

BIHAR MATHEMATICAL SOCIETY

BROCHURE FOR TSTMS (Junior/Senior)

Junior for Classes 6 to 12

Senior for B.Sc and M.Sc

Introduction of BMS

The Bihar Mathematical Society (BMS) was established on 01 February 1958 at Bhagalpur. The aim and objective of the society is to provide a common platform for teachers, scientists and research scholars from different parts of the country to exchange ideas for improvement in the field of Mathematics. About 700 Life Members of the society have been contributing substantially to the activities of Bihar Mathematical Society directed towards attainment of its goal. The first Journal of the society was published in 1961 while first conference of the society was held in 1970.

The Society has been conducting Talent Search Test in Mathematical Sciences (TSTMS) Junior- For classes VI to XII & (TSTMS) Senior- For B.Sc & M.Sc.

1.Aims & Objectives of the Society:

The aim of the society is to encourage and promote study and research works within India and abroad through the following methods

- I. To write, compile and publish journals, books and reports.
- II. To invite outstanding scholars to deliver memories and special lectures on their own contributions.
- III. To assist, subscribe and to cooperate with any other society having objectives similar to itself.
- IV. To establish a forum for the research workers and teachers for exchange of ideas through regular periodic meetings.
- V. To remove phobia of mathematics among students and search talented students through TSTMS examinations.
- VI. To equip the students for competitive examinations by Instructional School for Mathematical Sciences (ISMS) training of the young students and to create so much interest for the subject of mathematics.

2.Patron Members:

The Chancellor of the Universities of Bihar shall be the Ex-officio chief patron. The Vice-Chancellor of each University of Bihar shall be an Ex-officio Patron of Bihar Mathematical Society. The Heads of the Department of Mathematics/Statistics of every University of Bihar shall be an Ex-officio member of the society.

3. Editorial Board

An Editorial board is constituted to write, compile and publish journals, books and reports of Bihar Mathematical Society.

4. Conferences & Seminars:

The conference is intended to keep abreast of the latest development in the field of mathematical sciences in order to encourage and inspire the young researchers and teachers the society. The first conference of the society was held on 1970 and several seminars, workshops and training camp were held since then.

5. Journal of Bihar Mathematical Society

The Bihar Mathematical Society has been publishing its journal named as “Journal of the Bihar Mathematical Society”(JBMS) since 1961. The first Volume of Journal was released by the former Vice-Chancellor Prof. B.P Januar in 1961. The ISSN No. of the Journal is 0972-8716 .

Talent Search Test In Mathematical Sciences (TSTMS) Junior/Senior

Junior for Classes 6 to 12

Senior for B.Sc and M.Sc

Various mathematical sciences activities and outreach programmes are conducted by Bihar Mathematical Society (BMS) with the support of The Education Department, Govt. of Bihar and Bihar Council on Science and Technology (BCST) which is a wing of Department of Science and Technology, Government of Bihar to ignite & inculcate mathematical & scientific temperament amongst the students of the academic institutions as well as children of out of school system.

A brief description of Mathematical Sciences activities and outreach programmes are as given below.

The Society has been conducting Talent Search Test in Mathematical Sciences Junior for classes VI to XII and Talent Search Test in Mathematical Sciences Senior for B.Sc & M.Sc. These examinations are not merely competitions; they are the meeting places of the brightest young minds of the world. They do not lead directly to any career benefits; rather, they provide a stimulus to begin a career in mathematical sciences to undertake a lifelong journey into the realms of exciting intellectual challenges.

The Society started organizing Talent Search Test in Mathematics (TSTM) since 1993 for school going students. Since 2020, the Society in collaboration with Bihar Council on Science and Technology is organizing Shrinivasa Ramanujan Talent Search Examination (SRTSTM) for classes VI to XII.

In order to motivate young students towards Mathematical contest, Education Department, Government of Bihar & Department of Science & Technology Government of Bihar cooperate to conduct examinations & training & felicitation for the winners of the SRTSTM.

