

(1)

C.S.J.M. UNIVERSITY, KANPUR

SYLLABUS OF MATHEMATICS

B.A./B.Sc. I

(Applicable from Academic Session 2018-19 Onwards)

Paper I : Algebra and Trigonometry

(Maximum Marks : 33 for B.A. & 65 for B.Sc.)

Algebra - 80 % and Trigonometry - 20 %

Paper II : Calculus

(Maximum Marks : 33 for B.A. & 65 for B.Sc.)

Differential Calculus - 70 % and Integral Calculus - 30 %

Paper III : Geometry & Vector Analysis

(Maximum Marks : 34 for B.A. & 70 for B.Sc.)

Conics - 20 %, Three Dimensional Co-ordinate Geometry - 50 % and Vector Analysis - 30 %

B.A./B.Sc. II

(Applicable from Academic Session 2019-20 Onwards)

Paper I : Linear Algebra & Matrices

(Maximum Marks : 33 for B.A. & 65 for B.Sc.)

Linear Algebra - 60 % and Matrices - 40 %

Paper II : Differential Equations & Integral Transforms

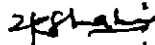
(Maximum Marks : 33 for B.A. & 65 for B.Sc.)

Differential Equations - 70 % and Integral Transforms - 30 %

Paper III : Mechanics & Statistics

(Maximum Marks : 34 for B.A. & 70 for B.Sc.)

Dynamics - 50 %, Statics - 20 % and Statistics - 30 %


Dr. Vinod Kumar
Convener, Board of Studies
in Mathematics
C.S.J.M. University
Kanpur

(2)

B.A./B.Sc. III

(Applicable from Academic Session 2018-19 Onwards)

Paper I : Real Analysis

(Maximum Marks : 30 for B.A. & 60 for B.Sc.)

Paper II : Complex Analysis & Tensors

(Maximum Marks : 30 for B.A. & 60 for B.Sc.)

Complex Analysis - 70 % and Tensors - 30 %

Paper III : Numerical Analysis & Programming in C

(Maximum Marks : 30 for B.A. & 60 for B.Sc.)

Numerical Analysis - 80 % and Programming in C - 20 %


Paper IV : OPTIONAL PAPER

(Maximum Marks : 30 for B.A. & 60 for B.Sc.)

CHOOSE ANY ONE OF THE FOLLOWING PAPERS :

[NOTE – The optional paper IV(f) entitled “Mathematical Statistics” shall be available for the examinations of 2018-19 and 2019-20 only. After that this paper will be discontinued.]

- (a) Linear Programming
- (b) Number Theory & Cryptography
- (c) Differential Geometry
- (d) Principles of Computer Science
- (e) Discrete Mathematics
- (f) Mathematical Statistics.


Dr. Vinod Kumar
Convener, Board of Studies
in Mathematics
C.S.J.M. University
Kanpur

**RECOMMENDED SYLLABUS OF
MATHEMATICS**

B.A./B.Sc. I

(From the Session 2018-19 onwards)

Paper I - ALGEBRA & TRIGONOMETRY

M.M. : 33/65

Algebra (80 %)

Sequence and its convergence (examples and basic idea only), Convergence of infinite series, Comparison test, Ratio test, Root test, Raabe's test, Logarithmic ratio test. Cauchy's condensation test, De Morgan and Bertrand test and higher logarithmic ratio test. Alternating series, Leibnitz test, Absolute and conditional convergence.

Equivalence relations and partitions, Congruence modulo m relation.

Definition of a group with simple properties and examples, Permutation groups, Subgroups, Centre and normalizer, Cyclic groups, Coset decomposition, Lagrange's theorem & its consequences.

Homomorphism and isomorphism, Cayley's theorem, Normal subgroups, Quotient group, Fundamental theorem of homomorphism.

Introduction to rings, subrings, integral domains and fields, Characteristic of a ring, Homomorphism of rings.

Trigonometry (20 %)

Complex functions and separation into real and imaginary parts, Exponential, direct and inverse trigonometric and hyperbolic functions, Logarithmic function, Gregory's series, Summation of series ($C + iS$ method only).

