MATHEMATICS

SEMESTER -I
Paper-1
Title: ALGEBRA, ANALYTICAL GEOMETRY AND CALCULUS

MARKS-Theory - 80 + Internal Assessment -20= 100

84 hrs

Unit: 1

Theory of Equations **(16 hrs)**

Theory of equations – Euclid's algorithm – Polynomials with integral coefficients Remainder theorem Factor theorem – Fundamental theorem of algebra (statement only) Irrational and complex roots occur in conjugate pairs – Relation between roots and coefficients of a polynomial equation – symmetric functions – Transformations Reciprocal equations – Descartes' rule of signs – Multiple roots – Solving cubic equations by Cardon's method – solving Quadratic equations by Descartes' and Ferrari's Method.

Unit: 2

Theory of Numbers: **(12 hrs)**

Division Algorithm – Divisibility – Prime and composite numbers – proving the existence and uniqueness, GCD and the Euclidean Algorithm – fundamental theorem of Arithmetic – the least common multiple, congruence – linear congruence – Wilson's theorem – simultaneous congruence – theorems of Euler, Fermat and Lagrange.

Unit: 3

Analytical Geometry **(34 hrs)**

Cartesian coordinates in three dimensional space – Relation between cartesian co-ordinates and position vector – Distance formula (cartesian and vector form) – Division formula (cartesian and vector form) – Direction cosines – Direction ratios – Projection on a straight line – Angle between two lines – Area of triangle – volume of a tetrahedron.

Straight line – Equations of straight lines (cartesian and vector form) – planes – Equations of planes (cartesian and vector form) – Normal form – Angle between planes – coaxial planes – parallel and perpendicular planes – length of a perpendicular from a point to a plane – Bisectors of angles between two planes – Mutual positions of lines and planes – Shortest distance between two skew lines.

Unit: 4

Differential Calculus (34 hrs)

Real Numbers – Inequalities – Absolute value – Intervals – Functions – Graphs – Limit of a function – Left hand and right hand limits - ε- *d*- definition of continuity of a function, problems. Differentiation – Linear approximation theorem – derivatives of higher order – Leibnitz's theorem – Monotone functions – Maxima and Minima – Concavity Convexity and points of inflection. Polar coordinates – angle between the radius vector and the tangent at a point on a curve – angle of intersection of two curves – Pedal equations – Derivative of arc length in cartesian, parametric and polar coordinates, curvature – radius of curvature – circle of curvature – evolutes.

Books for reference:

1. Natarajan, Manicavachogam Pillay and Ganapathy – Algebra
2. Shanthinarayan – Elements of Analytical Solid Geometry
3. Serge Lang – First Course in Calculus.
4. Lipman Bers – Calculus, Volumes 1 and 2.
5. N.Piskunov – Differential and Integral Calculus.
6. Courant and John – Introduction to Calculus and Analytical Geometry.
7. Shanthinarayan – Differential Calculus.
8. Advanced Engineering Mathematics III Jain Iyengar.
9. A.Thanga Pandi Isaac & S.Armugam – Numerical Methods.

SEMESTER - II Paper-2
Title: ALGEBRA, ANALYTICAL GEOMETRY, CALCULUS

MARKS-Theory - 80 + Internal Assessment -20= 100

84 hrs

Unit: 1

Matrices (40 hrs)

Matrices of order m x n. – Adjoint of a square matrix – Singular and non- singular matrices – Rank of a matrix – Elementary row/column operations – Invariance of rank under elementary operations – Inverse of a matrix by elementary operations.

System of m linear equation in n unknowns – matrices associated with linear equations – trivial and non-trivial solutions – Criterion for existence of non-trivial solutions of homogeneous and non-homogeneous systems – criterion for uniqueness of solutions – Problems.

Eigen values and Eigen vectors of a square matrix – characteristic equation of a square matrix – Eigen values and Eigen vectors of a real symmetric matrix – properties – Diagonalization of a real symmetric matrix – Cayley – Hamilton theorem – Applications to determine the powers of square matrices and inverses of non-singular matrices.

Unit: 2.

Quadric curves (20 hrs)

Translation and rotation of cartesian axes in a plane – curves of second degree – discriminant and trace – theorem on discriminant and trace – removing the mixed term – removing linear terms – proof of the theorem. The set of points (x,y) satisfying the equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ is either empty or a point or consists of one or two lines or is a parabola, an ellipse or a hyperbola – problems there on – polar equations of a conic.

Unit: 3.

