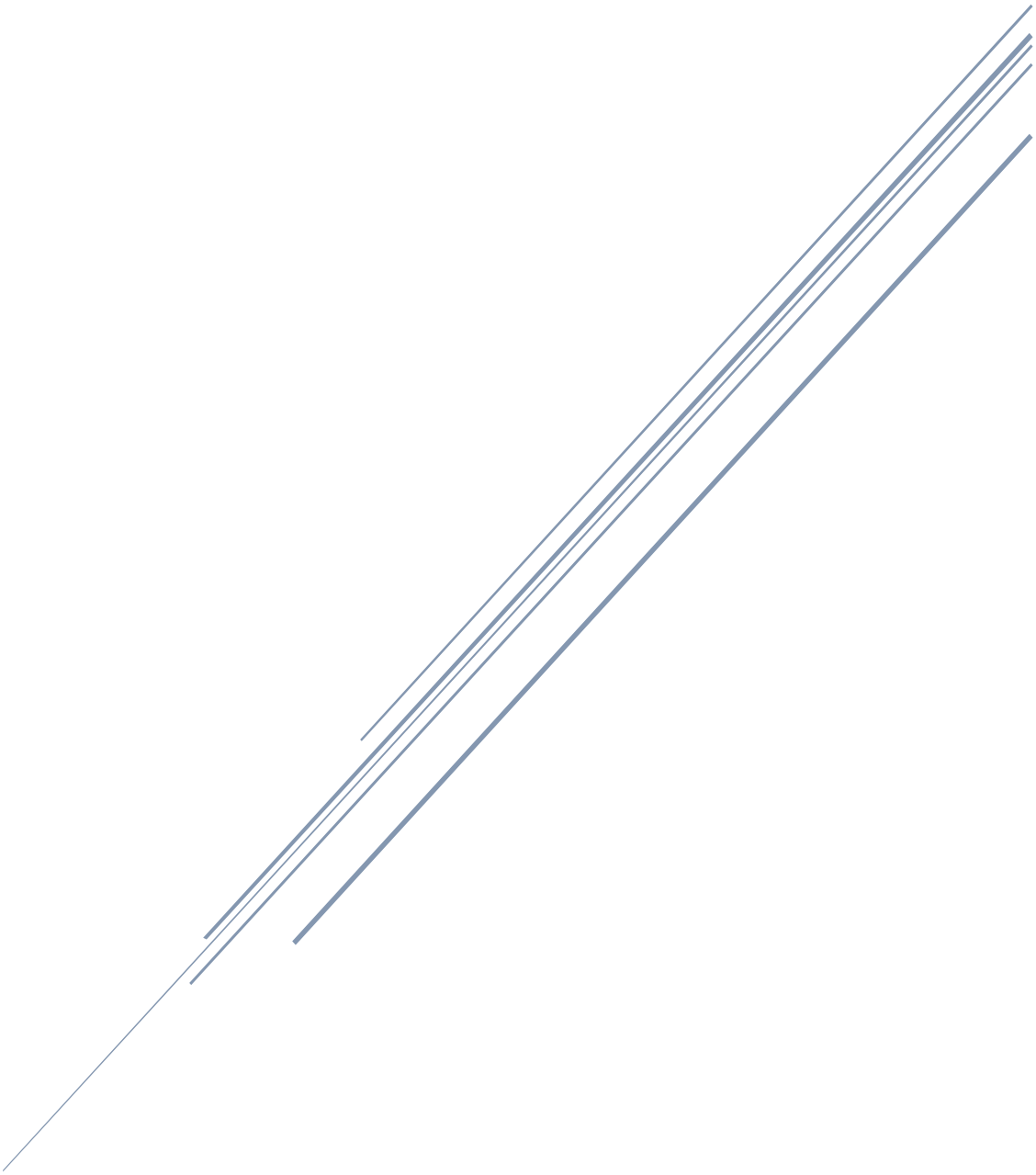
BACHELOR OF SCIENCE (HONS) (MATHEMATICS)-ODL

PROGRAMME PROJECT REPORT (PPR)



School of Sciences

PPR of B.Sc. in Mathematics approved by 39th Academic Council (vide memo no.: Reg/0322 dated 14.03.2023) for delivery of programme through Open Distance Learning mode.

i. Programme's mission and objectives:

The objective of learning through this programme is to help the learners to acquire the fundamental concept of higher Mathematics. Keeping in mind the horizons of open and distance learning, this programme aims at augmenting the domain knowledge and comprehension of the learners with the help of our learning resources in a very efficient and innovative manner. This degree will take learner's understanding of the concepts, theories and applications of mathematics to graduate level at per with the regular mode, and alongside give them exposure to concepts of natural sciences including statistics, theoretical physics etc. The syllabus is structured in such a way that a student can acquire the potential of analytical thinking towards solving a real-world problem in a formal mathematical way. The primary course objectives are:

- ✓ To democratize higher education in mathematics by providing access to large segments of the population, in particular the disadvantaged groups such as those living in remote and rural areas, including working people, women and other adults who wish to acquire and upgrade their mathematical knowledge and/or skills.
- ✓ To acquire knowledge about the nature, concepts, methods, techniques and objectives of advanced fields of Algebra, Analysis, Geometry, Numerical Analysis etc together with some historical perspective of their development.
- ✓ To develop an enhanced skill set that will put the learners at an advantage in careers as diverse as mathematics, education, computer science, economics, engineering and finance.
- ✓ To train learners to learn in an autonomous manner and know how to tackle research in mathematical sciences.