I. Objectives

The main aim of the TSTMS Examinations is to search the talent hidden among young children to motivate them towards rational thinking and learning from the earliest stage for the Mathematical contests. Such tests are sure to remove phobia of Mathematics and to make the students academically competent to appear for various competitive examinations.

We cultivate the talented

students and honour and inspire the students by awarding prizes. A training programme ISMS is conducted by subject experts periodically. The successful candidates in the merit list are called the TSTMS winners.

2. Eligibility

A candidate must be a citizen of India. A regular student of a particular class from any recognized educational institutions of India will be eligible to appear for the TSTMS examinations. All candidates are requested to carefully read the rules of the Examination notified by BMS. The Candidates applying for the examination should ensure that they fulfill all eligibility conditions for admission to Examination. The date of birth and other relevant educational certificates are required to be certified by the Principal or Head of the institution and submitted only at the time of award function and training camp. The maximum age of the applicant is determined from 31st March of the year of the exam.

Class	6	7	8	9	10	11	12	TSTMS Junior VI to XII	TSTMS Senior B.Sc & M.Sc
Max age (Years)	13	14	15	16	17	18	19	13 to 19	35

3. How to Apply:

The students are invited to directly register and enroll themselves online on official website www.bmsbihar.org of BMS. Detailed instructions for filling up online applications are available on the above mentioned website. The applicants must ensure that while filling their application form, they are providing their valid and active E-mail Id and mobile number as the society may use electronic mode of communication while contacting them. The applicants are advised to check their emails at regular intervals.

4. Examination Pattern:

It is objective type test with a duration of one hour comprising 25 questions. In case there are too many applicants the society may decide to subjective test of two hours duration of two hours comprising 10 questions.

5. Results:

The result of TSTMS are declared on the official website www.bmsbihar.org of Bihar Mathematical Society.

6. Medals and Certificates:

Top three rank holders in each class will be entitled to be awarded Gold, Silver and Bronze medals along with cash prizes and remaining winners will be entitled to be awarded cash prizes with certificate of excellence. Any Institution/Person actively contributing in organising the TSTMS will be awarded certificate of contribution for their co-operation.

5. Registration Fee:

The candidates will not have to pay registration fee for the Examination of TSTMS.

6. Examination Centres:

TSTMS Examination will be conducted at certain specified towns of Bihar. However, it may also be conducted in other towns provided the number of participants in that town is not less than 1000. They will be required to appear at Patna centre or nearby home district. The centres and the date of holding the examination as mentioned BELOW are liable to be changed at the discretion of the Society..

7. Programme Scheduled:

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|---|-------------------------|
| 1. Last date for submission of application form | 18 Dec 2023 |
| 2. Admit card available for examinations | 25-31 Dec, 2023 |
| 3. Date of Examination | 9 Jan & 10 Jan 2024 |
| 4. ISMS training camp | 01 June to 30 June 2024 |

8.Syllabus

The Syllabus OF THE TSTMS can be obtained from our Website on www.bmsbihar.org.

9.Examination Board:

An examination board is constituted to conduct the examinations of TSTMS. A controller of Examination including board of examination will look after all academic activities and examinations.

ISMS Training Programme

The Instructional School for Mathematical Sciences (ISMS) training is intended to provide an orientation program to the students of classes 6 to 12 and for B.Sc & M.Sc. The instructional school is planned to expose young minds to the excitement of higher mathematical pursuit and enable them to have a meaningful career in it. The teaching methodology in the training camp will be fundamentally different from regular classrooms. The participants will be asked to think and prove mathematical result on their own at every stage. Additionally with the intention to build the culture of holistic development of an individual's mind, body, and soul, several sessions on various outdoor and indoor games, practicing yoga, cultural activity and meditation etc. will be conducted.

The programme will be funded by the Education Department, Govt. of Bihar. The emphasis will be on learning mathematics by doing it.

