DETAILS OF ENTRANCE TEST- 2016

Name of the Faculty: Natural Sciences

Department/Centre: Department of Mathematics

Name of the Program: M. A./M.Sc. Mathematics (Self financed)

About Program's Prospects: The students who are serving as TGTs prefer the course to enhance their qualification for their promotion as PGTs and to move towards higher education through NET or Ph.D.

Summary of Entrance Test

S.No	Test-Component	Test Duration (minutes)	Max. Marks	Passing Marks	Negative Marking (Yes/No)
1.	Multiple Choice Questions	105	100		Yes

Any Other Information about the Entrance Test:

Important Instructions for Test:

Permissible material /equipment for Entrance Test (as required):

- Black/Blue Ball Pen,
- Calculator
- Pencil

Detailed Syllabus for the Entrance Test

Attached

B.Sc./B. A. (Hons.) 1st Year

Papers	Theory	Practical	Total
Calculus and Differential Equations	100	-	100
Geometry of Two and Three Dimensions	100	-	100

B.Sc.(H)/ B.A.(H) Mathematics Part I

Paper 1 : Calculus and Differential Equations

Unit I. ε-δ definition of the limit of a function. Algebra of limits. Continuous functions and classification of discontinuous functions. Differentiability. Successive differentiation. Leibnitz theorem. Rolle's theorem. Mean Value theorems. Taylor's theorem with Lagrange's and Cauchy's form of remainder. Taylor's and Maclaurins's series of elementary functions.

Unit II. Indeterminate forms. Curvature. Cartesian, polar and parametric formulae for radius o curvature. Partial derivatives. Euler's theorem on homogeneous functions.

Unit III. Asymptotes. Test for concavity and convexity. Points of inflexion. Multiple points. Tracing of curves in Cartesian and polar coordinates.

Unit IV. Reduction formulae. Quadrature. Rectification. Intrinsic equation. Volumes and surfaces of solids of revolution.

Unit V. Order and degree of a differential equation. Equations of first order and first degree. Equations in which the variables are separable. Homogeneous equation. Linear equations and equations reducible to linear form. Exact differential equations. Clairaut's form and singular solutions. Linear differential equations with constant coefficients

Unit VI. Homogeneous linear differential equations. Second order linear differential equations (exact. Normal and variation of parameters). Systems of linear differential equations.

Books Recommended

1. Shanti Narayan,
   (I) Differential Calculus
   (II) Integral Calculus
2. T.R. Prabhakar,
   (I) Differential Calculus
   (II) Ingegrated Calculus
3. D.A. Murray.
   Introductory Course in Differential Equations,
   Orient Longman (India). 1967
4. Zafar Ahsan,
   Differential Equations and their applications.
   Prentice Hall. 2001

5. Erwin Kreyszig,
Advanced Engineering Mathematics,
John, WILEY AND SONS.1999

B.Sc. (H)/ B.A. (H) Mathematics Part I

Paper II: Geometry of Two and Three Dimensions

Unit I. Conic sections. General equation of second degree. Pair of lines. Lines Joining the origin to the points of intersection of a curve and a line. Equation of parabola in standard and parametric form. Tangent. Normal pole and polar and their properties.

Unit II. Equations of ellipse and hyperbola in standard and parametric forms. Tangent Normal. Pole and polar and their elementary properties. Conjugate diameters. Asymptotes. Conjugate hyperbola and rectangular hyperbola.

Unit III. Polar Equation of a conic. Polar equation of tangent, normal, polar and asymptotes. Tracing of parabola, ellipse and hyperbola.

Unit IV. Equation of plane. Pair of planes. Equations of a line. Line and plane. Shortest distance.

Unit V. Equation of sphere. Tangent plane, plane of contact and polar plane. Intersection of two spheres. Radical plane. Coaxial spheres. Conjugate systems. Equation of cone. Intersection of Cone with plane and a line. Enveloping cone. Right circular cone.

Unit VI. Equation cylinder. Enveloping and right circular cylinders. Equations of central conicoids. Tangent plane. Normal. Plane of contact and polar plane. Enveloping cone and enveloping cylinder. Conjugate diameters and diameters planes. Equations of paraboloids and its simple properties.

Book Recommended:

1. P.K. Jain and Khalil Ahmad,
   Analytical Geometry of two Dimensions,
   New age International (P) Ltd, New Delhi, 1986
2. P.K. Jain and Khalil Ahmad,
   Analytical Geometry of Three Dimensions,
   New Age International (P) Ltd., New Delhi, 1991
3. R.J.T. Bell,
   Elementary Treatise on Co-ordinate Geometry of Three Dimensions,
   Machmillan India Ltd., 1994.
4. Ram Ballabh,
   A Textbook of Co-ordinate Geometry.