To mitigate the need of qualified professional having specialized knowledge in mathematics for better cognitive and socio-economic development of the country.

ii. Relevance of the program with HEI's Mission and Goals:

The mission of the Higher Education Institutions is to bring more and more learners in the higher education and thus contribute to economic as well as scientific development. In other way, involvement of more learners in higher education will help the nation to reach its goal.

Consistent with the mission of the HEI's this program is entirely consistent with the University's strategic goals as well as its mission to provide modern education to underprivileged sections of society. The program is also in accordance with the NSOU's goals to provide quality education in science establishing an equitable knowledge society within the state. Thus, NSOU brings forth this proposal after extended and thoughtful deliberations.

Beside above following are also considerable for this program –

- ✓ Persistent requests from study centers, local and regional students for UG mathematics program to be offered by NSOU in distance mode to meet educational, and career needs of students.
- ✓ NSOU has already had a big impact in mathematics education and research by training a large number of postgraduate and undergraduate students in mathematics. The department of mathematics has a working relationship with other prestigious universities/institutes in West Bengal, which facilitates the teaching process by adding subject matter specialists from other institutions as necessary.
- ✓ This course will help the economic and social growth of the country by supplying more qualified mathematician, which is basic need in today's competitive environment.

iii. Nature of prospective target group of learners:

For the programme, the students have studied Mathematics in Higher Secondary level from any recognized board. They are considered as the target group of learners for the programme. In West

Bengal, a lot of Learners pass higher secondary (10+2) examination with science background. But due to limitation of seats in the conventional Universities/ colleges in Mathematics (Honours), all of them could not get enrolled themselves in the subject of their choice (i.e., Mathematics). In recent years there are ample scope of higher studies as well as research in Mathematics, thus the Learners opt this subject by choice.

Besides, target group of learners are people from different age groups who wishes to pursue higher education and enhance their knowledge in the discipline to seek for a better career and lead a responsible life. The learners are from different socio-economic background and are located in different parts of the state of West Bengal and also from neighbouring other states. In compliance with the ultimate objective of distance education to reach the unreached, special care is taken to include learners from marginalised sections of the society, backward caste and tribes.

This makes for a very heterogeneous learner group.

iv. Appropriateness of programme to be conducted in Open and Distance Learning and/or Online mode to acquire specific skills and competence:

The ODL system can use this tool to help students develop the skills and expertise they need to succeed. Higher education institutions are held to a higher standard at the national and local levels, and they are tasked with ensuring that all students have access to a high-quality education. In addition to its physical infrastructure, managerial policy, and code of conduct, the school of sciences is constantly involved in the scholastic advancement of its topic areas. The School of Sciences has been designed its curriculum by the help of the Board of Studies (BOS), several learning resource materials, and feedback system through the BOS and an expert committee. Print-based educational resources known as Self-Learning Materials (SLMs) are created in accordance with the UGC guidelines and take the strategy of being self-explanatory, self-contained, self-motivating, and self-evacuating.

- ✓ It strives to provide quality service to the subject's students through the creation of high-quality and relevant Study Learning Materials (SLMs) and the incorporation of contemporary teaching and learning techniques.
- ✓ During the Practical Sessions or Laboratory Counselling-cum-evaluation Sessions (LCES), learners will acquire knowledge in the practical domain of Mathematics through hands-on practise. In the laboratory setting, students will improve their ability to assess their own and others' protection.
- ✓ Online support services, PCPs, tutorial classes are also provided.
- ✓ It also includes the usage of ICT and credibility of evaluation procedures.
- ✓ Organization of inter and intra Schools/ Institutional workshops, seminars on quality related themes and promotion of quality circles.
- ✓ Arrangement for feedback responses from learners, parents and other stakeholders on quality related institutional processes will help to maintain the quality of the programme.

v. Instructional Design:

The curriculum design and detailed syllabus for UG-CBCS Mathematics Learners is as follows.

Introduction: This programme for Honours in Mathematics (HMT) at undergraduate level is well designed and well structured following the Choice Based Credit system in compliance with UGC guidelines and the syllabus is also well framed following the major educational institutions in West Bengal and India. The programme consists of fourteen (14) Core Courses (CC), four (04) Discipline Specific Elective [DSE] courses, two (02) Skill Enhancement Courses [SEC], two (02) Ability Enhancement Compulsory Courses [AECC] and four (04) Generic Elective Courses [GEC]. The fresher and existing employees can take the advantage of ODL system

The Department takes every care to prepare the Learning Materials in printed form popularly known as the Self-Learning Materials (SLM) with the approach of self-explanatory, self-contained, self-motivating and self-evacuating following the guidelines offered by the University Grants Commission through its notifications. The details of the Under graduate programme given below:

a. Course Structure: (Please see the detailed table below):