1.Objectives:

The objective of the training is to instill scientific temper, develop interest, computational thinking and competitive mindset in students. The ISMS training of 30 days is involving intensive problem-solving camp to help students prepare for Olympiads and different competitive examinations. Moreover, it aims at motivating students to develop interest into higher mathematical Science and related career in it.

2. Pedagogical Approach:

The training camp is not to give routine lectures but to stimulate the participants to think, learn and analyze mathematics and science on their own and expose students to the excitement of doing mathematical and scientific research.

3. About Organising Bodies

This programme is being organized jointly by the Bihar Mathematical Society (BMS) and Education Department, Govt. of Bihar.

4.Programme Structure and Outline

The Camp will be held for 30 days. There will be two sessions conducted on the first afternoon. In the first session, participants begin with morning exercise and breakfast followed by two periods of classroom teaching. After lunch, mathematics classroom teaching will be held in the first period and the second period is tutorial classes and group discussions with recreational mathematics. Every day there will be two sessions of 4 periods of 01:30 hour duration for each of 4 levels followed by rigorous discussion and seminars, yoga, cultural and other activities.

5.Resource Persons

The faculty members for this programme will be reputed Mathematicians from different IITs/NITs besides some other elite institutions across the country. Teachers of this programme will act as Mentors (Subject Matter Experts). This would facilitate intense interaction between students and instructors giving closer attention to all the students. The role of the faculty will be to raise relevant questions to keep the students on the right track while leaving them to solve the problems on their own.

Those interested to be partner in the endeavour and willing to spend as Mentors every year during the conduct of the programme are welcome to join the Registry in a given format.

6.Syllabus for Camp

Topic to be covered

Lecture Code	Lecture Hours	Topics for Class VI to VIII
A1	03	Properties of real numbers, HCF and LCM, Divisibility rules
A2	02	Exponents and Powers, Digit at Unit and tens place in the power of positive integers
A3	03	Squares and Square Roots, Cubes and Cube Roots, Properties of factorial
A4	01	Expert Lecture
A5	03	Fraction and Decimals, Comparing Quantities, Ratio and Proportion, Reflection and Symmetry
A6	04	Simple and Compound Interest, Time and Distance, Work and Time
A7	01	Expert Lecture
A8	04	Algebraic Expressions and Identities, Linear equations and in-equations
A9	04	Line segment, Parallel lines, Polygons, The Triangles and its properties
A10	03	Quadrilaterals, Circle.
A11	03	Mensuration, Perimeter and Area of Triangle, Rectangle, Parallelogram, Trapezium, Rhombus, Square
A12	02	Cube and Cuboid
A13	01	Expert Lecture
A14	03	Elementary properties of Sets, Union, Intersection, Venn Diagram
A15	01	Expert Lecture
A16	03	Probability of Random experiments, Sample space, Events, the simple problems of single events
A17	03	Data Handling, Mean, Median, Mode and their Simple Properties

Lecture Code	No. of Lectures	Topic for Class XI and XII
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C01	1	Complex Numbers and their properties
C02	3	Sets and their properties, Subsets, Power Set, Union, Intersection, Complements of a set, Relations and functions, congruence modulo m, Relations and Functions, Equivalence Relations, Binary Operation
C03	2	Quadratic Equations and Expressions, Partial Fraction, Binomial Theorem
C04	1+1	Sequences and Series (A.P., G.P. and H.P.)
C05	2	Matrices and Determinants, Inequalities
C06	2	Functions, Limits, Continuity of a Function, Differentiation including Chain Rules
C07	3	Application of Derivatives, Tangent and Normal, Mean value theorem, Maxima and minima
C08	2	Integrals, Definite integrals. properties of definite integrals, Application of Integrals (area bounded by curve)
C09	3	Differential Equations of first degree and first order, order and degree, formation of differential equations, application of differential equations
C10	1	Coordinate Geometry of Straight Lines, Conic Sections of Circle, Parabola, Ellipse and Hyperbola
C11	2	Trigonometrical identities, Graphs, Conditional Identities, Trigonometrical Equations
C12	1	General solutions of trigonometrical equations, Properties of Triangles, Logarithms, Inverse Trigonometric Functions
C13	2	Simple Permutations and Combinations
C14	2	Vector Algebra, Scalar and Vector products of two and three vectors
C15	2 +1	Introduction to 3-D Geometry of Distance Formulae, Section Formulae, Direction Cosines and Ratios, Plane, straight lines, shortest distance between two lines
C16	2 + 1	Probability, Addition theorem, Multiplication theorem, Conditional probability, Probability of Different type Events Mutually Exclusive and Independent Events, Bayes' Theorem, Random variable, Expectations, Probability Distribution and Binomial Distribution
C17	2	Statistics (Measure of dispersion), Mean Deviation, Variance and Standard Deviation
EL	2(combined)	Expert Lecture