B.Sc./B. A. (Hons.) 2nd Year

Papers	Theory	Practical	Total
Functions of Several Variables & Complex Trigonometry	100	-	100
Abstract Algebra	100	-	100

B.Sc.(H)/ B.A.(H) Mathematics Part II

Paper III : Functions of Several Variables and Complex Trigonometry

Unit I. Functions of several variables. Domains and Range. Functional notation, Level curves and level surfaces. Limits and continuity. Partial derivatives. Total differential. Fundamental lemmas. Differential of functions of n variables and of vector functions. The Jacobian matrix. Derivatives and differentials of composite functions, the general chain rule.

Unit II. Implicit functions. Inverse functions. Curvilinear co-ordinates. Geometrical Applications. The directional derivatives. Partial derivatives of higher order. Higher derivatives of composite functions. The Laplacian in polar, cylindrical and spherical co-ordinates. Higher derivatives of implicit functions. Maxima and minima of functions of several variables.

Unit III. Introduction. Vector fields and scalar fields. The gradient field. The divergence of a vector field. The curl of a vector field. Combined operations. Irrotational fields and Solenoidal fields. Double integrals, triple integrals and multiple integrals in general. Change of variables in integrals. Arc length and surface area.

Unit IV. Line integrals in the plane. Integrals with respect to arc length, Basic properties of line integrals. Line integrals as integrals of vectors. Green's Theorem. Independence of path, Simply connected domains, Extension of results to multiply connected domains. Line Integrals in space. Surfaces in space, orientability. Surface integrals. The divergence theorem. Stokes's theorem. Integrals independent of path.

Unit V. Curves in space, parametric representation. Arc length and natural parameter. Contact of curves. Tangent to a curve. Osculating plane. Principal normal. Binomial. Expression for t, n and b in generalized parameter. Curvature and torsion. Serret Frenet Formulae. Helices. Fundamental theorem for space curves.

Unit VI. De Moivre's theorem and its applications. Expansion of $\sin n$, $\cos n$ and $\tan n$. Separation into real and imaginary parts. Summation of series based on C+iS method.

Books Recommended:

1. Wilfred Kaplan, Advanced Calculus.
   (Chapter 2:@1-12, 14-19 Chapter 3:@1-6, Chapter 4:@4-9, Chapter 5:@1-13), Adisson-Wasley Publishing Company, 1973.
2. E. Swokowski,
   Calculus with Analytic Geometry,

Prindle, Weber & Schmidt, 1984.

3. E. Kreyszig,
   Advanced Engineering Mathematics,
   John Wiley and Sons, 1999.
4. David Widder,
   Advanced Calculus, Prentice-Hall of India, 1999
5. S.L. Loney, Trigonometry Part II,
   Macmillan and company, London.

B.Sc.(H)/ BA.(H) Mathematics Part II

Paper IV: Abstract Algebra

Unit I Sets. Relations. Functions. Binary operations. Groups and its elementary properties. Subgroups and its properties. Cyclic groups. Cosets. Lagrange's theorem. Normal subgroups and factor groups.

Unit II Group homomorphism. Isomorphism. The isomorphism theorems. Permutation groups. Even and odd permutations.Alternating group. Cayley's theorem.

Unit III Automorphism. Inner Automorphism. Normaliser. Centre of a group. Conjugate classes. Class equation of a finite group and its applications. Sylows theorm and its applications.

Unit IV Rings and its elementary properties. Integral domains. Fields. Field of quotients. Subrings. Ideals. Quotient rings.

Unit V Homomorphism of rings and its properties. The isomorphism theorems. Rings of Polynomials. Some properties of R[X]. The division Algorithm. Roots of polynomials.

Unit VI Euclidean domain. Principal ideal domain. Unique factorization domain.

The following books are suitable:

1 J.B.. Fraleigh : A first course in Abstract (Relevant portion)
2 I.N. Herstein: Topics In Algebra (Relevant portions)
3 Qazi Zameeruddin and Surjeet Singh. Modern Algebra ,Vika Publications(Relevant portion)
4 N. Jacobson: Basic Algebra Vol I & II (2nd Edition). W.H. Eresma, N. Y. 1989

Reference Books:

1 Michael Artin: Algebra
2 N.S. Gopalakrishan: Universitv Algebra.
3 D.S. Malik,J.N. Mordeson and M.K. Sen. Fundamentals of Abstract Algebra, McGraw Hill-International Edition 1997

Note: This course is aimed at introducing and emphasizing to students computational techniques of functions of several variables rather than proving tedious theorems.

