# MANONMANIAM SUNDARANAR UNIVERSITY. TIRUNELVELI
# DIRECTORATE OF DISTANCE AND CONTINUING EDUCATION
# B.SC. MATHEMATICS
## (Effective from the Academic Year 2016-2017 onwards)
### I Year

| Paper | Credit |
|---|---|
| Part I:   Language | 6 |
| Part II:  English | 6 |
| Part III | |
| Calculus and Differential Equations | 8 |
| Algebra and Sequences and Series | 8 |
| Statistics | 4 |
| **Total** | **32** |

### II Year

| Paper | Credit |
|---|---|
| Part I:   Language | 6 |
| Part II:  English | 6 |
| Part III | |
| Analytical Geometry of 3D and Vector Calculus | 8 |
| Abstract and Linear Algebra | 8 |
| Numerical Methods | 4 |
| **Total** | **32** |

### III Year

| Paper | Credit |
|---|---|
| Part III | |
| Optimization Techniques | 6 |
| Real and Complex Analysis | 8 |
| Mechanics | 6 |
| Number Theory | 6 |
| Discrete Mathematics | 6 |
| **Total** | **32** |

**Total No. of credits: 32 + 32 + 32 = 96**

# I YEAR - CALCULUS AND DIFFERENTIAL EQUATIONS

**Unit I** :

Curvature – radius of curvature – Cartesian and polar – centre of curvature – Involute and evolute – Asymptotes in Cartesian and Polar co-ordinates.

**Unit II**:

Evaluation of double and triple integrals – Jacobeans, change of variables.

**Unit III**:

First order differential: equations of higher degree – solvable for p,x and y – Clairaut's form/ linear differential equations of second order – particular integrals for functions of the form, Xn, eax, eax (f(x). Second order differential equations with variable coefficients.

**Unit IV**:

Laplace transform-Inverse transform – Properties – Solving differential equations. Simultaneous equations of first order using Laplace transform.

**Unit V**:

Partial differential equations of first order – formation – different kinds of solution – four standard forms – Lagranges method.

Books:

1. Calculus Vol.1, Vol.2&Vol.3, By T.K. Manickavachagompillai& others.
2. Calculus Vol.1& Vol.2 by S. Arumugam and Isaac.


# ALGEBRA, SEQUENCES AND SERIES

**Unit I**: Theory of Equations: Every equation f(x) =0 of nth degree has 'n' roots. Symmetric functions of the roots in terms of the coefficients – sum of the rth powers of the roots – Newton's theorem – Descartes rule of sign – Rolle's theorem.

**Unit II:** Reciprocal Equations – Transformation of equations – solution of cubic and biquadratic equation – Cardon's  land Ferrari's methods – Approximate solution of numerical equations-Netwon's and Horner's methods.

**Unit III:** Sequences and series: Sequences – limits, bounded, monotonic, convergent, oscillatory and divergent sequence – algebra of limits – subsequences – Cauchy sequences in R and Cauchy's general principle of convergence.

**Unit IV**: Series – convergence, divergence – geometric, harmonic, exponential, binomial and logratithmic series – Cauchy's general principle of convergence – comparison test – tests of

convergence of positive termed series – Kummer's test, ratio test, Raabe's test, Cauchy's root test, Cauchy's condensation test.

**Unit V**: Summation of series using exponential, binomial and logarithmic series.

Books for reference:
1. Algebra – Vol. I, T.K. Manickavachagompillai& Others
2. Sequences and series, S. Arumugam& Others
3. Real Analysis – Vol.I, K. ChandrasekaraRao& K.S. Narayanan
4. Infinite series, Bromwich.

## STATISTICS

**Unit I** :Correlation – Karl Pearson's coefficient of Correlation, Lines of Regression – Regression coefficients – Rank correlation.

**Unit II**:Probability – Definition – application of addition and multiplication, theorems – conditional, Probability – Mathematical Expectations – Moment generating function – special distributions, (Binomial distribution, Poisson distribution, Normal distribution – properties).

**Unit III**:Association of attributes – Coefficient of association – consistency – time series – Definition – Components of a time series – Seasonal and cyclic variations.

**Unit IV:** Sampling – definition – large samples. Small samples – Population with one sample and population with two samples – students – t-test-applications – chi – square test and goodness of fit – applications.