BIHAR MATHEMATICAL SOCIETY

The Syllabus has been designed in accordance with National curriculum framework CBSE, ICSE, State Board and competitive Examinations. The objectives of teaching mathematics at senior school stage intend to help the students to acquire knowledge and critical understanding.

Talent Search Test in Mathematical Sciences (TSTMS Junior)

Syllabus (Class VI-XII)

Class-VI

Number system, Factors and Multiples, Test of divisibility of numbers, HCF and LCM, Decimals and Fractions, Unitary Method, Elementary Properties of Factorial.

Mensuration, Parameter and Area of simple curve.

Algebraic equations and Expressions, Ratio and Proportion, Percentage and their applications, Symmetry, Making symmetry figures, Reflection and Symmetry. Geometry, Understanding Elementary Shapes of 2 and 3 dimensions, Line segment, Parallel lines, Polygons, The Triangles and its properties, Quadrilaterals, Circle.

Data Handling.

Class-VII

Elementary properties of real numbers, LCM and HCF, Divisibility rules, Fractions and Decimals, Exponents and Powers, Digit at Unit and tens place in the power of positive integers, Identities, Comparing Quantities, Percentage, Profit and Loss, Simple interest.

Algebraic Equations and Expressions, Law of indices, Exponential Equation. Visualising of Solid Shapes, Lines and Angles, The Triangle and its Properties, Symmetry, Congruence of Triangles, Quadrilaterals, Polygons, Circles.

Perimeter and Area of Triangle, Rectangle, Parallelogram, Trapezium, Rhombus, Square, Cube and Cuboid.

Data Handling, Arithmetic Mean, Median and Mode.

Simple Trigonometrical identities and their properties.

Basic concept of Probability.

Class-VIII

Properties of real numbers, LCM and HCF of polynomials, Squares and Square Roots, Cubes and Cube Roots, Exponents and Powers, Comparing Quantities.

Percentage, Simple and Compound Interest, Discount and Partnership, Time and Distance, Work and Time.

Algebraic Expressions and Identities, Linear equations and inequations. Plane, Lines, Angles, Triangles, Congruence, Quadrilaterals, Circles Constructions,

Mensuration, Visualising Solid Shapes, Circle, Cone, Sphere, Cube and Cuboids Direct and Inverse Proportions, Factorisation, Introduction to Graphs.

Data Handling, Mean, Median, Mode and their Simple Properties.

Basic concept of Probability.

Elementary properties of Sets, Union, Intersection, Venn Diagrams, ordered pairs.

Class-IX

Number Systems, Prime and Composite numbers, Surds and rationalisation of surds, Congruence, Fermat and Wilson theorem, Pythagorean triads, Polynomials, Algebraic expression and identities, Linear Equations in Two Variables, Graph of linear equations

Coordinate Geometry, Coordinate of a point, Distance formula, Section formula, Area of Triangle and Quadrilateral.

Introduction to Euclid's Geometry, Lines and Angles, Triangles, Congruent triangle, Condition of similar triangles, Quadrilaterals, Constructions.

