) Define functions of bounded variations.

2. Answer the following : 15

Prove that, the outer measure of an interval equals its length. Also, show that, if $m^*(A) = 0$, then prove that $m^*(A \cup B) = m^*(B)$, for any set B.

3. Answer the following : 15

Let $f \in BV [a, b]$, then prove that : $f(b) - f(a) = P - N$ and $T = P + N$, where all variations being in the finite interval $[a, b]$. Also, let f be defined by $f(x) = x \sin (1/x)$ for $x \neq 0$, $f(0) = 0$, find the four derivatives at $x = 0$.

4. Answer the following : 15

Define Hereditary. Let μ^* be an outer measure on H(R) defined by μ on R, then show that S^* contains S(R), the σ-ring generated by R. Also, show that,

$$H(R) = \left\{ E \,!\, E \subseteq \bigcup_{n=1}^{\infty} E_n, E_n \in R \right\}.$$

5. Answer the following : 15

State and prove Hahn decomposition theorem. Also, show that if :

$\phi(E) = \int_E f\, d\mu$, where $\int f\, d\mu$ is defined, then ϕ is a signed measure.

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

(*a*) Show that, outer measure is translation invariant.

(*b*) Show that, if $f \in BV\ [a, b]$, then f is bounded on $[a, b]$.

(*c*) Show that, if μ is a σ-finite measure on R, then the extension $\bar{\mu}$ of μ to s^* is also σ-finite.

(*d*) Show that, if ν_1, ν_2 and μ are measures and $\nu_1 \perp \mu$, $\nu_2 \perp \mu$, then $\nu_1 + \nu_2 \perp \mu$.

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

NEPKR—235—2026

FACULTY OF SCIENCE AND TECHNOLOGY

M.A./M.Sc. (First Year) (Second Semester) EXAMINATION

APRIL/MAY, 2026

(NEP-2020)

MATHEMATICS

SMATC-453

(Topology)

(Wednesday, 22-4-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2½ *Hours* *Maximum Marks*—60

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

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

(*iii*) Answer any *three* from Q. No. **2** to Q. No. **6**.

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

1. Answer the following : 15

(*a*) Define the basis for a topology.

(*b*) Find all the topologies on the set X = {*a*, *b*}.

(*c*) Define the order topology.

(*d*) State Urysohn's lemma.

(*e*) Show that every T_1 space is T_0 space.

P.T.O.

2. Answer the following : 15

Define a stronger topology. If X is a non-empty set, B and B' are the bases for the topologies T and T' respectively, prove that the following conditions are equivalent :

(*i*) T' is finer than T.

(*ii*) For each $x \in X$ and for each basis element $B \in \mathbf{B}$ containing x, there exist $B' \in \mathbf{B}'$ such that $x \in B' \subseteq B$.

3. Answer the following : 15

If X and Y are topological spaces, then prove that the following conditions are equivalent :

(*i*) $f : X \to Y$ is continuous.

(*ii*) If V is closed in Y, then $f^{-1}(V)$ is closed in X.

4. Answer the following : 15

If X is compact and Y is Hausdorff space and $f : X \to Y$ is bijective continuous function, then prove that f is homeomorphism.

5. Attempt the following : 15

Prove that every second countable space is a first countable space, and further prove that a subspace of a second countable space is second countable.

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

(*a*) If X is a non-empty set, then show that, T_f = {set of all subsets of X} is a topology on X.

(*b*) If A is a subspace of X, then show that the inclusion mapping $j : A \to X$ is a continuous function.

(*c*) Show that the image of compact space under continuous map is compact.

(*d*) Show that the discrete topological space is regular.

This question paper contains **4** printed pages]

NEPKR—423—2026

FACULTY OF ARTS/SCIENCE

M.A./M.Sc. (First Year) (Second Semester) EXAMINATION

APRIL/MAY, 2026

(NEP-2020 Pattern)

MATHEMATICS

SMATE-451(B)

(Combinatorics)

(Friday, 24-04-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2.30 *Hours* *Maximum Marks*—60

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

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

(*iii*) Answer any *three* from Q. No. 2 to Q. No. 6.

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

1. Answer the following : 15

(*a*) What is the probability that a 4-digit campus telephone number has one or more repeated digits ?