Paper II - CALCULUS

M.M. : 33/65

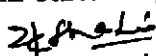
Differential Calculus (70 %)

Continuous functions and classification of discontinuities, Differentiability, Rolle's theorem, First and second mean value theorems, Taylor's theorems with Lagrange's and Cauchy's forms of remainder, Successive differentiation and Leibnitz's theorem.

Expansion of functions (in Taylor's and Maclaurin's series), Indeterminate forms, Partial differentiation and Euler's theorem, Jacobians.

Maxima and Minima (for functions of two variables only), Tangents and normal (polar form only), Curvature, Envelopes and evolutes.

Asymptotes, Singular points, Tracing of curves (in Cartesian, parametric & polar co-ordinates).


Dr. Vinod Kumar
 Convener, Board of Studies
 in Mathematics
 C.S.J.M. University
 Kanpur

(4)

Integral Calculus (30 %)

Integral as limit of a sum, Reduction formulae, Beta and Gamma functions.

Quadrature, Rectification, Volumes and surfaces of solids of revolution, Double and triple integrals, Change of order of integration, Dirichlet's and Liouville's integral formulae.

Paper III – GEOMETRY & VECTOR ANALYSIS

M.M. : 34/70

Conics (20 %)

General equation of the second degree, Tracing of conics, Polar equation of conics.

Three Dimensional Co-ordinate Geometry (50 %)

Projection and direction cosines, Plane, Straight line, Sphere, Cone and cylinder, Central conicoids, Reduction of general equation of second degree.

Vector Analysis (30 %)

Scalar and vector products of three and four vectors, Geometrical applications of vectors to straight line and plane.

Vector differentiation and integration, Gradient, divergence and curl and their properties, Line integrals, Theorems of Gauss, Green and Stokes.

B.A./B.Sc. II

(From the Session 2019-20 onwards)

Paper I – LINEAR ALGEBRA & MATRICES

M.M : 33/65

Linear Algebra (60 %)

Vector spaces and their elementary properties, Subspaces, Linear dependence and independence, Basis and dimension, Direct sum, Quotient space.

Linear transformations and their algebra, Range and null space, Rank and nullity, Matrix representation of linear transformations, Change of basis.

Linear functionals, Dual space, Natural isomorphism, Annihilators, Bilinear and quadratic forms, Inner product spaces, Concept of normed linear space, Schwarz's inequality, Orthogonality, Bessel's inequality.

Matrices (40 %)

Hermitian and skew-Hermitian matrices, Orthogonal and unitary matrices, Triangular and diagonal matrices, Rank of a matrix, Elementary transformations, Echelon and normal forms, Inverse of a matrix by elementary transformations.

Vinod Kumar

Dr. Vinod Kumar
Convener, Board of Studies
in Mathematics
C.S.J.M. University
Kanpur

Characteristic equation, Eigen values and eigen vectors of a matrix, Cayley-Hamilton's theorem and its use in finding inverse of a matrix, Application of matrices to solve a system of linear equations, Diagonalization of square matrices with distinct eigen values.

Paper II - DIFFERENTIAL EQUATIONS & INTEGRAL TRANSFORMS

M.M. : 33/65

Differential Equations (70 %)

Differential equations of the first order and first degree : Method of separation of variables, Solution of homogeneous equations, linear equations and exact equations, Linear differential equations with constant coefficients, Homogeneous linear differential equations, Differential equations of the first order but not of the first degree, Clairaut's equations and singular solutions.

Orthogonal trajectories, Simultaneous linear differential equations with constant coefficients, Linear differential equations of the second order (including the method of variation of parameters).

Series solutions of second order differential equations, Legendre and Bessel functions (P_n and J_n only) and their properties.

Order, degree and formation of partial differential equations, Partial differential equations of the first order, Lagrange's equations, Charpit's general method, Linear partial differential equations with constant coefficients.

Partial differential equations of the second order, Monge's method.

Integral Transforms (30 %)

The concept of transform, Integral transforms and kernel, Linearity property of transforms, Laplace transform, Inverse Laplace transform, Convolution theorem, Applications of Laplace transform to solve ordinary differential equations.