Properties of Polygons, Mensuration, Areas of Parallelograms and Triangles, Heron's Formula, Area of Cyclic quadrilateral, Surface Areas and Volumes of cube, cuboid, cylinder, cone, sphere and Circle.

Introduction of Statistics, Graphical representation of statistical data, Mean, Median of ungrouped data.

Trigonometrical identities and their Properties, Logarithm.

Definition of probability, Terms of probability.

Class-X

Real and Complex Numbers, Polynomials, Pair of Linear Equations in Two Variables, Quadratic Equations and Expressions, Arithmetic Progressions. Concepts of Coordinate Geometry, Straight Lines, Pair of Straight Lines.

Trigonometrical Ratio, compound angles, Multiple angles and Submultiple angles, Conditional Identities, Height and distance.

Geometry of triangle, Circles, Constructions, Mensuration, Areas related to Circles, Surface Areas and Volumes of Cylinder, Cone and Sphere.

Introduction of Statistics, Basic concepts of Mean, Median, Mode, Histograms and Ogive.

Probability of Random experiments, Sample space, Events, simple problem of single events.

Class-XI

Sets and their properties ,Subsets, Power Set, Union, Intersection, Complements of a set, Relations and functions.

Principle of Mathematical Induction, Complex Numbers, Quadratic Equations and Expressions, Partial Fraction, Binomial Theorem, Multinomial theorem, Linear Inequations, Sequences and Series (A.P, G.P and H.P), Combinatorics-Simple Permutations and Combinations, Pigeon Hole Principle (PHP).

Trigonometry, Domain and range of trigonometrical functions, Graphs, Conditional Identities, Trigonometrical Equations, General solutions of trigonometrical equations, Properties Triangles, Logarithms.

Coordinate Geometry of Straight Lines, Conic Sections of Circle, Parabola, Ellipse and Hyperbola.

Statistics (Measure of dispersion), Mean Deviation, Variance and Standard Deviation.

Functions, Limits, Continuity of a Function, Differentiation including Chain Rules, Application of Derivatives, Probability, Addition theorem, Multiplication theorem, Conditional probability.

Introduction to 3-D Geometry of Distance Formulae, Section Formulae, Direction Cosines and Ratios, Plane.

Indefinite Integration, Transformation rule of integration.

Class-XII

Number Theory, congruence modulo m , Relations and Functions, Equivalence Relations, Binary Operation, Inverse Trigonometric Functions.

Matrices and Determinants, Inequalities.

Continuity and Differentiability, Application of Derivatives, Tangent and Normal, Mean value theorem, Maxima and minima Integrals ,Definite integrals. properties of definite integrals, Application of Integrals (area bounded by curve) Differential Equations of first degree and first order, order and degree, formation of differential equations, application of differential equations.

Vector Algebra, Scalar and Vector products of two and three vectors.

Three dimensional geometry of plane and straight lines, shortest distance between two lines.

Probability of Different type Events, Mutually Exclusive and Independent Events, Addition and Multiplication theorem, Conditional Probability, Bayes' Theorem, Random variable, Expectations, Probability Distribution and Binomial Distribution.

Formation of Linear Programming Problem and their Solution by Graphical Method.

BIHAR MATHEMATICAL SOCIETY

SYLLABUS

(B. Sc , M. Sc, UPSC, NET, GATE & IIT JAM)

Candidates can download the syllabus on www.bmsbihar@gmail.com.



1.Linear Algebra:

Foundation Stage-Vector spaces over \mathbb{R} and \mathbb{C} , linear dependence and independence, subspaces, bases, dimension, linear transformations, rank and nullity, matrix of a linear transformation.

Matrices, operations of matrix algebra, Kinds of matrices, Transpose adjoint and inverse of the matrix, Product of determinants, row and column reduction, echelon form, Rank and inverse of matrix, Symmetric and skew-symmetric, Hermitian and skew-Hermitian, orthogonal and unitary matrices, congruence and similarity, Solutions of consistent Systems of Linear equation by Cramer's rule.