(*b*) Find the coefficient of x^9 in $(1 + x + x^2 + x^3 + ...)^n$.

P.T.O.

(*c*) How many 10 digit mobile numbers can be formed where the first digit of the mobile number is zero ?

(*d*) How many ways are there to distribute 13 cards from a standard deck of playing cards ?

(*e*) How many arrangements are there of the six letters *b, a, n, a, n a* ?

2. Answer the following : 15

Nine students, three from Ms. A's class, three from Mr. B's class, and three from Ms. C's class have bought a block of nine seats for their school's homecoming game. If three seats are randomly selected for each class from the nine seats in a row, what is the probability that the three A students, three B students and three C students will each get a block of three consecutive seats ?

3. Answer the following : 15

Build a recurrence relation for a_r, the number of integer solutions to the equations :

(*a*) $e_1 + e_2 + e_3 + e_4 + e_5 = r,\ 0 \le e_i \le 4$

(*b*) $e_1 + e_2 + e_3 = r,\ 0 < e_i < 5$

(*c*) $e_1 + e_2 + e_3 + e_4 = r,\ 2 \le e_i \le 6\ \ e_1$ even, e_2 odd

(*d*) $e_1 + e_2 + e_3 + e_4 = r,\ 0 \le e_i$

(*e*) $e_1 + e_2 + e_3 + e_4 = r,\ 0 < e_i,\ e_2,\ e_4$ odd, $e_4 \le 3$

4. Answer the following : 15

Suppose we draw n straight lines on a piece of paper so that every pair of lines intersect (but no three lines intersect at a common point). Into how many regions do these n lines divide the plane ?

5. Answer the following : 15

How many ways are there to send six different birthday cards, denoted C_1, C_2, C_3, C_4, C_5, C_6, to three aunts and three uncles, denoted A_1, A_2, A_3, U_1, U_2, U_3, if the aunt A_1 would not like cards C_2 and C_4; if A_2 would not like C_1 or C_5; if A_3 likes all cards; if U_1 would not like C_1 or C_5; if U_2 would not like C_4; and if U_3 would not like C_6 ?

6. Answer any *three* of the following : 15

(*a*) How many ways are there to pick a 5-person basketball team from 12 possible players ? How many teams if the weakest and the strongest player must be on the team ?

(*b*) Prove the binomial identity $\binom{n}{0}^2 + \binom{n}{1}^2 + \ldots + \binom{n}{n}^2 = \binom{2n}{2}$.

P.T.O.

(*c*) Solve the following recurrence relations assuming that n is a power of 2 (leaving a constant A to be determined)

$$a_n = 3a_{\frac{n}{3}} + 4$$

(*d*) If a school has 100 students with 40 taking French, 40 taking Latin and 40 taking German, 20 students are taking any given pair of languages and 10 students are taking all the three languages, then how many students are taking no language ?

Total No. of Printed Pages: 01

SUBJECT CODE NO- NEPKR-424-2026
FACULTY OF SCIENCE AND TECHNOLOGY
EXAMINATION SUMMER 2026
M.SC (FIRST YEAR) (SEM-II)
MATHEMATICS
DYNAMICS AND CONTINUUM MECHANICS

[Time: 3:00 Hours] **[Max. Marks: 60]**

"Please check whether you have got the right question paper."

N.B. (i) All questions carry equal marks
(ii) Q. No. 1 is compulsory
(iii) Answer any three from Q. No. 2 to Q. No. 6
(iv) Figures to the right indicate full marks

Q.1 Answer the following **15**
i) Explain indicial notation
ii) Define orthogonal tensor
iii) Prove that stress vector is second order tensor
iv) Define Dilation
v) Write a note on equations of hydrostatics

Q.2 Define tensor and obtain its components w.r.t. a set of unit vectors in the direction of $\{x_1 x_2 x_3\}$ axis respectively of a rectangular Cartesian coordinate system. **15**

Q.3 Explain transformation laws for Cartesian components of vectors and tensors **15**

Q.4 State and prove equation of conservation of mass **15**

Q.5 State and prove the constitute equation for a linear isotropic elastic fluid **15**

Q.6 Answer any three of the following **15**
a) Explain dyadic product of two vector
b) Explain dual vector of an antisymmetric tensor.
c) Explain principal stress
d) Write a note on principal of linear momentum

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

NEPKR—425—2026

FACULTY OF SCIENCE

M.A./M.Sc. (Second Semester) EXAMINATION

APRIL/MAY, 2026

MATHEMATICS

(Operations Research)

(Friday, 24-4-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2½ *Hours* *Maximum Marks*—60

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

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

(*iii*) Answer any *three* questions from Q. No. **2** to Q. No. **6**.