B.Sc./B. A. (Hons.) 3rd Year

Papers	Theory	Practical	Total
Real Analysis	100	-	100
Linear Algebra	100	-	100
Mechanics	100	-	100
Metric Spaces, Complex Analysis and Partial Differential Equations	100	-	100
Mathematical Statistics and Operational Research	100	-	100
Programming in C and Numerical Analysis	75	25	100

B.Sc.(H)/ BA.(H) Mathematics Part III

Paper V: Real Analysis

Unit I. Elements of Point-Set Theory

Introduction (addition, multiplication, and order in the set of real numbers and their properties). Bounded and unbounded sets. Infimum and supremum of a set and their properties. Countable and uncountable sets. Order completeness in R. Open set. Neighborhood. Interior of a set. Limit point of a set. Closed set.
Bolzano-Weirstrass theorem.

Unit ll. Real Sequences

Sequence of real numbers, convergent and non-convergent sequences. Cauchy's general principle of convergence. Algebra of sequences. Theorems on limits of sequences. Monotone sequences.

Unit III. Infinite Series

Infinite series and its convergence. Test for convergence of positive term series. Comparison Test. Ratio Test. Cauchy's Root Test. Raabe.s Test. Logarithmic Test, Integral Test. Alternating series. Absolute and conditional convergence. Product of two absolutely convergent series. Cauchy's product of two series one of
which is absolutely convergent.

Unit IV. Riemann Integration

Definition, existence and properties of Riemann integral of a bounded function. Darboux's Theorem. Condition of integrability. The integral as the limit of the sums. Properties of Riemann Integral. The fundamental theorem of calculus. Mean-value theorem of integral calculus. Integration by parts. Change of variables. Second mean-value theorem.

Unit V. Uniform Convergence

Definition of pointwise and uniform convergence of sequences and series of functions. The Cauchy's criterion for uniform convergence. Weirstrass M-test. Uniform convergence and continuity.Uniform convergence and Riemann integration. Uniform convergence and differentiation.

Unit VI. Improper Integrals

Definition of improper integrals. Convergence of improper integrals. Comparison test.Cauchy's test for convergence. Absolute convergence. Beta and Gamma functions and their properties.

Recommended Books

1. S.C, Mallick : Mathematical Analysis; Wiley Eastern Ltd (1991).
2. T.M. Apostal : Mathematical Analysis; Addison Wesley Series in Mathematics (1974)
3. C. Goffman : Introduction to Real Analysis; Harper International Edition, Harper and Row ,York, Tokyo (1967).

B.Sc.(H)/ BA.(H) Mathematics Part III

Paper VI: Linear Algebra

Unit I. Linear Systems and Gaussian Elimination
Linear systems. Matrix representation of linear systems. Gaussian-Jordan elimination. Homogeneous linear systems. Row echelon form and the General solution. Row rank of a matrix and solution sets of homogeneous linear systems and general linear systems. Elementary matrices.

Unit II. Vector Spaces
Definition, examples and basic properties. Subspaces. Linear independence. Linear combinations and span. Basis and dimension. Sum and intersection of subspaces. Direct sum of subspaces.

Unit III. Linear Transformations
Definition and examples. Properties of linear transformations. Rank and kernel. The rank and nullity of a matrix. The matrix representation of a linear transformation. Change of basis. Isomorphism.

Unit IV. Orthogonality in Vector Spaces
Scalar products in Rn and Cn. Complex matrices and orthogonality in Cn. Inner product spaces. Orthogonality in inner product spaces. Normed linear spaces. Inner product on complex vector spaces. Orthogonal complements. Orthogonal sets and the Gram-Schmidt process. Unitary matrices.

Unit V. Eigenvalues and Eigenvectors
Eigenvalues and eigenvectors. Characteristic equation and polynomial. Eigenvectors and eigenvalues of linear transformations. Similar matrices and diagonalization. Triangolizable matrices. Eigenvalues and eigenvectors of symmetric and Hermition matrices.

Unit VI. Canonical Forms
Quadratic forms and conic sections. Quadrices. Bilinear forms. Minimal polynomials. The Caley-Hamilton theorem.