Second stage-eigenvalues and eigenvectors, characteristic polynomial, Cayley-Hamilton theorem, Matrix representation of linear transformations, Jordan canonical forms, diagonal forms, inner product space, Gram-Schmidt orthonormalization process, self adjoint operator, orthonormal basis, triangular forms, Jordan forms, Quadratic forms, bilinear and quadratic forms.

2.Calculus

Foundation Stage- functions, limits, continuity, differentiability, indeterminate forms, successive differentiation, partial derivatives, Leibnitz theorem, Total derivatives, , mean value theorem, Tangent and Normal, Curvature, Taylor's theorem with remainders, asymptotes; curvature.

Integration of rational and irrational, Function notion of integral as limit of sum, evaluation of definite integrals, reduction formulae, curve tracing, Areas of curves, Length of curves, Volumes and surface areas of solids of revolution.

Second stage-functions of two or three variables, maxima and minima, Lagrange's method of multipliers, Beta and Gamma functions, Jacobian, Fundamental theorem of integral calculus, double and triple integrals, Dirichlet's and Liouville's theorem, Change of order of integration, Differentiation under sign of integration and integration under sign of integration, Areas, surface area using double integral and volumes using triple integral.

3. Analytic Geometry:

Foundation Stage-Family of straight lines and circles, Standard equation of Parabola, Ellipse and Hyperbola, General equation of second degree, Transformation of rectangular axes.

Cartesian and polar coordinates in three dimensions, second degree equations in three variables, reduction to canonical forms, plane, straight lines, shortest distance between two skew lines.

Second stage- General equation of conics and its reduction to normal form, Equation of tangent and normal at a point of conics, equation of chord of contact, pair of tangents and director circle, Polar equation of conics and their properties.

Sphere, Cone, Cylinder, Paraboloid, Ellipsoid, Hyperboloid of one and two sheets and their properties.S

4. Ordinary Differential Equations:

Foundation Stage-Formulation of differential equations, equations of first order and first degree, integrating factor, Bernoulli's equations, orthogonal trajectory; equations of first order but not of first degree, Clairaut's equation, singular solution, Second and higher order linear equations with constant coefficients, complementary function, particular integral and general solution.

Second stage-Second order linear equations with variable coefficients, Homogeneous Equation Higher order, Variation of Parameter, Euler-Cauchy equation; Method of Laplace transformations for solving ordinary differential equations, Power series, Legendre and Bessel functions and their orthogonal properties, Frobenius method, determination of complete solution, Application to initial value problems for second order linear equations with constant

coefficients, variation and parameters, Sturm-Liouville boundary value problems, Green function.

5. Vector Analysis and Vector Calculus:

Foundation Stage-Scalar and vector fields, Dot and Cross product of two vectors, Scalar triple product of vectors, Vector product of three and four vectors, vector identities and vector equations, Applications of vectors in mechanics.

Second stage-Differentiation of vector field of a scalar variable, Gradient, Divergence and Curl in cartesian and cylindrical coordinates, higher order derivatives, line integrals, surface integrals, Green, Stokes and Gauss theorems.

6. Theory of equations:

Foundation Stage- Division algorithm, greatest common divisors, polynomials, division algorithm derivative, integral, rational, real and complex roots of a polynomial relation between roots and coefficients, repeated roots, elementary symmetric function, fundamental theorem of algebra.

Second stage- Evaluation of symmetric functions of roots of cubic and biquadratic equations, solutions of cubic equation by Cardon's method, solution of biquadratic equations by Euler's method, Descartes rule of signs.

7. Hydrostatics:

Foundation stage-Pressure at a point, Equilibrium of fluids under given system of force. centre of pressure, Equilibrium of floating bodies.