Integral Calculus (36 hrs)

Techniques of integration – Integrals of Algebraic and transcendental functions – Reduction formulae – Definite integrals – properties.

Books for Reference.

1. Serge Lang – First Course in Calculus.
2. Lipman Bers – Calculus, Volumes 1 and 2.
3. N.Piskunov – Differential and Integral Calculus.
4. Courant and John – Introduction to calculus and analytical geometry.
5. F.Ayers – Matrices, Schaum Series.
6. Natarajan, Manicavachogam Pillay and Ganapathy – Algebra
7. Shanthinarayan – Elements of Analytical Solid Geometry.
8. Shanthinarayan – Integral Calculus.
9. Jain Iyengar -Advanced Engineering Mathematics III.
10. Modern Algebra Vol – I & Vol II – G.H.Ranganath

SEMESTER – III
Paper-3
Title: ALGEBRA, CALCULUS

MARKS-Theory - 80 + Internal Assessment -20= 100

Unit: 1
Limits, Continuity (10hrs)

Limits – continuous functions – discontinuous functions – theorems on continuity – Functions continuous on closed interval – uniform continuity (explaining the idea).

Unit: 2 (26hrs)

Differentiability and its applications

Differentiability – Theorems – Rolle's theorem – Lagrange's Mean value theorem – Cauchy's mean value theorem – Taylor's theorem – Maclaurin's theorem – Generalized mean value theorem – Taylor's infinite series and power series expansion – Maclaurin's infinite series – Indeterminate forms.

Asymptotes, Envelopes, Singular points, Multiple points, Cusp, node and Isolated points. Tracing of standard curves with Cartesian and polar coordinates.

Unit: 3 (30hrs)

Partial Derivatives

Functions of two or more variables – Explicit and implicit functions – The neighborhood of a point – The limit of a function – Continuity – Partial derivatives – Differentiable functions – Linear approximation theorem – Homogeneous functions – Euler's theorem – Chain rule – Change of variables – Directional derivative – Partial derivatives of higher order – Taylor's theorem (statement only) – Derivatives of implicit functions – Jacobians – Some illustrative examples.

Unit: 4
Line and Multiple Integrals (30 hrs)

Definition of a line integrals and basic properties – Examples on evaluation of line integrals-

Definition of a double integrals- Conversion to iterated integrals- Evaluation of duble integrals

1) under given limits 2) in regions bounded by curves- Change of variables- Surface areas.

Definition of a triple integrals- Evaluation- Change of variables- Voulmes as a triple integral.

Books for reference:

1. Lipman Bers – Calculus, volumes 1 and 2
2. Asha Rani Singhal and M.K.Singhal – A first Course in Real Analysis.
3. S.C.Malik – Real Analysis.
4. Shanthinarayan – Differential Calculus & Mittal
5. N.Piskunov – Differential and Integral Calculus.
6. Vijay K Khanna – Abstract Algebra
7. G S Grewal – Higher EngineeringMathematics
8. S.Lang - First course in calculus
9. I.N.Herstin – Modern Algebra
10. Birkoff and Maclaine – Brief survey of Modern Algebra.

SEMESTER - IV

Paper-4

Title: ALGEBRA AND DIFFERENTIAL EQUATIONS

MARKS-Theory - 80 + Internal Assessment -20= 100

84 hrs

Unit: 1.

Group Theory - I (48 hrs)

Definition and examples of Groups, some general properties of groups, permutations, permutation groups, cyclic permutation, even and odd permutations, powers of an element of a group subgroups, cyclic groups, $Z_n$and Z, cosets, index of a group, Lagrange's theorem. Homomorphism, isomorphism, Automorphism, fundamental theorem of homomorphism, isomorphism direct product of groups Cayley's theorem, P-Sylow's theorems for cyclic groups and Cauchy's theorem.

Unit: 2

Differential Equations - I (48 hrs)

Definition and examples of differential equations, forming of Differential equations by elimination the arbitrary constants. Differential equations of order one by separation of variables, equations with homogeneous coefficients, exact equations, linear equations of order one. The determination of Integrating factors. Substitution suggested by the equation. Bernoullis eqn., coefficient linear in two variables- Isthogonal trafectores polar coordinates.

Equations of first order and higher degree, equations solvable for P, solvable for x, solvable for y, Clairaut's equation. –Singular solutions and geometrical meaning.

Ordinary linear differential equations with constant co-efficients, complimentary function, particular integral-Inverse differential operators.