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

1. Answer the following : 15

(*a*) Write the limitations of Linear Programming Problem.

(*b*) Define the transportation problem with mathematical formulation.

(*c*) Differentiate between Assignment and Transportation Problem.

(*d*) Write a short note on different types of game models.

(*e*) Briefly explain the optimization techniques in linear programming problem with suitable example.

P.T.O.

2. Answer the following :

(*a*) Explain two-phase method. 8

(*b*) Find maximum value of : 7

$$Z = 5x_1 + 3x_2$$

Subject to :

$$2x_1 + x_2 \leq 1$$

$$x_1 + 4x_2 \geq 6$$

$$x_1, x_2 \geq 0$$

using two-phase method.

3. Answer the following :

(*a*) Explain least cost method. 8

(*b*) Find the basic feasible solution of the following transportation problem using Vogel's approximation method : 7

		Destinations				
						Supply
Plants	1	2	3	11	7	6
	2	1	0	6	1	1
	3	5	8	15	9	10
Requirement		7	5	3	2	17

4. Answer the following :

(*a*) Explain the Hungarian method. 8

(*b*) Solve the following Assignment problems : 7

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

5. Answer the following :

(*a*) Explain shortest cyclic route models. 8

(*b*) Explain characteristics of Games in detail. 7

6. Answer the following :

(*a*) For any 2×2 two-person zero sum game without any saddle point, having pay off matrix for player A as : 8

		Player B	
		B_1	B_2
Player A	a_{11}	a_{12}	
	a_{21}	a_{22}	

Find the optimal mixed strategies and value of the game.

(*b*) Explain degeneracy in Transportation problem. 7

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

NEPKR—422—2026

FACULTY OF SCIENCE

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

APRIL/MAY, 2026

(NEP-2020)

MATHEMATICS

SMATE-451(A)

(Partial Differential Equations)

(Friday, 24-04-2026) **Time : 10.00 a.m. to 12.30 p.m.**

Time—2.30 *Hours* *Maximum Marks*—60

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

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

(*iii*) Answer any *three* from Q. No. 2 to Q. No. 6.

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

1. Answer the following : 15

(*i*) Eliminate arbitrary function $F(z - xy, x^2 + y^2) = 0$ and find corresponding p.d.e.

(*ii*) Find complete integral of $p^2 + q^2 = x + y$.

P.T.O.

(*iii*) Explain classification of second order p.d.e.

(*iv*) Prove that the solution of Neumann problem is either unique or it differs from one another by a constant only.

(*v*) Write a note on characteristic strip.

2. Find general integral of $y^2p - xyq = x(z - 2y)$. 15

3. If $h_1 = 0$ and $h_2 = 0$ are compatible with $f(x, y, z, u_x, u_y, u_z) = 0$, then prove that $\frac{\partial(f, h)}{\partial(x, u_x)} + \frac{\partial(f, h)}{\partial(y, u_y)} = \frac{\partial(f, h)}{\partial(z, u_z)} = 0$, where $h = h_i$ $(i = 1, 2)$. 15

4. Reduce the equation $u_{xx} - x^2u_{yy} = 0$ to a canonical form. 15

5. State and prove Harnack theorem. 15

6. Answer any *three* of the following : 15

(*a*) Solve $p + q = z$.

(*b*) Find complete integral of $p^2x + q^2y = z\,uy$ using Jacobi's method.

(*c*) Reduce the equation $u_{xx} + x^2u_{yy} = 0$ to a canonical form.

(*d*) Find complete integral of $xpq + q^2y - 1 = 0$ by Charpit's method.