The following books are suitable:

1. Devek J.S. Robinson - A course in Linear Algebra with Applications. Chapters: 2,4,5,6,7,8.1,9
2. Steven J. Leon - Linear Algebra with Applications Chapters: 1,3,4,5,6 (Relevant portions)
3. N. Jacobson - Basic Algebra vol. 1 & 2 (2nd Edition) W.H. Freeman N.Y,1989

Reference Books

1. V. Krishnamurthy, V. P. Mainra, J. L. Arora -An Introduction to Linear Algebra
2. D. T. Finkbeiner -Introduction to Matrices and Linear Transformation
3. S. Kumaresan - Linear Algebra; A Geometric Approach Prentice Hall of India, 2000
4. Shanti Narayan : A Course of Mathematical Analysis; New S. Chand & Co. Pvt. LId.

B.Sc.(H)/ BA.(H) Mathematics Part III

Paper VII: Mechanics

Unit I

Basic Concept of Mechanics:- Fundamental laws of Newtonian mechanics. Intertial frame of reference. Particle, mass, rigid body, rest and motion and force. External and internal forces. Forces acting at a point. Triangle law of forces and polygon law of forces. Lami's theorem. Equilibrium of a system of particles. Necessary conditions for equilibrium forces.

Unit II

Moments, parallel forces, couples, moment of a force about a point and a line. Theorem of varignon. Necessary conditions for equilibrium (moment). Equilibrium of two couples. Reduction of a general plane force system, parallel force system in two and three dimensions. Friction.

Unit III

Work and Energy: Conservative field and potential energy. Principle of conservation of energy for a particle and principle of virtual work for a system of particles. Catenary (cartesian, intrinsic forms). Geometrical properties of catenary. Centre of gravity and centre of parallel forces. Centre of gravity of some simple bodies: rod, triangle, arc, plane area, surface of revolution, sum of difference of two bodies, segment of a sphere and some simple curves.

Unit IV

Components of velocity and acceleration (cartesian, radial and transverse, tangential and normal). Uniformly accelerated motion. Simple harmonic motion. Resisted motion. Harmonic oscillators. Damped and forced vibration. Elastic strings. Hooke's law. Vertical and horizontal vibrations of a particle attached to an elastic string.

Unit V

Projectile and motion in a non-resisting medium. Constrained motion on a smooth vertical circle. Simple pendulum. Collisions (direct).

Unit VI

Motion of a Particle under a central force. Derential equation of a central orbit in both reciprocal polar and pedal coordinates, Newton's law of gravitation and planetary orbits. Kepler's laws of motion deducted from Newton's laws of gravitation and vice-versa. Motion of the mass centre and motion relative to mass centre. Principle of linear momentum. Angular momentum and energy for a particle and for a system of particles. D'Alembert's principle. General theory of plane impulse.

Books Recommended :

1. Synge and Griffith : Principle of Mechanics
2 S.L. loney : Dynamics of particles and rigid bodies
3. A.S. Ramsey : Statics
4. F. Chorlton : A Text book of Dynamics
5. R.S. Verma : Statics

B.Sc.(H)/ BA.(H) Mathematics Part III

Paper VIII: Metric Spaces,Complex Analysis and Differential Equations

Unit I

Definition and examples of metric spaces. Open spheres and close spheres.Neighbourhoods.Open sets.Interior points.Limit points. Closed sets and closure of a set. Boundary points. Diameter of a set. Subspace of a metric space. Convergent and Cauchy sequences.Complete metric space.Dense subsets and separable spaces. Nowhere dense sets.

Unit II

Definition and examples of continuous functions. Characterizations of continuous functions. Uniform continuity.Isometry and homeomorphism.Compact spaces. Sequential compactness and Bolzano Weierstrass property. Continuous functions on compact sets.Connectedness.Components.Continuous functions on connected sets.

Unit III

Complex numbers as ordered pairs. Geometrical representation of complex numbers. Stereographic projection.Continuity and differentiability of complex functions. Analytic functions.Cauchy Rieman equations. Harmonic functions.Elementry functions.

Unit IV

Mapping by elementary functions. Mobius transformations.Fixed points.Cross ratio. Inverse points and critical mappings. Conformal mappings.

Unit V

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

Unit VI

Partial differential equations of second and higher orders. Classification of linear partial differential equations of second order. Homogeneous and non homogeneous equations with constant coefficients.Partial differential equations reducible to equations with constant coefficients. Monge's method.

Books Recommended:

1. P.K Jain and Khalil Ahmad: Metric Spaces , Narosa Publishing house, New Delhi,2001
2. R. V. Churchill and J. W. Brown: Complex Variables and Applications, 5th Edition, McGraw Hill, New York,1990.
3. D.A. Murray: Introductory Course on Differential Equations, Orient Longman (India), 1967.
4. I.N. Sneddon: Elements of Partial Differential Equations, McGraw-Hill Book Company,1988.

