

SHRI GURU RAM RAI UNIVERSITY

(Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017)



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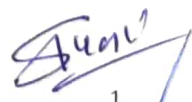

Syllabus of

BA/B.Sc. (MATHEMATICS)
(Three Year Course- Semester System)
Under CBCS

Effective from Academic Session
2017-2018
Discipline Specific Electives (DSE)

Dr. Sheetal ✓ *Trishanku mansh*
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Semester	Core Course(06) (Theory-05+ Tutorial-01)	Ability Enhancement Course (04)	Skill Enhancement Course (04)	Discipline Specific Elective (DSE) (06) (Theory- 05+Tutorial-01)
1	BMTC-101 Differential Calculus	AECC101/102/103 Environment /English /MIL Communication		
2	BMTC-201 Differential Equations	AECC201/202/203 Environment /English /MIL Communication		
3	BMTC-301 Real Analysis		BMTS-301 Logic and Sets BMTS-302 Analytical Geometry BMTS-303 Integral Calculus	
4	BMTC-401 Algebra		BMTS-401 Vector Calculus BMTS-402 Theory of Equations BMTS-403 Number Theory	
5			BMTS-501 Probability and Statistics BMTS-502 Mathematical Finance BMTS-503 Mathematical Modeling	BMTD-501 Matrices BMTD-502 Mechanics BMTD-503 Linear Algebra
6			BMTS-601 Boolean Algebra BMTS-602 Transportation and Game Theory BMTS-603 Graph Theory	BMTD-601 Numerical Methods BMTD-602 Complex Analysis BMTD-603 Linear Programming

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DSE 1A (choose one)

1. Matrices (BMTD-501)
2. Mechanics (BMTD-502)
3. Linear Algebra (BMTD-503)

DSE 1B (choose one)

1. Numerical Methods (BMTD-601)
2. Complex Analysis (BMTD-602)
3. Linear Programming (BMTD-603)

Skill Enhancement Course (SEC)

SEC 1 (choose one)

1. Logic and Sets (BMTS-301)
2. Analytical Geometry (BMTS-302)
3. Integral Calculus (BMTS-303)

SEC 2 (choose one)

1. Vector Calculus (BMTS-401)
2. Theory of Equations (BMTS-402)
3. Number Theory (BMTS-403)

SEC 3 (choose one)

1. Probability and Statistics (BMTS-501)
2. Mathematical Finance (BMTS-502)
3. Mathematical Modeling (BMTS-503)

SEC 4 (choose one)

1. Boolean Algebra (BMTS-601)
2. Transportation and Game Theory (BMTS-602)
3. Graph Theory (BMTS-603)

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Semester I

Total hours-60**Credit-06****BMTC-101****L/W- 06****1.1: Differential Calculus****Unit-1**

Limit and Continuity (ϵ and δ definition), Types of discontinuities, Differentiability of functions.

Unit-2

Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions, Tangents and normals.

Unit-3

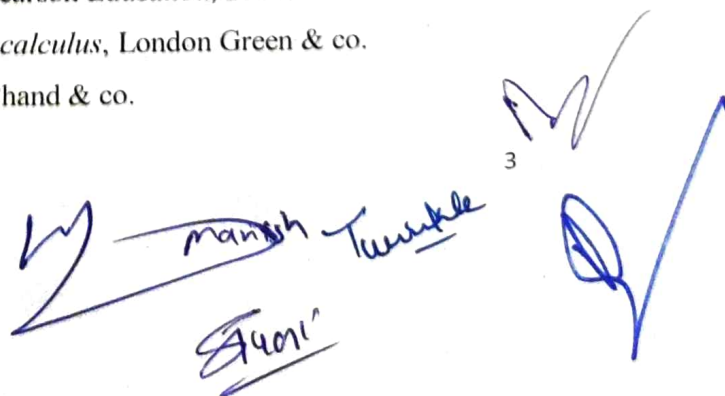
Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Unit-4

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$, Maxima and Minima, Indeterminate forms.

Books Recommended

1. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2011.
2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.
3. Ganesh Prasad, *A textbook for differential calculus*, London Green & co.
4. Shanti Narayan, *Differential Calculus*, S.Chand & co.

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Semester II

Total hours-60

Credit-06

BMTC-201

L/W- 06

2.1: Differential Equations

Unit-1

First order exact differential equations. Integrating factors, rules to find an integrating factor.

Unit-2

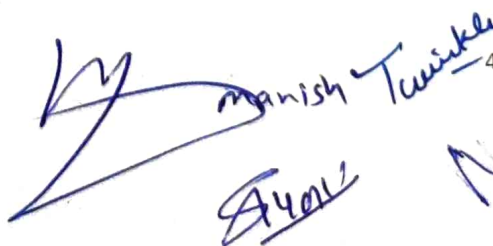
First order higher degree equations solvable for x , y , p . Methods for solving higher-order differential equations, Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.

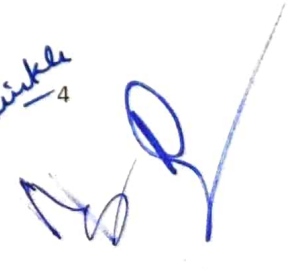
Unit-3

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Unit-4




Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.


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Books Recommended

1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.
3. Schaum's, Outlines of Differential Equations, McGraw-Hill, International Education Pvt Ltd.