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

NEPKR—17—2026

FACULTY OF SCIENCE AND TECHNOLOGY

M.A./M.Sc. (Second Year) (Third Semester) EXAMINATION

APRIL/MAY, 2026

(NEP-2020)

MATHEMATICS

(SMATC-501)

(Field Theory)

(Thursday, 16-4-2026) **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* questions from Q. No. 2 to Q. No. 6.

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

1. Attempt the following : 20

(*a*) If $f(x) = a_0 + a_1 x + \ldots + a_{n-1} x^{n-1} + x^n \in \mathbb{Z}[x]$ is a monic polynomial and has a root $a \in \mathbb{Q}$, then prove that $a \in \mathbb{Z}$ and $a | a_0$.

P.T.O.

(*b*) If E is a finite extension of F, then prove that E is a normal extension of F if and only if E is a splitting field of a polynomial $f(x) \in F[x]$.

(*c*) Show that the group $G(\mathbb{Q}(\alpha)/\mathbb{Q})$, where $\alpha^5 = 1$ and $\alpha \neq 1$, is isomorphic to the cyclic group of order 4.

(*d*) If a and b are constructible numbers, then prove that $a\ b$ and a/b, $b \neq 0$ are also constructible.

2. Attempt the following : 20

(*a*) Prove that $\sqrt{2}$ and $\sqrt{3}$ are algebraic over $\mathbb{Q}$.

(*b*) State and prove Kronecker theorem.

3. Attempt the following : 20

(*a*) If K is a splitting field of the polynomial $f(x) \in F[x]$ over a field F and E is another splitting field of $f(x)$ over F, then prove that there exists an isomorphism $\sigma : E \to K$ that is identity on F.

(*b*) Prove that the multiplicative group of non-zero elements of a finite field is cyclic.

4. Attempt the following : 20

(*a*) Show that the Galois group of $x^4 - 2 \in \mathbb{Q}[x]$ is the octic group.

(*b*) State and prove fundamental theorem of Algebra.

5. Attempt the following : 20

(*a*) (*i*) Show that if an irreducible polynomial $p(x) \in F[x]$ over a field F has a root in a radical extension of F, then $p(x)$ is solvable by radicals over F.

(*ii*) Show that the polynomial $x^7 - 10x^5 + 15x + 5$ is not solvable by radicals over $\mathbb{Q}$.

(*b*) If E is a splitting field of $x^n - a \in F[x]$, then prove that G(E/F) is a solvable group.

6. Attempt the following : 20

(*a*) (*i*) Show that the polynomial $\Phi_p(x) = 1 + x + ... + x^{p-1}$ is irreducible over $\mathbb{Q}$, where p is a prime. 5

(*ii*) Show that the splitting field of $x^3 + x^2 + 1 \in \mathbb{Z}/(2)[x]$ is a finite field with eight elements. 5

(*b*) (*i*) Show that the Galois group of $x^4 + 1 \in \mathbb{Q}[x]$ is the Klein four-group. 5

(*ii*) If a is constructible, then prove that $\sqrt{a}$ is also constructible. 5

This question paper contains **4** printed pages]

NEPKR—311—2026

FACULTY OF SCIENCE AND TECHNOLOGY

M.A./M.Sc. (Second Year) (Third Semester) EXAMINATION

APRIL/MAY, 2026

(NEP 2020 Pattern)

MATHEMATICS

Paper SMATE501(A)

(Integral Transforms)

(Thursday, 23-4-2026) **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*) Answer any *three* from Q. No. **2** to Q. No. **6**.

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

1. Answer the following : 20

(*a*) State and prove the initial value theorem for Laplace transform.

P.T.O.

(*b*) Find the Mellin transform of $1/(1 + ax)^m$, $m > 0$.

(*c*) Find a Fourier integral representation of the function :

$$f(x) = e^{-|x|}, -\infty < x < \infty.$$

(*d*) Find the Hankel transform of order v of a function :

$$f(r) = r^{v-1} e^{-ar}, a > 0.$$

2. Answer the following : 20

(*a*) If f is piecewise continuous on $t \geq 0$ and is $O(e^c 0^t)$, then prove that :

$$\mathcal{L}[t^n f(t)] = (-1)^n F^{(n)}(p)$$

where F(p) is the Laplace transform of $f(t)$.