**Unit V:** Index numbers – Types of Index Numbers – Tests – Unit test, Commodity reversal test, time reversal test, factor reaversal test – Chain index numbers – cost of living index- Interpolation – finite differences operators - Newton's forward, backward interpolation formulae, Lagrange's formula.

Books:
1. Statistics: S. Arumugam& others
2. Statistics: D.C. Sancheti&Kapoor
3. Statistics: Mangaladas& Others
4. Statistics: T. Sankaranarayana& Others.

## II YEAR  - ANALYTICAL GEOMETRY OF 3D AND VECTOR CALCULUS

**Unit I** : Rectangular Cartesian Coordinates in space – Distance formula – Direction ratio and cosines – Angle between lines – simple problems. Plane – different forms of equation – angle between two planes – perpendicular distance from a point on a plane – projection of a line or a point on a plane.

**Unit II**: Lines – symmetrical form – plane and a straight line – The perpendicular from a point on a line – Coplanar lines – shortest distance between two skew lines and its equation. Sphere –

Different forms of equations- plane section – the circle and its radius and centre – tangent plane – condition for tangency – touching spheres – common tangent plane – point of orthogonality of intersection of two spheres.

**Unit III:** Vector differentiation – Gradient, Divergence and Curl operators – solenoidal and irrotational fields- formulas involving the Laplace operator.

**Unit IV**: Vector integration – single scalar variables – line, surface and volume integrals.

**Unit V**: Gauss's Stoke's and Green's theorems – statements and verification only.

Books for reference:
1. Analytical Geometry of 3D-Part II, ManickavachagomPillai
2. Analytical Geometry of 3D & Vector Calculus – P. Duraipandian& Others
3. Analytical Geometry of 3D & Vector Calculus – S. Arumugam& Others
4. Vector Analysis, K. Viswanathan.

## ABSTRACT AND LINEAR ALGEBRA
**Unit I**
Relations – Equivalence relations – Functions – Composition of functions – Inverse of a function - Groups – Definition and examples – Elementary properties – Permutation groups – Subgroups – Cyclic groups.

**Unit II**
Order of an element – Cosets – Lagrange's theorem – Euler's theorem – Fermat's theorem – Normal subgroups – Quotient groups – Homomorphism and Isomorphism between groups – Cayley's theorem – Fundamental theorem of homomorphism.

**Unit III**
Rings – Definition and examples – Elementary properties – Isomorphism between rings Types of rings – Characteristics of a ring– Subrings –Ideals – Quotient rings – Maximum ideals – Prime ideals – Homomorphism of rings – fundamental theorem of homomorphism.

**Unit IV**
Vector Spaces: Definition and Examples– Subspaces – Linear transformation – Linear span, Linear dependence, Linear independence and their basic properties – Basis and Dimension of Vector Spaces.

**Unit V**
Matrix of a Linear Transformation and their representation as matrices – Algebra of linear transformations – Inner Product Spaces – Definition and Examples – Schwartz inequality – Orthogonality – Orthogonal sets and basis – Gram Schmidt Orthogonalisation Process.

**Reference books**
1. Modern Algebra, Dr. S. Arumugam and A. Thangapandi Isaac, Scitech Publications, Chennai
2. Modern Algebra, Vasistha
3. Topics in Algebra, I.N. Herstein, Vikas Publishers

# NUMERICAL METHODS

**Unit I** :Finite differences – difference table – operators E,Δ and ▽ - Relations between these operations – Factorial notation – Expressing a given polynomial in factorial notation – Difference equation – Linear difference equations – Homogeneous linear difference equation with constant coefficients.

**Unit II:** Interpolation using finite differences – Newton – Gregory formula for forward interpolation – Divided differences – Properties – Newton's formula for unequal intervals - Lagrange's formula – Relation between ordinary differences and divided differences – inverse interpolation.

**Unit III:** Numerical differentiation and integration – General Quadrature formula for equidistant ordinates – Trapezoidal Rule – Simpson's one third rule – Simpson's three eight rule – Waddle's rule – Cote's method.

**Unit IV**: Numerical solution of ordinary differential equations of first and second orders – Piccards method. Eulers method and modified Euleis method – Taylor's series method – Milne's method – Runge – Kutta method of order 2 and 4 – Solution of algebraic and transcendent equations. Finding the initial approximate value of the root – Iteration method – Newton Raphson's method.