Books for References

1. Daniel A Murray – Introductory Course to Differential equations.
2. Ranville and Bedient – A short course in Differential equations.
3. I.N.Herstein – Topics in Algebra
4. G.D.Bikhoff and S Maclane – A brief Survey of Modern Algebra.
5. J.B.Fraleigh – A first course in abstract Algebra.
6. Vijay K Khanna – Abstract Algebra
7. Grosswald – Topics from the Theory of Numbers.
8. I.M.Vinogradov – Elements of Number Theory.
9. I.Niven and H.S.Zuckerman – An Introduction of Theory of Numbers.
10. S.B.Malik – Basic Number Theory.

SEMESTER - V
Paper-5 (Compulsory Paper)
Title: CALCULUS -II
MARKS-Theory - 80 + Internal Assessment -20= 100

42 hrs

Unit: 1
Real Numbers (6 hrs)

Introduction- Field structure-Order structure-Bounded and unbounded sets- Supremum and infimum completeness- Some important subsets of R- Archimedean Property of real numbers- Countable and uncountable sets.

Unit: 2

Real Sequences (16hrs)

Sequences of real numbers – Bounded and unbounded sequences – Infimum and supremum of a sequence – Limit of a sequence – sum, product and quotients of limits – standard theorems on limits – Convergent, divergent and oscillatory sequences – standard properties – subsequences – monotonic sequences and their properties – limit point of a sequence – Cauchy's general principal of convergence.

Unit: 3

Infinite Series (16 hrs)

Infinite series of real numbers – Convergence – divergence and oscillation of series – properties of convergence – positive term series – geometric series – comparison tests – Cauchy's root test – D'Alembert's ratio test, Raabe's test, Integral test – Absolute and conditional convergence – D'Alembert's test for absolute convergence – Leibnitz's test for alternating series.Summation of Binomial, Exponential and logarithmic series.

Unit: 4
Improper Integrals (10 hrs)

Improper integrals of the first and second kinds – convergence – Gamma and Beta Functions, and results following the definitions – connection between Beta and Gama functions – Applications to evaluation of integrals – Duplication formula – Sterling formula.

Books for Reference.

1. Lipman Bers – Calculus, Volumes 1 and 2
2. N.Piskunov – Differential and Integral Calculus
3. Asha Rani Singhal and M.K.Singhal – A First Course in Real Analysis.
4. S.C.Malik – Real Analysis.
5. B.S.Grewal – Higher Engineering Mathematics
6. E.Kreyszig - Advanced Engineering Mathematics
7. Jain Iyengar - Advanced Engineering Mathematics III
8. Shanthi Narayanan – Differential Calculus.
9. Manikavachokam Pillai – Algebra
10. Walter Rudin – Principles of Mathematical Analysis.

SEMESTER - V
Paper-6(Compulsory Paper)
Title: ALGEBRA AND CALCULUS

MARKS-Theory - 80 + Internal Assessment -20= 100

42 hrs

Unit: 1.
Rings and Fields **(32 hrs)**

Rings – Examples – Integral Domains – Division rings – Fields – Sub rings – Subfields – Characteristic of a ring – Ordered integral domain – Imbedding of a ring into another ring – The field of quotients – Ideals – Algebra of Ideals – Principal ideal ring – Divisibility in an integral domain – Units and Associates – Prime Elements – Polynomial rings – Divisibility – Irreducible polynomials – Division Algorithm – Greatest Common Divisors – Euclidean Algorithm – Unique factorization theorem – Prime fields – Quotient rings – Homomorphism of rings – Kernel of a ring homomorphism – Fundamental theorem of homomorphism – Maximal Ideals – Prime Ideals – Properties – Unique Factorization domain – Einstein's Criterion of irreducibility.

Unit: 2 **(16 hrs)**

Riemann Integration

The Riemann Integral – upper and lower sums – criterion for integrability – integrability of continuous functions and monotonic functions – Fundamental theorem of Calculus – change of variables – integration by parts – First and second mean value theorems of integral calculus

Books of Reference.

1. I.N.Herstein – Topics in Algebra
2. G.D.Birkhoff and S.Maclane – A brief Survey of Modern Algebra
3. T.K.Manicavachagom Pillai and K.S.Narayanan – Modern Algebra Volume 2
4. J.B.Fraleigh – A First Course in Abstract Algebra
5. S.C.Malik – Real Analysis.
6. Leadership Project, Bombay University – Text Book of Mathematical Analysis.
7. Vijay K Khanna – Abstract Algebra
8. Gopala Krishna – Modern Algebra 9. Lipmann Bers – Vol I and II

SEMESTER - V
Paper-7 (Elective)
Title: APPLIED MATHEMATICS

MARKS-Theory - 80 + Internal Assessment -20= 100

42 hrs

Unit: 1.