8. Topology:

Foundation Stage-Metric spaces and their basic properties, open sphere, open set, neighborhoods, closed set, accumulation point, closure and interior, convergence of sequence in a metric space and their properties, Cauchy sequence and complete metric space, continuous mappings, Compactness and their basic properties , finite intersection property, Normed linear space.

Second stage- Definition and examples of topological space, closed set, closure, Dense subset, Derived set, Bases and sub-spaces, Continuity of functions and homeomorphism, separation axiom T_0 , T_1 , T_2 spaces their characteristics and basic properties, connectedness.

9. Set Theory

Foundation Stage- Set, Subsets, Power Set, Algebra of Sets, De Morgan's Laws, Cartesian Product of sets, relation, equivalence relation, Definition and examples of partial and total order relation, Countable and uncountable sets, Countability of rational, Real And algebraic number system, Countability of unions.

Second Stage-Equivalence relation induced by a partition of a set, Fundamental theorem of equivalence relation, Composition and factorization of mapping, set mapping, countability of rational, real and algebraic number system.

10. Probability

Foundation stage-Event, Probability of an event, sample space, probabilities a finite sample space, Mutually exclusively events and complementary events, independent events, conditional probability, multiplication theorem, theorem of total probability, Bayes theorem and independents of events.

Second stage-Random variables and their probability functions. Mathematical expectation and moment of a random variable, Mean absolute deviation, variance, standard variation, Chebyshev's theorems for a probability distribution and frequency distribution of measurements.



1. Algebra:

Foundation Stage- Binary operation, Notions of group, Abelian group with examples, groups, subgroups, cyclic groups, cosets, Lagrange's theorem, normal subgroups, quotient groups, homomorphism of groups, automorphism, basic isomorphism theorems, Centre, Normalizer, Conjugacy, class equation, Commutator and commutator sub group

Rings, integral domains, subrings and ideals, integral domain, division ring, polynomial ring, field and their examples.

Second stage-Permutation groups, Cayley's theorem, Sylow theorems, homomorphisms of rings, Isomorphism, Kernel of a ring homomorphism, quotient rings, Fundamental theorem of homomorphism rings, imbedding of a ring and integral domain in a field, characteristics of a field, polynomials over commutative ring, unique factorization domain, principal ideal domains, Euclidean domain, polynomial rings, finite fields, field extension, Galois theorem.

2. Real Analysis:

Foundation Stage-Real number system as an ordered field with least upper bound property, Dedekind's theory of real numbers, Cantor's construction of real numbers, properties of real numbers sequences, limit of a sequence, Cauchy sequence, completeness of real line, Monotonic function, Continuity and uniform continuity of functions, properties of continuous functions on compact sets.

Infinite series and their convergence, Comparison test, Cauchy root test, Raabe's test, Cauchy condensation test, Integral test, Leibnitz's test, Gauss Test, Kummer's test, de Morgan and Bertrand's test, absolute convergence and rearrangement of series, Pringsheim's theorem, Cauchy's multiplication of series and its convergence.

Second stage-Riemann sum and Riemann integral, Improper integral, convergence of an improper integral, comparison tests, fundamental theorems of integral calculus. Uniform convergence of sequence and series of functions, Weierstrass M-test, uniform convergence and continuity, Dini's test, Abel's test, Dirichlet's Test, Uniform convergence and integration, Uniform convergence and differentiation, Weierstrass sequence and series of functions and their pointwise convergence, continuity, differentiability and integrability for sequences and series of functions, Inverse and Implicit theorems, maxima and minima, Ascoli-Arzelà theorem, Contraction mapping principle.

3. Complex Analysis:

Foundation Stage-Algebra of complex numbers, Continuity, Differentiability, Analytic functions, Cauchy-Riemann equations, Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Morera's theorem, Taylor's series, Laurent's series.

Second stage-Calculus of residue, singularities; Isolated singularity, meromorphic function, Argument Principle, Schwartz lemma, open mapping theorem, Cauchy's residue theorem, Rouché's theorem, fundamental theorem of algebra, contour integration, power series representation of an analytic function, Möbius transformation, Conformal mappings.