SEM		CODE	Course Name	Credit	Study Hours	TE Full Marks	Assig. Full Marks	Total Marks
1st Year	I	**CC-MT-01**	Algebra	6	180	50	20	70
		CC-MT-02	Analytical Geometry	6	180	50	20	70
		GE-01: # Refer Table below		6	180	50	20	70
		AE-BG-11	* Bengali	2	60	50	20	70
		AE-EG-12	* English					
	II	**CC-MT-03**	Calculus	6	180	50	20	70
		CC-MT-04	Real Analysis	6	180	50	20	70
		GE-02: # Refer Table below		6	180	50	20	70
		AE-ES-21	Environmental Studies	2	60	50	20	70
2nd Year	III	**CC-MT-05**	Numerical Methods	6	180	50	20	70
		CC-MT-06	Computer Programming & Numerical Methods Lab	6	180	70	--	70
		CC-MT-07	Differential Equations	6	180	50	20	70
		GE-03: # Refer Table below		6	180	50	20	70
		SE-MT-11	Logic and Sets	2	60	50	10	60
	IV	**CC-MT-08**	Theory of Real Functions and Functions of Several Variables	6	180	50	20	70
		CC-MT-09	Riemann Integration and Series of Functions	6	180	50	20	70
		CC-MT-10	Group Theory	6	180	50	20	70
		GE-04: # Refer Table below		6	180	50	20	70
		SE-MT-21	Graph Theory	2	60	50	10	60
3rd Year	V	**CC-MT-11**	Multivariate Calculus and PDE	6	180	50	20	70
		CC-MT-12	Ring Theory and Linear Algebra	6	180	50	20	70
		DS-MT-11	Number Theory	6	180	50	20	70
		DS-MT-21	Probability and Statistics	6	180	50	20	70
	VI	**CC-MT-13**	Mechanics	6	180	50	20	70
		CC-MT-14	Metric Spaces and Complex Analysis	6	180	50	20	70
		DS-MT-31	Linear Programming	6	180	50	20	70
		DS-MT-41	Integral Transform	6	180	50	20	70

GE combination list:

Subject	SEM-I: GE-01	SEM-II: GE-02	SEM-III: GE-03	SEM-IV: GE-04
Physics	**GE-PH-11:** Mechanics	**GE-PH-21:** Thermal Physics	**GE-PH-31:** Waves and Optics	**GE-PH-41:** Elements of Modern Physics
Geography	**GE-GR-11:** Rural Development	**GE-GR-21:** Geography of Tourism	**GE-GR-31:** Climate Change: Vulnerability and Adaptations	**GE-GR-41:** Disaster Management
Chemistry	**GE-CH-11:** Basic Physical Chemistry	**GE-CH-21:** Basic Inorganic Chemistry	**GE-CH-31:** Basic Organic Chemistry	**GE-CH-41:** Application Oriented Chemistry
				GE-CH-42: Approved MOOCs'

* Learners have to choose any one from AE-BG-11: Bengali or AE-EG-12: English as Ability Enhancement Compulsory Course 1

Learners have to choose any one course from each individual GE group of Semester I, II, III and IV.

Course Legend: CC – Core Courses, AECC – Ability Enhancement Compulsory Courses, GEC – Generic Elective Courses, SEC – Skill Enhancement Courses, DSEC – Discipline Specific Elective Courses

b. Detailed Syllabus: (Learners are advised to check the relevant Self Learning Materials (SLM's) for actual distribution of Modules and Units. All courses have been designed in keeping with UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 regarding the minimum number of Units)

Semester-I
Core Course-1 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-01, Course Title: Algebra

Polar representation of complex numbers, n^{th} roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex number.

General properties of equations, Descartes's rule of signs, relation between roots and coefficients, transformation of equations, cubic and biquadratic equations.

The inequality involving AM>GM>HM, Cauchy-Schwartz inequality.

Inverse of a matrix, Rank of a matrix,

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence. characteristic equation of a matrix, Eigen value of a matrix, Eigen vectors, Cayley-Hamilton theorem.

Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

Semester-I
Core Course-2 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-02, Course Title: Analytical Geometry

Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola. rotation of axes, General Equation of second degree, classification of conics (including pair of straight lines) using the discriminant. Polar Equations of Conics, Tangent and Normal, Conjugate Diameters
Equation of planes, straight lines, Spheres, Cone, Cylinder, central conicoids, paraboloid, tangent and normals, planes section of conicoids, generating lines, classification of quadrics.

Vector Triple product, vector equation and application to geometry

Semester-II
Core Course-3 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-03, Course Title: Calculus

Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of Type $e^{ax+b}sinx$, $e^{ax+b}cosx$, $(ax+b)^n sinx$, $(ax+b)^n cosx$, curvature, concavity and inflection points, asymptotes, Envelopes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\, dx$, $\int \cos^n x\, dx$, $\int \tan^n x\, dx$, $\int \sec^n x\, dx$, $\int (\log x)^n\, dx$, $\int sin^n x \sin^m x\, dx$,parametric equations, arc length, arc length of parametric curves, area and volume of surface of revolution.

Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.

Semester-II

Core Course-4 (Theory) Credit-6, Full Marks-70

Course Code: CC-MT-04, Course Title: Real Analysis

Algebraic and Order Properties of *R,* -neighborhood of a point in *R,* Idea of countable sets, uncountable sets and uncountability of *R.* Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of *R,* The Archimedean Property, Density of Rational (and Irrational) numbers in *R,* Intervals. Limit points of a set, isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's n^{th} root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence, Power series, radius of convergence.

Semester-III
Core Course-5 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-05, Course Title: Numerical Methods

Use of Scientific Calculator is allowed.

Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation.

Transcendental and Polynomial equations: Bisection method, Secant method. Regular-falsi method, Newton-raphson method, Rate of convergence of these methods.

System of linear algebraic equations: Gaussian elimination and Gauss-Jordan methods. Gauss-Jacobi, Gauss-Siedel and SOR iterative methods and their convergence analysis.

Interpolation: Lagrange's and Newton's methods (forward difference, backward difference and central difference interpolation), error bounds, finite difference operators.

Numerical differentiation.

Numerical Integration: Newton cotes formula, trapezoidal rule, Simpson's rule, Weddle's rule.

Computer Language: Concept of programming languages, Machine language, Assembly language, High-level language, Interpreter, Compiler, Source and Object programs.

Number Systems: Binary, decimal, octal and hexadecimal number systems and their conversions.