(*b*) Find the Laplace transform of :

$$f(t) = \int_0^t (u^2 - u + e^{-u})\, du.$$

3. Answer the following : 20

(*a*) Using Laplace transform, solve the initial value problem :

$$y'' - 3y' + 2y = 4e^{2t}, \; y(0) = -3, \; y'(0) = 5.$$

(*b*) Using Laplace transform, solve the following partial differntial equation under the given boundary conditions (B.C.) and initital conditions (I.C.) :

$$u_{xx} = c^{-2} u_{tt} \qquad 0 < x < \infty, \qquad t > 0$$

$$\text{B.C. : } u(0, t) = f(t),\ u(x, t) \to 0 \text{ as } x \to \infty$$

$$\text{I.C. : } u(x, 0) = 0,\ u_t(x, 0) = 0,\ 0 < x < \infty$$

4. Answer the following : 20

(*a*) If f is piecewise continuous and absolutely integrable on the entire real axis, then prove that :

$$\lim_{\lambda \to \infty} \int_{-\infty}^{\infty} f(t) \cos \lambda t \ dt = \lim_{\lambda \to \infty} \int_{-\infty}^{\infty} f(t) \sin \lambda t \ dt = 0$$

or equivalently :

$$\lim_{\lambda \to \infty} \int_{-\infty}^{\infty} f(t) \ e^{i\lambda t} \ dt = 0$$

(*b*) If :

$$f(x) = \begin{cases} 0, & x < 0 \\ e^{-x} & x > 0 \end{cases}$$

(*i*) Show that :

$$f(x) = \frac{1}{\pi} \int_0^{\infty} \frac{\cos sx + s \sin sx}{s^2 + 1} \, ds$$

(*ii*) Verify directly that the above integral representation converges to the value 1/2 at $x = 0$.

P.T.O.

5. Anwer the following : 20

(*a*) Using Fourier transform, solve the boundary value problem :

$$y'' - y = e^{-|x|}, \quad -\infty < x < \infty$$
$$y(x) \to 0,\ y'(x) \to 0 \text{ as } |x| \to \infty$$

(*b*) Using Fourier transform, solve the boundary value problem :

$$y'' - y = e^{-x}, \quad 0 < x < \infty$$
$$y'(0) = 0,\ y(x) \to 0,\ y'(x) \to 0 \text{ as } x \to \infty$$

6. Answer the following : 20

(*a*) Find the inverse Laplace transform of the function :

$$F(p) = \frac{(p+1)\, e^{-\pi p}}{p^2 + p + 1}$$

(*b*) If $F_c\{f(t)\} = F_c(s)$ represents the Fourier cosine transform of $f(t)$, find :

(*i*) $F_c\{e^{-at} \cos at\}$ and

(*ii*) $F_c\{e^{-at} \sin at\}$

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

NEPKR—184—2026

FACULTY OF SCIENCE AND TECHNOLOGY

M.A./M.Sc. (Second Year) (Third Semester) EXAMINATION

APRIL/MAY, 2026

(NEP-2020 Pattern)

MATHEMATICS

Paper–SMATC-503

(Analytical Number Theory)

(Tuesday, 21-4-2026) **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*) Answer any *three* from Q. No. **2** to Q. No. **6**.

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

1. Answer the following : 20

(*a*) Show that 3 is a quadratic residue of 23, but a non-residue of 31.

(*b*) Find the Bell series of Euler's totient ϕ function.

(*c*) Find the remainders when 2^{50} and 41^{65} are divided by 7.

(*d*) Verify that 2 is a primitive root of 19, but not of 17.

P.T.O.

2 Answer the following : 20

(*a*) Show that, the linear congruence $ax \equiv b \pmod{n}$ has a solution if and only if $d \mid b$, where $d = gcd\ (a, n)$. Prove that, if $d \mid b$, then it has d mutually incongruent solution modulo n.

(*b*) Solve the given system of simultaneous congruences :

$$x \equiv 2 \pmod{3}$$

$$x \equiv 3 \pmod{5}$$

$$x \equiv 2 \pmod{7}$$

3. Answer the following : 20

(*a*) If p is prime and

$f(x) = a_0 x^n + a_{n-1}x^{n-1} + \ldots\ldots\ldots\ldots + a_1 x + a_0,\ a_n \not\equiv 0 \pmod{p}$

is a polynomial of degree $n \geq 1$ with integer coefficient, then prove that the congruence $f(x) \equiv 0 \pmod{p}$ has at most n incongruent solution modulo p.