Fourier transforms (finite and infinite), Fourier integral, Applications of Fourier transform to boundary value problems, Fourier series.

Paper III - MECHANICS & STATISTICS

M.M. : 34/70

Dynamics (50 %)

Velocity and acceleration along radial and transverse directions, and along tangential and normal directions, Simple harmonic motion, Motion under other laws of forces, Earth attraction, Elastic strings.

Constrained motion (circular and cycloidal only), Central orbits and Kepler's law, Motion under resisting medium.

Dr. Vinod Kumar
 Dr. Vinod Kumar
 Convenor, Board of Studies
 in Mathematics
 C.S.J.M. University
 Kanpur

Statics (20 %)

Common catenary, Centre of gravity, Virtual work.

Statistics (30 %)

Measures of skewness and kurtosis, Moments, Curve fitting by least square method (straight line and parabola of second degree only), Correlation and regression, Rank correlation.

Classical, mathematical & axiomatic definitions of probability, Conditional probability, Addition and multiplication theorems of probability, Binomial & multinomial theorems of probability, Baye's theorem, Probability density function, Expectation, Binomial, Poisson and normal distributions.

B.A./B.Sc. III

(From the Session 2018-19 onwards)

Paper I - REAL ANALYSIS**M.M. : 30/60**

Axiomatic study of real numbers, Completeness property in R , Archimedean property, Countable and uncountable sets, Neighbourhood, Interior points, Limit points, Open and closed sets, Derived sets, Dense sets, Perfect sets, Bolzano-Weierstrass theorem.

Sequences of real numbers, Subsequences, Bounded and monotonic sequences, Convergent sequences, Cauchy's theorems on limit, Cauchy sequence, Cauchy's general principle of convergence, Uniform convergence of sequences and series of functions, Weierstrass M -test, Abel's and Dirichlet's tests.

Sequential continuity, Boundedness and intermediate value properties of continuous functions, Uniform continuity, Meaning of sign of derivative, Darboux theorem.

Limit and continuity of functions of two variables, Taylor's theorem for functions of two variables, Maxima and minima of functions of three variables, Lagrange's method of undetermined multipliers.

Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus.

Improper integrals and their convergence, Comparison test, μ -test, Abel's test, Dirichlet's test.

Integral as a function of a parameter and its differentiability and integrability.

Definition and examples of metric spaces, Neighbourhoods, Interior points, Limit points, Open and closed sets, Subspaces, Convergent and Cauchy sequences, Completeness, Cantor's intersection theorem.

Paper II - COMPLEX ANALYSIS & TENSORS**M.M. : 30/60****Complex Analysis (70 %)**

Functions of a complex variable, Concepts of limit, continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations (Cartesian and polar forms), Harmonic functions, Orthogonal system, Power series as an analytic function.

zphali

Dr. Vinod Kumar
Convener, Board of Studies
in Mathematics
C.S.J.M. University
Korpur

Elementary functions, Mapping by elementary functions, Linear and bilinear transformations, Fixed points, Cross ratio, Inverse points and critical points, Conformal transformations.

Complex integration, Line integral, Cauchy's fundamental theorem (statement only), Cauchy's integral formula, Liouville's theorem, Morera's theorem, Taylor and Laurent series.

Singularities and zeros of an analytic function, Argument principle, Rouché's theorem, Fundamental theorem of algebra.

Tensors (30 %)

Contravariant and covariant vectors and tensors, Mixed tensors, Symmetric and skew-symmetric tensors, Algebra of tensors.

Contraction and inner product, Quotient law, Reciprocal tensors, Christoffel's symbols, Covariant differentiation, Gradient, Divergence and curl in tensor notations.

Paper III - NUMERICAL ANALYSIS & PROGRAMMING IN C

M.M. : 30/60

Numerical Analysis (80 %)

NOTE. Scientific calculators can be allowed in the examination, if required to use in any question.

Shift operator, Forward and backward difference operators and their relationships, Fundamental theorem of difference calculus, Interpolation, Newton-Gregory's forward and backward interpolation formulae.