Semester-III
Core Course-6 (Practical) Credit-6, Full Marks-70
Course Code: CC-MT-06, Course Title: Computer Programming & Numerical Methods Lab

Programming Language in C or any other language: Character set, Keywords, Basic data types, Numeric constants and variables operators, Expressions, Assignment statements, I/0 – statements.

Control Statements: Decision making and Looping statements , break continue and goto statements, Example of simple programs. Subscripted variables: Concept of array variables in programming language, Rules for one dimensional subscripted variable , Simple programs.

List of Practicals (using any software)

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.
(ii) To find the absolute value of an integer.
(iii) Enter 100 integers into an array and sort them in an ascending order.
(iv) Bisection Method.
(v) Newton Raphson Method.
(vi) Secant Method.
(vii) Method of False Position.
(viii) LU decomposition Method.
(ix) Gauss-Jacobi Method.
(x) SOR Method or Gauss-Siedel Method.
(xi) Lagrange Interpolation or Newton Interpolation.
(xii) Simpson's rule, Weddle's rule(or Trapezoidal rule)

Semester-III
Core Course-7 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-07, Course Title: Differential Equations

Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Clairaut's equations, Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations

Lipschitz condition and Picard's Theorem (Statement only). General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients,

Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.

Eigen-value problems,Equilibrium points, Interpretation of the phase plane
Power series solution of a differential equation about an ordinary point, solution bout a regular singular point.

Rectilinear Motion and Simple Harmonic Motion. Damped and Forced Oscillation,

Semester-IV
Core Course-8 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-08, Course Title: Theory of Real Functions and Function of Several Variables

Limits of functions (approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval,

intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities.

Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/(ax+b)$ and $(1 +x)^n$.

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters

Semester-IV
Core Course-9 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-09, Course Title: Riemann Integration and Series of Functions

Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability.

Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.

Improper integrals; Convergence of Beta and Gamma functions.

Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Limit superior and Limit inferior. Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

Semester-IV
Core Course-10 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-10, Course Title: Group theory

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

Semester-V

Core Course-11 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-11, Course Title: Multivariate Calculus and PDE

Directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl

Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates.

Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

Partial differential equations of the first order, Lagrange's solution, nonlinear first order partial differential equations, Charpit's general method of solution, some special types of equations which can be solved easily by methods other than the general method.

Classification of second order linear equations as parabolic, hyperbolic or elliptic and their reduction to canonical forms.

Method of separation of variables.

Semester-V

Core Course-12 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-12, Course Title: Ring Theory and Linear Algebra

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients. Introduction to polynomial ring.

Vector spaces, subspaces, algebra of subspaces, dimension of sub-spaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigen spaces of a linear operator. Diagonalizability, invariant subspaces.

Semester-VI
Core Course-13 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-13, Course Title: Mechanics

Co-planar forces, Astatic equilibrium, friction, Equilibrium of a particle on a rough curve, virtual work, forces in three dimensions, general conditions of equilibrium, centre of gravity for different bodies, stable and unstable equilibrium.

Radial and cross-radial,Tangential and Normal components of acceleration, Equation of motion referred to a set of rotating axes.

Central forces, modeling of ballistics and planetary motion, Inverse Square Law, Kepler's laws on Planetary Motion.

Motion of a projectile in a resisting medium(including vertical directionx, stability of nearly circular orbits, slightly disturbed orbits, varying mass. Motion of artificial satellites, constrained motion of a particle on smooth curve.

Degree of freedom, Moments and products of inertia. Momental ellipsoid, principal axes, D'Alembert's principle. Motion about a fixed axes. Compound pendulum. Motion of a rigid body in two dimensions under finite and impulsive forces, Conservation of momentum and energy.

Semester-VI
Core Course-14 (Theory) Credit-6, Full Marks-70
Course Code: CC-MT-14, Course Title: Metric Spaces and Complex Analysis

Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space

Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor's intersection theorem. R is a complete metric space. Q is not complete.

Continuous mappings, sequential criterion of continuity. Uniform continuity.

Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

Concept of connectedness and some examples of connected metric space, connected subsets of R, C. Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic functions. M¨obius transformation.

Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series

Discipline Specific Elective Courses

Semester-V
Discipline Specific Elective Course-1 (Theory) Credit-6, Full Marks-70
Course Code: DS-MT-11, Course Title: Number Theory

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function. Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation x2 + y2= z2, Fermat's Last theorem.

Semester-V

Discipline Specific Elective Course-2 (Practical) Credit-6, Full Marks-70
Course Code: DS-MT-21, Course Title: Probability and Statistics

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states

Random samples, Sampling distributions, Estimation of parameters, Testing of hypothesis.

Semester-VI
Discipline Specific Elective Course-3 (Theory) Credit-6, Full Marks-70
Course Code: DS-MT-31, Course Title: Linear Programming

Introduction to linear programming problem, graphical solution, convex sets, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem, Travelling Salesman Problem.

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

Semester-VI

Discipline Specific Course 4 (Theory) Credit-6, Full Marks-70

Course Code: DS-MT-41, Course Title: Integral Transform

Laplace Transform: Laplace of some standard functions, Existence conditions for the Laplace Transform, Shifting theorems, Laplace transform of derivatives and integrals, Inverse Laplace transform and their properties, Convolution theorem, Initial and final value theorem, Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function, Applications of Laplace transform to solve ODEs and PDEs. Finite Laplace Transform: Definition and properties, Shifting and scaling theorem.

Fourier series: Trigonometric Fourier series and its convergence. Fourier series of even and odd functions, Gibbs phenomenon, Fourier half-range series, Parseval`s identity, Complex form of Fourier series.