(*b*) Find the order of integers 2, 3, 5 :

(*i*) Modulo 17

(*ii*) Modulo 19.

4. Answer the following : 20

(*a*) Let p be an odd prime and $gcd\ (a, p) = 1$, then prove that a is a quadratic residue of p if and only if $a^{(p-1)/2} \equiv 1 \pmod{p}$.

(*b*) Find the values of the following Legendre symbols :

(*i*) (19/23)

(*ii*) (–23/59).

5. Answer the following : 20

(*a*) State and prove Selberg identity.

(*b*) Find :

(*i*) $\phi(343)$

(*ii*) $\phi(4300)$

(*iii*) $\phi(2013)$.

6. Answer the following : 20

(*a*) Calculate, $5^{110} \pmod{131}$ and also, verify that 3 is a primitive root of 7.

(*b*) Use Gauss-Lemma to compute each of the Legendre symbols :

(*i*) (5/13)

(*ii*) (6/31).

Also, define Livouville's function $\lambda(n)$ and find the table $\lambda(n)$ for $n = 1$ to 10.

Total No. of Printed Pages:02

SUBJECT CODE NO- NEPKR-45-2026

FACULTY OF SCIENCE AND TECHNOLOGY

EXAMINATION SUMMER 2026

M.SC. (SECOND YEAR) (SEM-IV)

RESEARCH PUBLICATION ETHICS

NEPRPE-1002

[Time: 2:00 Hours] **[Max. Marks:40]**

"Please check whether you have got the right question paper."

N.B. (i) Question No. 1 is compulsory.

(ii) Solve any three questions from Question number 2 to 6

Q1. Write note on: **10**

a) Scope of philosophy.
b) Principles of good scientific practices.
c) Objective of publishing paper.
d) Open access publication.
e) International standard book number.

Q2. a) Write briefly on any two branches of philosophy. **5**
b) Explain common form of scientific misconduct. **5**

Q3. a) What constitute a violation of publication ethics? **5**
b) Mention various steps of Sherpa Romeo online resource to view detail of journal. **5**

Q4. a) What are the characteristics of predatory journals? **5**
b) What is i_{10} index? calculate the i_{10} index of following citation. **5**

Rank	Citation
1	29
2	26
3	15
4	14
5	12
6	11
7	11
8	09
9	06

Q5. a) Define publication ethics. Discuss unethical practices prevalent in research publications. **5**

b) What is plagiarism? Explain its types and importance in research. **5**

Q6. Explain: **10**

a) Types of ethics.

b) Salami slicing

c) Elsevier

d) Turnitin

Total No. of Printed Pages:02

SUBJECT CODE NO- NEPKR-135-2026

FACULTY OF SCIENCE AND TECHNOLOGY
EXAMINATION SUMMER 2026
M.SC.(SECOND YEAR) (SEM-IV)
MATHEMATICS
NUMERICAL ANALYSIS
SMATC551

[Time: 3:00 Hours] **[Max.Marks:80]**

"Please check whether you have got the right question paper."

N.B. i) All questions carry equal marks
ii) Q. No. 1 is Compulsory
iii) Answer any three questions from Q. No. 2 to Q. No. 6
iv) Figures to the right indicate full marks.
v) Scientific Calculator is allowed

Q. 1 Answer the following **20**

a) Perform three iterations of the Newton-Raphson method to obtain the approximate value of $17^{\frac{1}{3}}$. Take the initial approximation as $x_0 = 2$.

b) Show that the decomposition method fails to solve the system of equations

$$\begin{bmatrix} 1 & 1 & -1 \\ 2 & 2 & 5 \\ 3 & 2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 2 \\ -3 \\ 6 \end{bmatrix}$$

c) Discuss in detail the Successive Over-Relaxation method to obtain the solution of the system of equations $Ax = b$.

d) Calculate the n^{th} divided difference of $\frac{1}{x}$, based on the points $x_0, x_1, \ldots, x_n$

Q. 2 Answer the following **20**

a) Show that the Rate of Convergence of the Secant method is 1.618.

b) Obtain the smallest positive root of the equation $f(x) = x^3 - 5x + 1 = 0$ by using the Newton-Raphson method. Perform four iterations.