Linear Differential Equations (14 hrs)

Cauchy- Eular differential equations- Simultaneous differential equations (two variables with constant coeffecients)- Solution of ordinary second order linear differential equations by the following methods.

i) Reduction of order method and variation of parameters.
ii) Changing the independent variable.
iii) Changing the department variable
iv) Exact equations, Total differential equations-Necessary and sufficient condition for the equation Pdx+Qdy+Rdz=0 to be exact.(proof only for the necessary part)-simultaneous equations of the form dx/P=dy/Q=dz/R.

Unit: 2
Laplace Transforms (14 hrs)

Definition and basic properties – Laplace transforms of exp kt, coskt, sinkt, t^n , coshkt and sinhkt - Laplace transforms of e^{at} F (t) – problems – Theorems on the derivative of Laplace transform and the transform of derivatives – Inverse Laplace transforms – problems, α – functions, theorems on the Laplace transform of integrals – Laplace transform of F (t) /t.

Convolution theorem (without proof) - simple initial value problems – special integral equations – solution of first and second order differential equations with constant coefficients by Laplace transform method – systems of equations- Laplace transform of periodic function

Unit: 3

Fourier series (10 hrs)

Introduction – periodic functions – Fourier series and Euler formulae for period 2p and 2L, L ≠p, Even and odd functions, Half range series. Change of interval.

Unit: 4

Partial Differential Equations (10 hrs)

Basic concepts – Formation by elimination of arbitrary constants – Formation by elimination of arbitrary functions – Solution of partial differential equations – Solution by direct integration – Lagrange's linear equations. P p + Qq = R – Standard types of first order non – linear partial differential equations – Charpit's method. Simultaneous differential equations, solutions by reducing to normal form (changing the dependent variable or removing the first derivative) changing the independent variable, exact equations.

Books of Reference:

1. G.Stephenson – An Introduction to Partial Differential Equations.
2. Murray R.Speigel – Laplace Transforms
3. B.S.Grewal – Higher Engineering Mathematics
4. E.Kreyszig – Advanced Engineering Mathematics
5. E.D.Raiville and P.E.Bedient – A Short Course in Differential Equations
6. D.A.Murray – Introductory Course in Differential Equations.
7. G.P.Simmons – Differential Equations
8. F.Ayres – Differential Equations (Schaum Series)
9. Martin Brown – Applications of Differential Equations.
10. Jain Iyengar Advanced Engineering Mathematics III.
11. N P Bali- Golden Series Maths

SEMESTER – VI

Paper-8 (Compulsory Paper)

Title: NUMERICAL ANALYSIS AND VECTOR CALCULUS

MARKS-Theory - 80 + Internal Assessment -20= 100

42 hrs

Unit: 1.

(8 hrs)

Numerical solutions of Algebraic and transcendental equations – Bisection method – The method of false position – Iteration method – Newton – Raphson method.

Unit: 2 **(8 hrs)**

Numerical solutions of first order linear differential equations by Euler – Cauchy method, Euler's modified method, Runge - Kutta fourth order method, Picard's method.

Unit: 3 **(14hrs)**

Finite differences – Forward and backward differences – Shift operator – Derivative operator – Weirstrass theorem (statement) – Interpolation – Newton – Gregory forward and backward difference formulae – Lagrange's interpolation formula – finding first and second derivatives using interpolation formulae- Difference equations.

Unit: 4 **(8 hrs)**

Numerical integration – General quadrature formula – Trapezoidal Simpson's 1/3 rule – Rule, Simpson's 3/8 rule and Weddle's rule.

Unit: 5

Vector Calculus **(10 hrs)**

Vectors – scalars – vector field – scalar field – vector differentiation – the vector differential operator del, gradient, divergence and curl. Standard properties. Vector integration the divergence theorem of Gauss, Stokes theorem and Green's theorem in the plane.