Fourier Transforms: Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral representation, Fourier transform, Fourier transform of derivatives and integrals, Fourier sine

and cosine transforms and their properties, Convolution theorem, Application of Fourier transforms to Boundary Value Problems.

Skill Enhancement Course (1-2)

Semester-III

Skill Enhancement Course 1 (Theory) Credit-2, Full Marks-60

Course Code: SE-MT-11, Course Title: Logic and Sets

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.

CRelation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, n-ary relations.

Semester-IV

Skill Enhancement Course 2 (Theory) Credit-2, Full Marks-60

Course Code: SE-MT-21, Course Title: Graph Theory

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

Generic Elective Courses

(For learners of Honours programmes other than Mathematics)

Semester-I

Generic Elective Course-1 (Theory) Credit-6, Full Marks-70

Course Code: GE-MT-11, Course Title: Statistical Techniques

Probability

Unit 1: Basic concepts, Classical definition of probability with its limitations, Axiomatic definition of probability, idea of random variables (with examples).

Unit 2: Empirical and theoretical distribution with their properties, probability mass function and probability density function, mathematical expectation, conditional expectation. Variance and Co-variance.

Unit 3: Moments and moment generating function mgf), properties of mgf, mgf of some distributions.

Unit 4: Markov chain, Chebyshev's inequality and its uses, Characteristic function and its properties

Theoretical Distribution

Unit 1. Various discrete distributions e.g., Uniform distribution of the discrete type, Binomial, Negative Binomial, Poisson and Geometric distributions.

Unit 2. Various continuous distributions, e.g., Uniform distribution of the continuous type, Exponential, Erlangian, Gamma, Beta, Normal and Log-normal distributions.
Unit 3. Sampling distributions, e.g., Chi-square, t distribution, and F distribution and also their uses.
Unit 4. The idea of bivariate distribution, Bivariate normal distribution and its marginal and conditional distributions, Weak Law of Large Numbers (WLLN), Central Limit Theorem (CLT).

Survey Methodology

Unit 1. Sample Survey and Complete Enumeration, their advantages and disadvantages, sampling and non-sampling errors.
Unit 2: Different types of sampling, simple random sampling with replacement (SRSWR), simple random sampling without replacement (SRSWOR), idea of sampling errors in SRSWR and SRSWOR.
Unit 3. The method of drawing random samples, random numbers – their uses and properties, different tests for random numbers.
Unit 4. Random number generation using inverse transformation technique with reference to some standard distributions, e.g., Cauchy, exponential, gamma, etc.

Estimation Theory

Unit 1. Statistic and Parameter, properties of good estimator- unbiasedness, consistency, sufficiency and efficiency, with examples. The concept of completeness of a distribution. Basu's Theorem and its application.
Unit 2. Minimum variance unbiased estimator, Cramer-Rao Inequality and its uses.
Unit 3: The method of generating minimum variance unbiased estimator (MVUE), Rao-Blackwellisation. Examples with some standard distributions.
Unit 4. Method of Maximum Likelihood, Method of Moments.

Testing Statistical Hypothesis

Unit 1. Population and sample, Type 1 and Type 2 error, power of a test, level of significance of a test, uniformly most powerful (UMP) test.
Unit 2. Confidence co-efficient and confidence interval, point estimation and interval estimation, Confidence intervals for mean, variance and proportions.
Unit 3. Large sample theory of testing for mean, proportions. Chi-square test for goodness of fit.
Unit 4. Tests based on Chi-square, t and F – distributions.

Correlation and Regression

Unit 1. Association between two random variables, the idea of correlation co-efficient and its properties.
Unit 2. Mathematical relationship between random variables, regression equation, curve fitting by the method of least squares.
Unit 3. Regression equations considering the cases of two variables as well as three variables separately.
Unit 4. Partial and Multiple Correlation (for three variables only)

Semester-II

Generic Elective Course-2 (Theory) Credit-6, Full Marks-70

Course Code: GE-MT-21, Course Title: Dynamical Systems

Definition: Dynamical System, Continuous dynamical System, Discrete dynamic system, Autonomous and non-autonomous dynamic system.

Linear Continuous Dynamical Systems: First order equations, existence, uniqueness theorem, Single species growth equation, logistic growth, Single species model with harvesting, Planar linear systems,

equilibrium points, stability, Classification of equilibrium points, phase space, n- dimensional linear systems, stable, unstable and center subspaces.

Nonlinear autonomous Systems: Motion of pendulum, local and global stability, Liapunov method, periodic solution, Bendixson's criterion, Poincare Bendixson theorem, Gradient and Hamiltonian systems, limit cycle, attractors, index theory, Hyperbolic and non-hyperbolic equilibrium points, center manifolds, Local Bifurcation of equilibrium points: Fixed points, saddle node, pitchfork, trans-critical bifurcation, Hopf bifurcation, co-dimension.

Discrete systems: Logistic maps, equilibrium points and their local stability, cycles, period doubling, chaos, necessary conditions for chaos, Liapunov exponents, routes to chaos, tent map, Logistic map, horse shoe map. Deterministic chaos: Duffing's oscillator, Lorenz System.

Semester-III

Generic Elective Course-3 (Theory) Credit-6, Full Marks-70

Course Code: GE-MT-31, Course Title: Applications of Algebra

Unit 1: Balanced incomplete block designs (BIBD): definitions and results, incidence matrix of a BIBD, construction of BIBD from difference sets.

Unit 2: Coding Theory: introduction to error correcting codes, linear cods, generator and parity check matrices, minimum distance, Hamming Codes, decoding and cyclic codes.