Q. 3 Answer the following **20**

a) Explain in detail the Gauss elimination method of solving the system of equations $Ax = b$.

b) Solve the system of equations,

$$x_1 + x_2 + x_3 = 1$$
$$4x_1 + 3x_2 - x_3 = 6$$
$$3x_1 + 5x_2 + 3x_3 = 4$$

by using LU decomposition method.

Q. 4 Answer the following **20**

a) Discuss in detail Jacobi Iteration method of solving the system of equations $Ax = b$. Also obtain its error format.

b) Solve the system of equations,

$$2x_1 - x_2 + 0x_3 = 7$$
$$-x_1 + 2x_2 - x_3 = 1$$
$$0x_1 - x_2 + 2x_3 = 1$$

by using Gauss-Seidel Method. Take initial approximation as $x^{(0)} = 0$. Perform three Iterations.

Q. 5 Answer the following **20**

a) Discuss in detail (i) Lagrange linear Interpolation, (ii) Iterated Interpolation, and (iii) Newton's Divided Difference Interpolation.

b) Find a unique polynomial of degree 2 or less, such that $f(0) = 1, f(1) = 3, f(3) = 55$, using,

i) The iterated Interpolation.

ii) Newton's divided difference interpolation.

Q. 6 Answer the following **20**

a) Solve the system of equations

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 8 & 22 \\ 3 & 22 & 82 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 5 \\ 6 \\ -10 \end{bmatrix}$$

by using the Cholesky method.

b) Construct the divided difference table for the data,

x	0.5	1.5	3.0	5.0	6.5	8.0
$f(x)$	1.625	5.875	31.0	131.0	282.125	531.0

Hence find the interpolating polynomial and also find the approximate value of $f(7)$.

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

NEPKR—236—2026

FACULTY OF SCIENCE AND TECHNOLOGY

M.A./M.Sc. (Second Year) (Fourth Semester) EXAMINATION

APRIL/MAY, 2026

(NEP-2020)

MATHEMATICS

Paper-SMATC-522

(Classical Mechanics)

(Wednesday, 22-4-2026) **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*) Answer any *three* from Q. No. 2 to Q. No. 6.

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

1. Answer the following : 20

(*a*) Write a short note on constraint with examples.

(*b*) If Lagrangian L is scleronomic, then prove that Hamiltonian H represents the total energy.

(*c*) Find the extremal of the functional :

$J[y(x)] = \int_0^1 (y^2 + 12xy)\, dx$, with $y(0) = 0$, $y(\pi/2) = 1$.

(*d*) Discuss the isoperimetric problems.

P.T.O.

2. Answer the following : 20

(*a*) Derive the Lagrange's equation of motion for conservative system.

(*b*) Find the Lagrangian L and equation of motion for simple pendulum. Find the time period T for simple pendulum.

3. Answer the following : 20

(*a*) Derive Hamilton's canonical equation of motion.

(*b*) Define Routh's function and obtain the Routh's equation of motion.

4. Answer the following : 20

(*a*) Prove that the necessary condition for :

$$\int_{x_1}^{x_2} \mathrm{F}(x, y, y')\, dx$$

to be extremum is :

$$\mathrm{F}_y - \frac{d}{dx}\mathrm{F}_{y'} = 0.$$

(*b*) Among all the curves joining two points (x_0, y_0) and (x_1, y_1). Find the one which generate the surface of minimum area when rotated about x-axis.

5. Answer the following : 20

(*a*) Find the plane curve of fixed perimeter and maximum area.

(*b*) Explain Brachstocrone problem and find its extremal.

6. Answer the following : 20

(*a*) Obtain an equation of motion in Linear Harmonic Oscillator. Also, prove that the generalised momentum conjugate to a cyclic co-ordinate is conserved.

(*b*) Discuss the invariance of Euler's equation. Also, find the extremal of the functional :

$J[y(x)] = \int_0^{\pi/2} (y'^2 - y^2)\,dx$, with $y(0) = 0$, $y(\pi/2) = 1$.