Divided differences, Newton's divided difference formula, Lagrange's interpolation formula, Central differences, Formulae based on central differences : Gauss', Stirling's, Bessel's and Laplace-Everett's formulae.

Numerical differentiation, Numerical integration, General quadrature formula, Trapezoidal and Simpson's rules, Weddle's rule, Cote's formula, Numerical solution of first order differential equations : Euler's method, Picard's method, Runge-Kutta method and Milne's method, Numerical solution of linear, homogeneous and simultaneous difference equations, Generating function method.

Solution of transcendental and polynomial equations by iteration, bisection, Regula-Falsi and Newton-Raphson methods, Algebraic eigen value problems : Power method, Jacobi's method, Given's method, Householder's method and $Q-R$ method; Approximation : Different types of approximations, Least square polynomial approximation, Polynomial approximation using orthogonal polynomials, Legendre approximation, Approximation with trigonometric functions, exponential functions, rational functions, Chebyshev polynomials.

Programming in C (20 %)

Programmer's model of computer, Algorithms, Data type, Arithmetic and input/output instruction, Decisions, Control structures, Decision statements, Logical and conditional operators, Loop case

V. K. Sharma

Dr. Vinod Kumar
Convener, Board of Studies
in Mathematics
C.S.J.M. University
Kampur

control structures, Functions, Recursion, Preprocessors, Arrays, Puppeting of strings, Structures, Pointers, File formatting.

Paper IV – OPTIONAL PAPER

M.M. : 30/60

CHOOSE ANY ONE OF THE FOLLOWING PAPERS :

[NOTE – The optional paper IV(f) entitled “MATHEMATICAL STATISTICS” shall be available for the examinations of 2018-19 and 2019-20 only. After that this paper will be discontinued.]

Paper IV(a) – LINEAR PROGRAMMING

Linear programming problems, Statement and formation of general linear programming problems, Graphical method, Slack and surplus variables, Standard and matrix forms of linear programming problem, Basic feasible solution.

Convex sets, Fundamental theorem of linear programming, Simplex method, Artificial variables, Big- M method, Two phase method, Resolution of degeneracy.

Revised simplex method, Sensitivity analysis.

Duality in linear programming problems, Dual simplex method, Primal-dual method, Integer programming.

Paper IV(b) – NUMBER THEORY & CRYPTOGRAPHY

Divisibility : gcd, lcm, prime numbers, fundamental theorem of arithmetic, perfect numbers, floor and ceiling functions, Congruence : properties, complete and reduced residue systems, Fermat's theorem, Euler functions, Chinese remainder theorem.

Primality testing and factorization algorithms, Pseudo-primes, Fermat's pseudo-primes, Pollard's rho method for factorization.

Introduction to cryptography : Attacks, services and mechanisms, Security services, Conventional encryption - Classical techniques : Model, Steganography, Classical encryption technique, Modern techniques : DES, cryptanalysis, block cipher principles and design, Key distribution problem, Random number generation.

Hash functions, Public key cryptography, Diffie-Hellmann key exchange, Discrete logarithm-based crypto-systems, RSA crypto-system, Signature schemes, Digital signature standard (DSA) RSA signature schemes, Knapsack problem.

Elliptic curve cryptography : Introduction to elliptic curves, Group structure, Rational points on elliptic curves, Elliptic curve cryptography, Applications in cryptography and factorization, Known attacks.

2/8/20
 Dr. Vinod Kumar
 Convener, Board of Studies
 in Mathematics
 C.S.J.M. University
 Kanpur

Paper IV(c) – DIFFERENTIAL GEOMETRY

Local theory of curves - Space curves, Examples, Plane curves, tangent and normal and binormal, Osculating plane, normal plane and rectifying plane, Helices, Serret-Frenet formulae, contact between curve and surfaces, tangent surfaces, involutes and evolutes of curves, Intrinsic equations, fundamental existence theorem for space curves, Local theory of surfaces - Parametric patches on surface curve of a surface, surfaces of revolutions, Helicoids, metric-first fundamental form and arc length.