Unit 3: Symmetry groups and color patterns: review of permutation groups, groups of symmetry and action of a group on a set; colouring and colouring patterns, Polya theorem and pattern inventory, generating functions for non-isomorphic graphs

Unit 4: Special types of matrices: idempotent, nilpotent, involution, and projection tri diagonal matrices, circulant matrices, Vandermonde matrices, Hadamard matrices, permutation and doubly stochastic matrices, Frobenius- König theorem, Birkhoff theorem. Positive Semi-definite matrices: positive semi-definite matrices, square root of a positive semidefinite matrix, a pair of positive semi-definite matrices, and their simultaneous diagonalization. Symmetric matrices and quadratic forms: diagonalization of symmetric matrices, quadratic forms, constrained optimization, singular value decomposition, and applications to image processing and statistics.

Unit 5: Applications of linear transformations: Fibonacci numbers, incidence models, and differential equations. Least squares methods: Approximate solutions of system of linear equations, approximate inverse of an m×n matrix, solving a matrix equation using its normal equation, finding functions that approximate data. Linear algorithms: LDU factorization, the row reduction algorithm and its inverse, backward and forward substitution, approximate inverse and projection algorithms.

Semester-IV

Generic Elective Course-4 (Theory) Credit-6, Full Marks-70

Course Code: GE-MT-41, Course Title: Modeling and Simulation

What is Mathematical Modeling? History of Mathematical Modeling, Merits and Demerits of Mathematical Modeling.

Introduction to difference equations, Linear Difference equations, Introduction to Discrete Models,

Linear Models: Exemplifying through growth model, Steady state solution: Exemplifying through growth models with stocking and harvesting, linear stability analysis, Newton’s Law of Cooling, Bank Account Problem, Mortgage problem, Drug Delivery Problem: Decay model and Absorption, Harrod Model of Economic growth, War Model, Lake pollution model, Alcohol in the bloodstream model, Arm Race models, Density dependent growth models with harvesting.

Introduction to Continuous Models, Carbon Dating, Introduction to compartmental models, Drug Distribution in the Body, Growth and decay of current in a L-R Circuit, Vertical Oscillations, Horizontal Oscillations, Damped Oscillation, Damped Forced Oscillation, Dynamics of Rowing, Combat Models, Mathematical Model of Influenza Infection (within host), Epidemic Models (SIR, SIRS, SI, SIS), Spreading of rumour model, Steady State solutions, Linearization, Local Stability Analysis, Exponential growth, logistic growth, Gomperzian model, prey predator model, Competition model.

Fluid flow through a porous medium, heat flow through a small thin rod, Wave equation: Vibrating string, Traffic flow, Theory of Car-following, Crime Model. Numerical Solution of the models and its graphical representation using EXCEL for discrete and continuous cases.

c. Duration of the programme:
The minimum duration of the Programme is 3 (three) years from the date of registration. The registration is valid for a period of maximum 6 (six) years.

d. Faculty & Support Staff requirement:

Sl. No.	Faculty	Name of the Faculty	Work at (HQ/RC)	Number
1	Professor	Prof. Kajal De	On Lien	
2	Associate Professor	Mr. Ratanes Misra	RC - 1	1
3	Associate Professor	Dr. Nemai Chand Dawn	RC - 1	1
4	Assistant Professor	Mr. Mrinal Nath	RC - 1	1
5	Assistant Professor	Dr. Ushnish Sarkar	RC - 1	1
6	Assistant Professor	Dr. Chandan Kumar Mondal	RC - 1	1

e. Support Staff:

Sl. No.	Office Staff (Designation)	Work at (HQ/RC)	Number
1	Junior Assistant	RC - 1	1
2	Junior Assistant Cum Typist	HQ - 1	1

f. Instructional Delivery Mechanisms:

The NSOU follows a modern ICT enabled approach for instruction. The methodology of instruction in NSOU is different from that of the conventional/regular programs. Our ODL system is more learner-oriented and the learner is an active participant in the teaching-learning process. Most of the instruction is imparted through distance, rather than face-to-face communication. NSOU academic delivery system comprises:

Print Material: NSOU has major focus on print based material and their continuous upgradation by eminent teachers/scholars both from NSOU and other reputed universities/institutes. Since text is still the dominant form of information in a distance environment, print-based instruction has a critical role in NSOU distance learning initiatives. Print offers compelling strengths as a distance education medium. It is easy to reproduce, portable, ideal for self-study, and a familiar medium to learners.

Audio-Visual Material Aids: The learning package contains audio and video programmes which have been produced by NSOU, for better clarification and enhancement of understanding of the course material given to the student. A video programme is normally of 25-30 minutes' duration. The video programmes are delivered using laptop/desktop or a mobile app. NSOU has several mathematical modules already developed by the experts in different topics of post graduate mathematics course like Topology, Numerical Analysis, Graph Theory, Programming, Complex Analysis, Differential and Integral calculus.

Face to Face Counselling Sessions: Normally, counselling sessions are held as per a schedule drawn beforehand by the Study Centre Coordinator. They are held on weekends, i.e., Saturday and Sunday. There are 6 counselling sessions of 2½ hour duration for each course in face to face mode. Eminent teachers from NSOU and other institutes drive these sessions with their vast experience and help the learners to understand the subject better.

Laboratory Counselling Sessions: NSOU has state-of-the-art laboratory where modern computing techniques are practiced while solving different mathematical problems. The laboratory has capacity of 50 learners and well equipped with different programming language software like C, C++, Python, R which is the basic needs of modern days mathematical programming for PG level.