**Unit V**:Simultaneous linear algebraic equations – Different methods of obtaining the solution – The elimination method by Gauss – Jordan method – Grouts' method – Method of factorization .
Books:
Calculus of finite differences and Numerical Analysis, P.P. Gupta & G.S. Malik, Krishna PrakashamMardin, Mecrutt.

## III YEAR - OPTIMIZATION TECHNIQUES

**Unit 1**
Linear Programming Problem (LPP): Mathematical Formulation – Graphical Method of Solution –- Simplex Method – Big 'M' Method – Two Phase Simplex Method – Duality– Dual Simplex Method.

**Unit  II**
Transportation Problems (TP): Mathematical Formulation – Balanced and Unbalanced TP – North-West Corner Rule – Least Cost Method – Vogel's Approximation Method – Test for Optimality – Maximization Problems in TP – Assignment Problems (AP): Mathematical Formulation – Method of Solution – Maximization in AP.

**Unit III**
Sequencing Problems: Introduction – Basic Assumptions – Sequencing n Jobs on 2 Machines – Sequencing n Jobs on 3 Machines – Sequencing 2 Jobs on n Machines.

Queuing Theory: General concepts and definitions – Classification of queues – Poisson process, Properties of Poisson process – Queuing Models: 1. (M/M/1) : ($\infty$/FCFS), 2. (M/M/1): (N/FCFS), 3. (M/M/c) : ($\infty$/FCFS).

**Unit IV**
Inventory Control: Basics – Types of inventory models: Deterministic Models: [Model I Purchase Model without Shortages – Model II Production Model without Shortages – Model III Purchase Model with Shortages – Model IV Production Model with Shortages– Model V Price Break Model. Probabilistic Models: Newspaper boy problem – Discrete and Continuous type cases – ABC analysis.

**Unit V**
Network Analysis: Drawing network diagrams – Critical path method – Concept of Slack and Floats on network – PERT – Three types of time estimates – Algorithm for PERT – Differences in PERT and CPM.

**Books for Reference**
1. Operations Research, KantiSwarup, P.K. Gupta, Manmohan, (Sultan Chand & Sons)
2. Operations Research (Theory and Applications), J. K. Sharma, (Macmillan Publishers Pvt. Ltd.)
3. Resource Management Techniques (Operations Research), V. Sundaresan, K.S. Ganapathy, K. Ganesan, (A.R. Publications)
4. Operations Research, Dr. R. Panneerselvam, (Prentice Hall of India), 2008
5. Operations Research, Dr. P.R. Vittal and Dr. V. Malini, Margham Publications.


## REAL AND COMPLEX ANALYSIS

**Unit I**:Metric spaces – open sets – Interior of a set – closed sets – closure – completeness – Cantor's intersections theorem – Baire – Category Theorem.

**Unit II**:Continuity of functions – Continuity of compositions of functions – Equivalent conditions for continuity – Algebra of continuous functions – hemeomorphism – uniform continuity – discontinuities connectednon – connected subsets of R – Connectedness and continuity – continuous image of a connected set is connected – intermediate value theorem.

**Unit III**:Compactness – open cover – compact metric spaces – HerniBorel theorem. Compactness and continuity – continuous image of compact metric space is compact – Continuous function on a compact metric space in uniformly continuous – Equivalent forms of compactness – Every compact metric space is totally bounded – Bolano – Weierstrass property – sequentially compact metric space.

**Unit IV**: Algebra of complex numbers – circles and straight lines – regions in the complex plane – Analytic functions Cauchy – Rienann equations – Harmonic functions – Bilinear transformation translation, rotation, inversion – Cross – ratio- Fixed points – Special bilinear transformations.

**Unit V**: Complex Integration – Cauchy's integral theorem – Its extension – Cauchy's integral formula – Morera's theorem – Liouville's theorem – fundamental theorem of algebra – Taylor's series – Laurent's series – Singularities. Residues – Residue Theorem – Evaluation of definite integrals of the following types. $\int_0^{2\pi}$ F (Cos x, sin x) dx and $2\int_{-\infty}^{\infty}\dfrac{f(x)}{g(x)}$ dx

Books for reference:

1. Modern Analysis – Arumugam and Issac.
2. Real Analysis – Vol. III – K. ChandrasekharaRao and K.S. Narayanan, S. Viswanathan Publisher.
3. Complex Analysis – Narayanan &ManicavachagamPillai
4. Complex Analysis – S. Arumugam&Issac.
5. Complex Analysis – P. DuraiPandian
6. Complex Analysis – Karunakaran, Narosa Publishers.