4. Operation Research:

Foundation Stage-Linear programming problems, basic solution, basic feasible solution and optimal solution; graphical method, convex set, simplex method of solutions.

Second stage-Revised simplex method, Infeasible and unbounded linear programming problem, Big-M Method, Two phase method, duality, transportation, assignment problems, Game theory, two person-zero sum games with mixed strategies, Sequencing, Replacement model, Kuhn-Tucker condition for constrained optimization, Wolfe's and Beale's methods, Queuing theory, Poisson probability law, Distribution of inter arrival time, Distribution of time between successive arrivals.

5. Partial differential equations:

Foundation stage-Family of surfaces in three dimensions and formulation of partial differential equations, solution of quasi-linear partial differential equations of the first order.

Second stage- Linear partial differential equations of the second order with constant coefficients, Lagrange's and Charpit's methods for solving first order solving PDEs, Cauchy's problem for first order PDEs, Monge's Method, Method of separation of variables for Laplace, Heat and wave equations.

6. Numerical Analysis:

Foundation Stage-Finite differences, Newton's forward and backward interpolation, Lagrange's interpolation, Hermite and spline interpolation, Numerical methods, solution of algebraic and transcendental equations of one variable by bisection, Secant method, iteration method, order of convergence, Regula-Falsi method, Newton-Raphson methods.

Second stage-Solution of system of linear equations by Gaussian elimination and Gauss-Jordan (direct), Gauss-Seidel (iterative), Relaxation Method, Numerical integration, Trapezoidal rule, Simpson's rules, Gaussian quadrature formula. Numerical solution of ordinary differential equations, Euler, Modified Euler and Runge Kutta-methods, Picard's method.

7. Fluid Dynamics:

Foundation stage- Lagrangian and Eulerian methods, Equation of continuity, Euler's equation of motion for inviscid flow, Stream-lines, path of a particle, Potential flow, irrotational and rotational motions, Sources and sinks, vortex motion.

Second Stage-Navier-Stokes equation for a viscous fluid, Bernoulli's theorem, equation of motion by flux method, equation referred to moving axis, impulsive actions.

8. Functional Analysis:

Foundation Stage- Complex linear space, normed linear space, completion of a normed linear space, quotient space of normed linear space, Banach space and their definition, properties and examples.

Second stage- Inner product space and Hilbert space and their properties and examples, Orthonormal bases, projection theorem, Riesz representation theorem, spectral theorems for self adjoint operators, Cauchy Schwartz inequality, parallelogram law and polarization identity, Hahn-Banach theorem on real linear space, Open mapping theorem and closed graph theorems, Principle of uniform boundness.

9. Statistics

Mean, Variance and standard deviation of random variables, Binomial, Poisson and Normal distributions, Correlation and linear regressions.

10. Mechanics

Foundation course- Coplanar force of system, Condition for equilibrium of particles, Equipollent force system, Reduction of a force system to a force and a couple, Work and Energy principle, Equation of the resultant Principle of virtual work in two dimension

Uniformly accelerated motion, Dynamics S.H.M. Simple Pendulum, Elastics String and springs, Hook's Law, vertical and horizontal vibrations of a particle attached to an elastic strings, Components of velocities and acceleration, Cartesian, radial and transverse, tangential and normal.

Second Stage- stable equilibrium, Energy test for stability, Catenary Poinot's central axis pitch, Null lines, Euler's theorem on displacement of a rigid body with one fixed point, displacement of a rigid body, Motion about a fixed point, angular velocity and linear velocity, General motion of a body, Principle of linear momentum, angular momentum and energy for a rigid body, D'Alembert's principle of general equations of motions of rigid body.

Projectile motion in non-resisted medium, Motion of a particle under central force, Differential equation of central orbit in polar and pedal forms Newton's law of gravitation and planetary orbit, Kepler's laws, Moment of inertia, Parallel axes and perpendicular axes theorem.

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