Multimedia Based material: NSOU developed several lectures on rigorous mathematical topics which comprised of words, pictures/Diagrams along with relevant automation for better clarity and visualization. CD-ROM and DVDs have been used as storage for this lecture which will be distributed to the learners as per their needs.

Online/Virtual Classes: Additionally, NSOU, conducts live/virtual classes using technology. These are pre-calendared classes where the faculty or external experts are invited to conduct live sessions for students. Students are able to ask questions and the instructor is able to answer questions after the lecture using technology.

Mobile App: NSOU provides a mobile app to each and every student using which students can go through entire learning material at their convenience. The mobile app has the capability to make the entire content (Video, Textual, Quizzes etc.) in off-line mode too. This is a unique offering of NSOU which has made the learning process convenient and very effective for the learners.

Mode of Delivery/ Types	**Delivery Mechanisms**	**Provided (Yes/No)**	**Detailed Information (Please Mention the Activity Hour)**
Face to Face Mode	PCP	Yes	Provided at LSC. For 6 Credits Theory Courses 9 counselling sessions of 2 hours each (Total 18 hrs); for 2 Credits Ability/Skill Courses 3 counselling sessions of 2 hours each (Total 6 hrs)
	Tutorials/ Special Classes/ Remedial Classes/ PCP	Yes	Provided online by NSOU faculty @ 6 hrs for each 6 Credits Course; Offline remedial classes once every semester at RC's (6 hrs for each 6 Credits Course)
	Seminar/ Research Colloquium	Yes	Learners participates in the seminar/workshops conducted by the University as per prior notice
	Laboratory based Practical	Yes	96 hour Practical session per Core Courses and Discipline Specific Courses
Self-Learning	SLMs	Yes	All Courses are designed within the range of Units specified by relevant regulations. 20 hours of self- study time is envisaged for each SLM
	Reference Books	Yes	All Units have suggested reading lists. Additionally, faculty at LSC (during PCP) & NSOU faculty (at online sessions) guide learners regarding Reference Books
ICT/ Digital Wellness of students	Online (Web driven/Mobile App)	Yes	Learners have access to institutional Learning Management System (LMS)
	Offline DVD/SD Card/USB Drive	Yes	
	Telecommunications	Yes	Supports are given as per need. Communication Support is provided to the learners through University technical team as per requirement

Mode of Delivery/ Types	Delivery Mechanisms	Provided (Yes/No)	Detailed Information (Please Mention the Activity Hour)
Blended	Smart Classrooms	Yes	Arrangements are available both at RC's and at LSC's
	Flipped Learning	No	Will come into effect in a phased manner from the upcoming session with the development of NSOU MOOC

vi. Procedure for admissions, curriculum transaction and evaluation:

University frames its policy related to admission entry criteria, method of admission, conduction of admission through the Admission Committee (statutory body) following the guideline of the UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 and Department of Higher Education, Govt. of West Bengal. Admissions are conducted entirely through Online mode centrally by the University.

Information Circulation Policy:

All information related to the programme like admission policy, eligibility, fee structure, course curriculum, medium of instruction, method of instruction, evaluation method, SLMs etc. are transacted through prospectus, brochure, official notification etc.

Learner Support Services:

Learner support services are provided by the University at three level of functioning of the Open University architecture i.e. Learner Support Centre (LSC), Regional Centre and Head Quarter.

Following the UGC (Open and Distance Learning and Online Programmes) Regulations, 2020 LSCs are provide various learner support services in order to facilitate the acquisition of teaching-learning experience for its enrolled learners throughout at various phases of learners' study life cycle. LSC also main contact points for access by the learners, responsive and facilitating information centres, arranging contact sessions and other operations like processing of assignments etc.

University has constituted Learner's Facilitation Centre (LFC) at each Regional Centres to provide various support services. Beside that University has also provided learners support services through web based platform/ telephone/ email/ instant messaging services.

Transaction of Curriculum and Academic Planner:

The whole curriculum of the programme is well structured and well designed with the updated syllabus structure. The curriculum transaction involves the face to face PCP sessions through chalk and talk method, use of Power Point presentations, web-based lessons, animated videos, etc. The PCP sessions would be such that the learner should participate actively in the discussion. Apart from this ICT enables online supports are provided for better understanding of the subject.

For practical courses exclusive study materials containing the requirements, procedure for the experiments are issued to the learners. In the laboratory, instruction would be given for the experiments followed by demonstration and finally the learners have to do the experiments individually.

Curriculum transaction is through Online and or Offline modes as detailed above and all academic activities are conducted following the programme is following the below mentioned activity planner during the academic session:

Name of the Activity	Tentative months schedule (specify months) during Year			
	From (Month)	To (Month)	From (Month)	To (Month)

Admission	Jun	Jul	NA	NA
Distribution of SLM	Jul	Aug	NA	NA
Contact Programmes (counselling, Practical, etc.)	Aug	Oct	Jan	Mar
Assignment Submission	Oct	Nov	Mar	Apr
Evaluation of Assignment	Nov	Nov	Apr	Apr
Examination	Nov	Dec	May	Jun
Declaration of Result	Dec	Dec	Jun	Jun
Renewal/ Re–registration	NA	NA	Jun	Jul

Evaluation:

Evaluation is on a 2-tier basis, divided into Assignment submission (online mode) and Term End Examinations (Offline mode). The weightage is as follows:
Assignment – 20 marks
Term End Examination – 50 marks
Total marks for each course – 70

A**ssignment / Internal Assessment/ Continuous Assessment / Formative Assessment:** Assignment submission is the first interaction between the learner and the teacher. It has a very important role to play in the teaching-learning process in distance education. So, submission of Assignment is mandatory for all learners. The assignment responses reflect what the learners have understood and learnt. The assignment answer scripts are returned to the learners so that the assignment answers serve the purpose of providing feedback to the learners and inform them their strengths and weaknesses. Learners will be required to submit assignment for each course and the marks obtained on evaluation of those assignment courses will be entered into his/her individual record of performance. This will constitute 30% (maximum) of the Full marks in the course as per University Grants Commission (Open and Distance Learning Programmes and Online Programmes) regulations, 2020. All the Marks secured by the learners will be progressively entered into the result card. Every learner is required to submit the assignment courses before each Term-End Examination. In practical course of Science stream, there is no assignment.