B.Sc.(H)/ BA.(H) Mathematics Part III

Paper IX: Mathematical Statistics and Operational Research

Unit I. Mathematical Statistics
Classical, relative frequency and axiomatic approaches. Basic laws of total probability and compound probability. Random variable (discrete and continuous). Mathematical expectation.

Unit II
Binomial, Poisson, normal, multi-normal, lognormal, rectangular and Cauchy distributions. Bivariate populations. Regression and correlation. Rank correlation. Least square method of fitting regression lines.

Unit III
Sampling. Random sampling. Random number. Large sample tests of means and proportion. Distributions of t, x2(chi) and F (without derivation) and tests of significance based on them.

Unit IV. Operational Research
Different types of models, their distribution and general methods of solutions. Elementary inventory and replacement models. Sequencing theory.

Unit V. Linear Programming
Simplex method, duality, transportation and assignment problems.

Unit VI. Theory of Games
Rectangular games. Saddle points. Mixed strategies. Relation of dominance. Various methods for solving rectangular games. Inter - relation between the theory of games and linear progrnmming.

The following books are suitable:

1. C.E. Weatherburn: Mathematical Statistics
2. Ackoff, Church Man and Arnoff: Introduction to Operational Research
3. S.I. Gass: Linear programming - Methods and applications
4. J.N. Kapur, and Saxena, H.C. Mathematical Statistics,

B.Sc.(H)/ BA.(H) Mathematics Part III

Paper X: Programming in C and Numerical Analysis.

Unit I. Introduction to Computer
Number system Booting Process. Computer Language Introduction to operating system. Types of programming languages. Compilers and interpreters. Programmer's model of a computer. Algorithms. Flow charts. Data types. Storage Classes.

Unit II. C Programming
Operators and Expressions. Arithmetic input/output instructions. Structure of C programs.Decision control structure. Decision statements.Loop. Case control. Structures and unions. Functions. Recursions. Preprocessors arrays. Puppetting of strings. Structures and unions. Pointers. File formatting.

Unit III. Algebraic and Transcedental Equations
Bisection method. Regula Falsi method. Iteration method. Newton-Raphson method. Rate of convergence of Newton Raphson formula. Chebyshev method. Write a program in C for the above methods.

Unit IV. Systems of Linear and Nonlinear Equations
Solution of system of linear equations: by direct methods. Gauss elimination method, Gauss-Jordan method and by indirect method, Jacobi's and Gauss-Seidel iteration methods. Solution of system of nonlinear equations by method of iteration and Newton Raphson method. Write algorithm and program in C for Gauss elimination method, Gauss-Jordan method, Gauss Jacobi's and Gauss-Seidel iterative method.

Unit V. Interpolation
Finite difference operators. Polynomial interpolation formulae based on equidistant points. Newton forward and backward formulae. Gauss forward & backward formulae. Sterling formula. Bessel's and Everest formula. Polynomial interpolation formulae based on arbitrary points. Lagranges formula and Newton's divided formula. Write a program in C for Newton forward and backward formula.

Unit VI. Numerical Differentiation, Numerical Integration and Ordinary Differential Equations
Numerical differentiation. Numerical integration:-trapezoidal and Simpson's rule,Romberg integration & their algorithm as well as program in C. Numerical solution of ordinary differential equations by Taylor's series, Picards method, Euler's method, second and fourth order Runge Kutta method.

Books Recommended:

1. Smuel D. Conte ,Carl de Boor : Elementry Numerical Analysis : An Algorithm Approach: McGraw Hill International Editions.
2. S.S.Sastry: Introductory Methods of Numerical Analysis,Prentice Hall of India.

Reference Books:

1. B.W. Kernighan and D.M. Ritchie: The C Programing Language,2nd

Edition,(Ansi features)Prentice Hall,1989

2. Robert C. Hutchisopn and Sterven B.Tust:Programming using C Language,Mc Graw Hill 1988.
3. V.Rajaraman: Programming in C,Prentice Hall of India,1994.
4. M.K. Jain,S.R.K.Iyengar and R.K. Jain: Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd.,1999
5. Byron Gottfried : Programming with C
6. E Balagurusamy: Programming in Ansi C

Objective of the Course

To solve algebraic and transcendental equations, system of linear and nolinear equations, find the interpolating polynomials and their values at given points. Perform operation of calculus and solve ordinary differential equations using computers.