Local theory of surfaces (Contd.), Direction coefficients, families of curves, intrinsic properties, geodesics, Canonical geodesic equations, normal properties of geodesics, geodesics curvature, geodesics polars, Gauss-Bonnet theorem, Gaussian curvature, normal curvature, Meusnier's theorem, mean curvature, Gaussian curvature, umbilic points, lines of curvature, Rodrigue's formula, Euler's theorem.

The fundamental equation of surface theory – The equation of Gauss, the equation of Weingarten, the Mainardi-Codazzi equation, Tensor algebra : Vector spaces, the dual spaces, tensor product of vector spaces, transformation formulae, contraction, special tensor, inner product, associated tensor.

Differentiable Manifolds - examples, tangent vectors, connexions, covariant differentiation, Elements of general Riemannian geometry - Riemannian metric, the fundamental theorem of local Riemannian Geometry, Differential parameters, curvature tensor, Geodesics, geodesic curvature, geometrical interpretation of the curvature tensor and special Riemannian spaces.

Paper IV(d) – PRINCIPLES OF COMPUTER SCIENCE

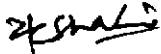
Data Storage - Storage of bits, main memory, mass storage, Information of storage, The binary system, Storing integers, storing fractions, communication errors.

Data Manipulations - The central processing unit, The stored program concept, Program execution, Other Architectures, arithmetic/logic instructions, Computer – peripheral communication.

Operating System and Network - The evolution of operating system, Operating system architecture, Co-ordinating the machine's activities, Handling competition among process, networks, network protocol.

Algorithms - The concept of an algorithm, Algorithm representation, Algorithm, Discovery, Iterative structure, Recursive structures, Efficiency and correctness, (algorithm to be implemented in C++).

Programming Languages - Historical perspective, Traditional programming Concepts, Program units, Languages implementation, Parallel computing, Declarative computing.


 Dr. Vinod Kumar
 Member, Board of Studies
 in Mathematics
 C.S.J.M. University
 Kanpur

Software Engineering - The software engineering discipline, The software life cycle, Modularity, Development, Tools and techniques, Documentation, Software ownership and liability.
Data Structures - Array, Lists, Stack, Queues, Trees, Customised data types, Object-oriented.

Paper IV(e) – DISCRETE MATHEMATICS

Propositional Logic - Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradiction, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification.

Method of Proof - Mathematical induction, proof by implication, converse, inverse, contrapositive, negation and contradiction, direct proof by using truth table, proof by counter example.

Relation - Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation.

Posets, Hasse Diagram and Lattices - Introduction, ordered set, Hasse diagram of partially ordered set, isomorphic ordered set, well ordered set, properties of lattices, and complemented lattices.

Boolean Algebra - Basic definitions, sum of products and product of sums, Logic gates and Karnaugh maps.

Graphs - Simple graph, multi graph, graph terminology, representation of graphs, Bipartite, regular, planar and connected graphs, connected components in a graph, Euler graphs, Hamiltonian path and circuits, Graph colouring, chromatic number, isomorphism and homomorphism of graphs.

Tree - Definition, Rooted tree, properties of trees, binary search tree, tree traversal.

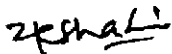
Combinatorics - Basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (n^{th} order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relations), generating function (closed form expression, properties of G.F., solution of recurrence relation using G.F., solution of combinatorial problem using G.F.).

Finite Automata - Basic concepts of automation theory, Deterministic finite automation (DFA), transition function, transition table, Non deterministic finite automata (N DFA), Mealy and Moore machine, Minimization of finite automation.

Paper IV(f) – MATHEMATICAL STATISTICS

[NOTE – This optional paper shall be available for the examinations of 2018-19 and 2019-20 only. After that this paper will be discontinued.]

Probability Theory – Three definitions of probability (Mathematical, empirical and


 Dr. Vinod Kumar
 Convener, Board of Studies
 in Mathematics
 C.S.J.M. University
 Kanpur

axiomatic), Dependent, independent and compound events, Addition and multiplication theorems of probability, Conditional probability, Binomial and multinomial theorems of probability, Baye's theorem, Mathematical expectation and its properties, Moment generating functions (m.g.f.) and cumulants.