Books for Reference

1. Murray R Spiegel – Theory and Problems of Vector Analysis
2. Shanthinarayan & J.N.Kapur – A Text Book of Vector Calculus.
3. B.D.Gupta – Numerical Analysis.
4. H.C.Saxena – Finite Difference and Numerical Analysis.
5. S.S.Shastry – Introductory Methods of Numerical Analysis.
6. B.S.Grewal – Numerical Methods for Scientists and Engineers.
7. E.Kreyszig – Advanced Engineering Mathematics.
8. G.C.Sharma & Madhujain – Engineering Mathematics

SEMESTER – VI
Paper-9 (Compulsory Paper)
Title: LINEAR ALGEBRA
MARKS-Theory - 80 + Internal Assessment -20= 100

42hrs

Unit: 1

Vector Spaces (24 hrs)

Vector spaces – Introduction – Examples – Vector subspaces – Criterion for a subset to be a subspace – Algebra of subspace – Linear combinations – Linear spans – Linear dependence and linear independence of vectors – Theorems on linear dependence and linear independence – Basis of a vector space – Dimension of a vector space – Finite dimensional vector spaces – Some properties – Coordinate systems – Quotient spaces – Homomorphism of vector spaces or linear transformations – Isomorphism of vector spaces – Direct sums – Inner product spaces – Euclidean vector space – Distance – length – Properties – Normal orthogonal vectors – Gram Schmidt orthogonalization process (only statement)– orthogonal complement.

Unit: 2

Linear Transformations (24 hrs)

Linear transformations – Linear maps as matrices – Change of basis and effect of associated matrices – Kernel and image of a linear transformation – Rank and nullity theorem – Singular and non-singular linear transformations.

Books of Reference

1. Stewart – Introduction to Linear Algebra
2. K.S.Narayanan and T.K.Manicavachagom Pillay – Modern Algebra Volume 2
3. S.Kumaresan – Linear Algebra
4. G.D.Birkhoff and S.Maclane – Brief Survey of Modern Algebra.
5. Gopalakrishna – University Algebra
6. Saymour Lipschitz – Theory and Problems of Linear Algebra.
7. J.B.Fraleigh – A first course in abstract algebra.
8. Linear Algebra – Schamseries.

SEMESTER - VI
Paper-10
Title: COMPLEX ANALYSIS (Elective)

MARKS-Theory - 80 + Internal Assessment -20= 100

42 hrs

Unit: 1
Introduction – Complex Numbers **8 Hrs**

The complex number system – Absolute value and conjugate of a complex number – Geometrical representation – Polar form of complex numbers – De Moivre's theorem – Euler's formula – Dot and cross product.

Neighborhoods – Limits points – Interior, exterior, Isolated and boundary points – Open sets – closed sets bounded sets – compact sets – connected sets – Domain – Simply connected regions.

Equation to a circle and a straight line in complex form – Jordan arc – closed contour – The extended complex plane.

Unit: 2 **12 Hrs**

Functions of a Complex Variables

Functions of a complex variable – limit of a function – Continuity and differentiability – Analytic functions – Singular points – Cauchy – Riemann equations in Cartesian and polar forms – Necessary and sufficient condition for f(z) to be analytic – Harmonic functions – Real and imaginary parts of an analytic function are harmonic – Construction of analytic functions 1) Milne Thomson Method – 2) Using the concept of Harmonic function.

Unit: 3 **10 Hrs**

Complex Integration

The Complex Line Integral – Examples and Properties – Proof of Cauchy's Integral theorem using Green's theorem – Direct consequences of Cauchy's theorem – The Cauchy's integral formula for the function and the derivatives – Applications to the evaluations of simple line integrals – Cauchy's inequality – Liouville's theorem – Fundamental theorem of Algebra.

Unit: 4 **10 Hrs**

Transformations

Definition – Jacobian of a transformation – identity transformation – Reflection – Translation – Rotation – Stretching – Inversion – Linear Transformations – Definitions – The Bilinear transformation – Cross Ratio of four points – Cross Ratio Preserving property – Preservation of the family of straight lines and circles – conformal mappings – Discussion of the transformations $w = z^2$, w = sinz, $w= e^z$, w= ½ (z + 1/z). Residues and Singularities

Unit: 5 **8 Hrs**

Calculus of Residues

Zeros and Singularities, Residues- The residue theorem- Evaluation of definite integrals.

Books for Reference.

1. L.V.Ahlfors – Complex Analysis
2. Bruce P.Pallca – Introduction to the Theory of Function of Complex Variable.
3. Serge Lang – Complex Analysis.
4. Shanthinarayan – Theory of Functions of a Complex Variable.
5. S.Ponnuswamy – Foundations of Complex Analysis.
6. R.P.Boas – Invitation to Complex Analysis.
7. Sharma – Complex Analysis.
8. Thyagi – Complex Analysis.
9. Churchill – Complex Analysis.