## MECHANICS

**Unit I:** Forces acting at a point – parallelogram of forces – triangle of forces – Lami's theorem, Parallel forces and moments – Couples – Equilibrium of three forces acting on a rigid body.

**Unit II:** Friction – Laws of friction – Equilibrium of a particle (i) on a rough inclined plane. (ii) under a force parallel to the plane (iii) under any force – Equilibrium of strings – Equation of the common catenary – Tension at any point – Geometrical properties of common catenary – uniform chain under the action of gravity – Suspension bridge.

**Unit III:** Dynamics – Projectiles – Equation of path, Range etc – Range on an inclined plane – Motion on an inclined plane. Impulsive forces – Collision of elastic bodies – Laws of impact – direct and oblique impact – Impact on a fixed plane.

**Unit IV:** Simple harmonic motion in a straight line – Geometrical representation – Composition of SHM's of the same period in the same line and along two perpendicular directions – Particles suspended by spring – S.H.M. on a curve – Simple pendulum – Simple Equivalent pendulum – The seconds pendulum.

**Unit V:** Motion under the action of Central forces – velocity and acceleration in polar coordinates – Differential equation of central orbit – Pedal equation of central orbit – Apses – Apsidal distances – Inverse square law.

Books for Reference:

1. Statics and Dynamics: S. Narayanan
2. Statics and Dynamics : M.K. Venkataraman
3. Statics: Manickavachagompillai
4. Dynamics: Duraipandian.

# NUMBER THEORY

**UNIT 1:**

Divisibility Theory in the integers:Mathematical Induction-The Binomial Theorem-The Division    Algorithm-The GCD-The Euclidean Algorithm-The Diophantine equation ax+by=c.

Chapter1. Section 1.1,1.2

Chapter2. Section 2.2,2.3,2.4,2.5.

**UNIT 2:**

Primes and Their Distributions:The Fundamental Theorem of Arithmetic-The Sieve of Eratosthenes-The Goldbach Conjecture.

Chapter 3. Section 3.1,3.2, 3.3

**UNIT3:**

The Theory of Congruence: Basic properties of congruence-Binary and Decimal Representation of Integers-Linear congruence and the Chinese Remainder Theorem

Chapter4: Section 4.2,4.3,4.4

**UNIT4:**

Fermat's  Theorem:  Fermat's  Little Theorem and Pseudoprimes-Wilson's Theorem-The Fermat-Kraitchik Factorization Method

Chapter5. Section 5.2,5.3,5.4

**UNIT5:**

Number Theoretic Functions: The sum and number of divisors-The Mobius Inversion Formula-The Greatest Integer Function

Chapter6. Section 6.1,6.2,6.3

5. Text: Elementary Number Theory, Tata McGraw Hill Education Private Limited, Seventh Edition, David M.Burton

# DISCRETE MATHEMATICS

**Unit I:**
Definition and examples of graphs – degrees – subgraphs – ismorphims – Ramsey numbers – independent sets and coverings – intersection graphs and line graphs – matrices – operations in graphs – degree sequences, graphic sequences.

**Unit II:**
Walks – trails and paths – connectedness and components – blocks – connectivity – Eulerian graphs – Hamiltonian graphs – trees – characterization of trees – centre of a tree

**Unit III:**
Planar graph and their properties – characterization of planas graphs – thickness – crossing and outerplanarity – Chromatic number – chromatic index – five colour theorem – four colour problem – chromatic polynomials – Directed graphs and basic properties – paths and connections in digraphs – digraphs and matrices – tournaments.

**Unit IV:**
Permutations – ordered selections – unordered selections – further remarks on binomial theorem – Pairings within a set – pairings between sets, - an optimal assignment problem.

**Unit V:**
Recurrence relations – Fibonacci type relations – Using generating functions – miscellaneous methods – The inclusion exclusion principle and rook polynomials.

**Text Books:**
1. Invitation to graph theory, S. Arumugam and S. Ramachandran, Scitech Publications.
2. A first course in combinational mathematics, Ian Anderson (Oxford applied Math. Series)

-------