Term-End Examinations: Minimum 70% of the total credit points of the course (except practical course where it is 100%) would be reserved for Term-End Examination as per University Grants Commission (Open and Distance Learning Programmes and Online Programmes) Regulations, 2020. Minimum qualifying marks in each course is 30% (Term End Examination Marks + Assignment Marks).

Waive of Programme Fee:

University waive of full course fee for transgender learners.

vii. Requirement of the laboratory support and Library Resources:

To educate the students in more scientific way, a rhythmic practical class programme has been introduced. NSOU provides the necessary laboratory facilities to the students in their respective study centres. For UG level, a period of 12 days (eight hours per day) has been allotted for the students during the Puja vacation. The College and University teachers have been appointed to take classes which show a good sharing of resource persons among the conventional and distance institutions. The students of different study centres have been clubbed into a nearby study centres for practical classes. Due to the increased number of enrolments, the number of study centres for practical classes have been enhanced accordingly.
Library facility is one of important services in any higher educational institution. In addition to the Self Learning Materials (SLMs) and other learning resources the University provides library facility to all of its registered learners. The Library Department, Netaji Subhas Open University is located at Kalyani Campus.

Further, to cater to the needs of huge number of registered students, the University needs unlimited libraries to provide educational support to everyone. To cope with the situation, the University has initiated the process of setting up a strategic partnership with the existing network of Public Libraries that are available in the State of West Bengal to offer educational support to our learners all over the State. This initiative taken by NSOU is the first of its kind in the country.

viii. Cost estimate of the programme and the provisions:

Total course fee is Rs. 13,800/- (Excluding Examination and Studentship Renewal Fees). An approximate distribution of expenditure is given below to get prior view:

Assigned Head	Sub Head	% of Expenditure
Development	SLM Preparation and Development Cost	7
	SLM Printing	44
Maintenance & Programme Delivery	Maintenances Grant	15
	Counselling/ PCP/ Lab Counselling	15
	Delivery Charges	4
	Other Overhead Expenses	8
ICT Support	Admission Processing	1
	ICT Support Services	5
	Computer Training	1

ix. Quality assurance mechanism and expected programme outcomes:

Centre for Internal Quality Assurance (CIQA) as per UGC (Open and Distance Learning and online programme) Regulations, 2020 to ensure the delivery of high quality programmes to its learners and CIQA has the following functions:

- ✓ Facilitating the creation of a learner-centric environment conducive for quality education and faculty maturation to adopt the required knowledge and technology for participatory teaching and learning process.
- ✓ Arrangement for feedback responses from stakeholders, such as Learners, alumni, employers, and community members, is gathered through surveys, focus groups, and other methods to ensure that the program is meeting the needs of the community and to identify areas for improvement.
- ✓ Dissemination of information on the various quality parameters of the University.
- ✓ Development of quality culture in the University, and encourage creativity and innovation among the faculty and staff.
- ✓ Organization of inter and intra Schools/ Institutional workshops, seminars on quality related themes and promotion of quality circles.
- ✓ Documentation of the various programmes / activities of the School leading to quality improvement
- ✓ Acting as a nodal agency of the institution for quality-related activities, including adoption and dissemination of good practices.

Moreover, CIQA records activities undertaken on quality assurance along with the preparation of the PPRs and Annual Reports. The program aims to make learners knowledgeable, proficient and competent enough to secure good job opportunities as well as take up further research work.

Board of Studies (BOS): Board of Studies ensure quality of the Curriculum of Bachelor's Degree Programme in Mathematics as per University norms. BOS plays a vital role as the following

- ✓ Curriculum review and development of quality Self Learning Materials (SLMs) in print under Choice Based Credit System (CBCS) system. The curriculum is reviewed regularly to ensure that it is up-to-date and relevant to the needs of learners.

- ✓ Learner's assessment and evaluation process through a variety of methods, including exams, assignments. This helps to ensure that Learners are meeting the learning outcomes of the Programme.

Expected Programme outcomes:

- ✓ In addition to merely mastering crude problem- solving techniques, learners will also be able to understand the axiomatic approach in mathematics and capable of developing ideas based on them.
- ✓ Sound sense of reasoning through rigorous mathematical approach will be inculcated.
- ✓ Learners will be able to characterize various mathematical phenomena as well as appreciate and produce counter-examples when no characterization is possible.
- ✓ Learners will be able to translate different real- life problems into rigorous mathematical problems and solve as well as analyse them to understand the concerned real- life problems.
- ✓ Learners will be equipped with a wide range of mathematical methods/tools suitable for other scientific and engineering domains.
- ✓ Advanced knowledge of the domain and augmented analytical capability in pure as well as applied mathematics will empower the learners to pursue higher studies and research at reputed academic institutions.
- ✓ Learners will be instilled with aptitude and attitude required for lifelong continuous education process.
- ✓ Learners will become eligible to be employed in various job sectors including teaching, banking, insurance, risk management etc.