Discrete Distributions – Binomial and Poisson distributions and their properties.

Continuous Distributions – Distribution function, probability density function (p.d.f.), Cauchy's distribution, Rectangular distribution, Exponential distribution, Beta, Gamma and Normal distribution and their proportions.

Fitting of the curves by method of least square – Straight line, parabola and exponential curves.

Correlation and Regression – Bivariate population, Meaning of correlation and regression, Coefficient of correlation, Rank correlation, Lines of regression, Properties of regression coefficients, Partial and multiple correlation and their simple properties.

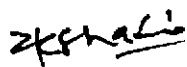
Sampling Theory – Types of population, Parameters and statistics, Null hypothesis, Level of significance, Critical region, Procedure for testing hypothesis, Type I and type II errors, Chi-square distribution and its properties.

Simple and random sampling, Test of significance for large samples, Sampling distribution of mean, Standard error, Test of significance based on chi-square, Test of significance based on t , F and z distributions, ANOVA.

Project Work & Viva Voce.

M.M. : 30/60

Every student shall choose a topic from the syllabus of Mathematics prescribed for B.Sc. I, II & III *in or around the first week of December* and shall prepare a Project comprising of, *neatly handwritten or typed*, 15 to 25 pages of A-4 size after consultation with the *subject teacher*. The first page of the Project shall consist of the name of the *College and Department, Academic Session, Title of the Project, Name of the Student* including his/her *Class and Roll No.* (if available). The project should be **signed by the student and checked by the teacher**. 10/20 marks for B.A./B.Sc. shall be for the Project and remaining 20/40 marks for viva on the Project as-well-as on the entire syllabus of Mathematics for B.A./B.Sc. I, II & III.


 Dr. V. L. S. Kumar
 Convener, Board of Studies
 in Mathematics
 C.S.J.M. University
 Kanyur

M.A./M.Sc. (Previous)

(Applicable from Academic Session 2018-19 Onwards)

Note. *There shall be 5 papers of 90 marks each and a "Project Work & Viva Voce" of 50 marks. Papers I to IV shall be compulsory and Paper V optional.*

Paper I : Real Analysis

Paper II : Complex Analysis

Paper III : Topology

Paper IV : Rigid Dynamics & Calculus of Variations

Paper V : **Optional Paper – Choose any one of the following papers :**

(a) Programming in C (with ANSI features)

(b) Differential Equations

(c) Advanced Discrete Mathematics

(d) Differential Geometry of Manifolds

(e) Mathematical Statistics

(f) Mechanics of Solids

(g) Operations Research

M.A./M.Sc. (Final)

(Applicable from Academic Session 2019-20 Onwards)

Note. *There shall be 5 papers of 90 marks each and a "Project Work & Viva Voce" of 50 marks. Papers I to IV shall be compulsory and Paper V optional.*

Paper I : Advanced Abstract Algebra

Paper II : Fluid Dynamics

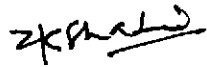
Paper III : Functional Analysis

Paper IV : Integral Equations and Boundary Value Problems

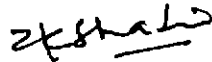
Paper V : **Optional Paper – Choose any one of the following papers :**

(a) Fundamentals of Computer Science

(b) Partial Differential Equations & Mechanics


Dr. Vinod Kumar
Convener, Board of Studies
in Mathematics
C.S.J.M. University
Kanpur

- (c) Space Dynamics
- (d) Non-linear Programming
- (e) Special Functions
- (f) General Relativity & Cosmology
- (g) Banach Algebras
- (h) Fuzzy Sets and their Applications
- (i) Wavelets
- (j) Non-commutative Rings
- (k) Theory of Linear Operators
- (l) Biomechanics
- (m) Analytic Number Theory
- (n) Algebraic Number Theory.



Dr. Vinod Kumar
Convener, Board of Studies
in Mathematics
C.S.J.M. University
Kanpur