Semester III

Total hours-60

Credit-06

BMTC-301

L/W- 06

3.1: Real Analysis

Unit-1

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of \mathbb{R} , Archimedean property of \mathbb{R} , intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Unit-2

Sequence. Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Unit-3

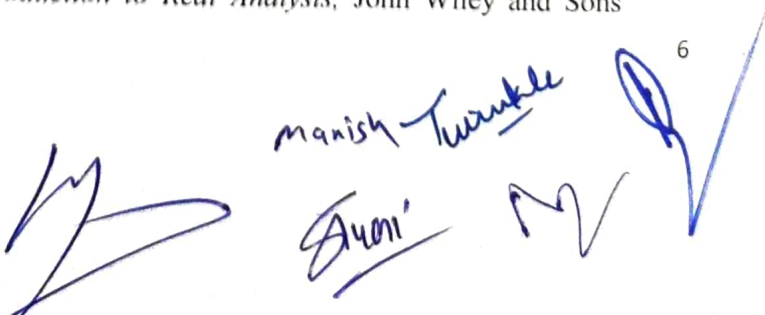
Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series,

Unit-4

Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence. Sequences and series of functions, Pointwise and uniform convergence. M_n -test, M -test.

Books Recommended




1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons

The bottom of the page features several handwritten signatures in blue ink. One signature is clearly legible as 'Manish Tiwari'. To its right, there is a signature that appears to be 'Suman'. Further right, there is another signature that looks like 'M'. On the far right, there is a large, stylized signature that resembles a checkmark or a large 'V'. A small number '6' is written in the top right corner of this section.

(Asia) P. Ltd., 2000.

3. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series-* Undergraduate Texts in Mathematics, Springer Verlag, 2003.

4. S.C. Malik & Savita Arora, *Mathematical Analysis*, New age international publisher.

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Total hours-60

Credit-04

BMTS-301

L/W- 04

SEC 1.1: Logic and Sets

Unit-1

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Unit-2

Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit-3

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Unit-4

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation.

Book Recommended

1. R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
2. P.R. Halmos, Naive Set Theory, Springer, 1974.
3. E. Kamke, Theory of Sets, Dover Publishers, 1950.

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Total hours-60

Credit-04

BMTS-302

L/W- 04

SEC 1.2: Analytical Geometry

Unit-1

Introduction of parabola, techniques for sketching parabola.

Unit-2

Ellipse and hyperbola, Reflection properties of parabola, ellipse and hyperbola, Classification of quadratic equations representing lines

Unit-3

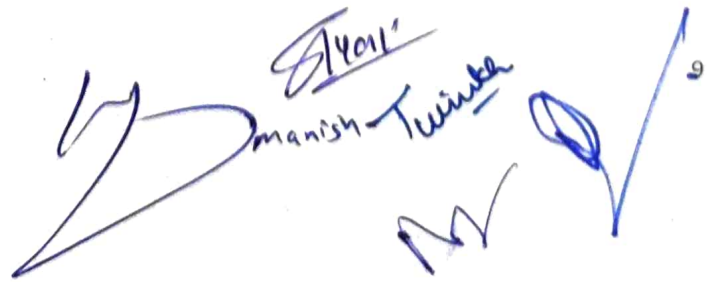
Sphere, Cone, Cylindrical Surfaces, Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid. Central Conicoids.

Book Recommended

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) Pvt. Ltd., 2002.
3. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

Total hours-60

Credit-04



BMTS-303

L/W- 04

SEC 1.3: Integral Calculus

Unit-1

Integration by Partial fractions, integration of rational and irrational functions.

Unit-2

Properties of definite integrals. Reduction formulae for integrals of rational

Unit-3

Trigonometric, exponential and logarithmic functions and of their combinations.

Unit-4

Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution.
Double and Triple integrals.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.

Semester IV

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Total hours-60

Credit-06

BMTC-401

L/W- 06

4.1: Algebra

Unit-1

Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group $U(n)$ of units under multiplication modulo n . Cyclic groups from number systems, complex roots of unity, circle group,

Unit-2

The general linear group $GL_n(n, R)$, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group $Sym(n)$, Group of quaternions, Subgroups, cyclic subgroups,

Unit-3

The concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Unit-4

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n the ring of integers modulo n , ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Z_p , Q , R , and C .

Books Recommended




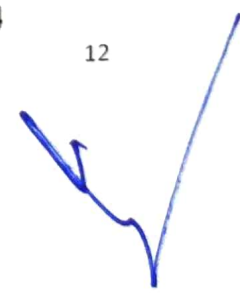
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1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
4. George E Andrews, Number Theory, Hindustan Publishing Corporation, 1984.

Total hours-60

Credit-04

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BMTS-401

L/W- 04

SEC 2.1: Vector Calculus

Unit-1

Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors.

Unit-2

Gradient, divergence and curl.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd. 2002.
3. P.C. Matthew's, *Vector Calculus*, Springer Verlag London Limited, 1998.

Total hours-60

Credit-04



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BMTS-402

L/W- 04

SEC 2.2: Theory of Equations

Unit-1

General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials,

Unit-2

General properties of equations, Descarte 's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Unit-3

Symmetric functions, Applications symmetric function of the roots, Transformation of equations.

Unit-4

Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

Books Recommended

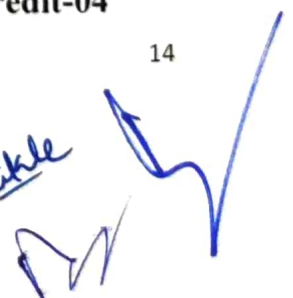
1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.
2. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

Total hours-60

Credit-04



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BMTS-403

L/W- 04

SEC 2.3: Number Theory

Unit-1

Division algorithm, Lame's theorem, linear Diophantine equation, fundamental theorem of arithmetic, prime counting function, statement of prime number theorem.

Unit-2

Goldbach conjecture, binary and decimal representation of integers, linear congruences, complete set of residues.

Unit-3

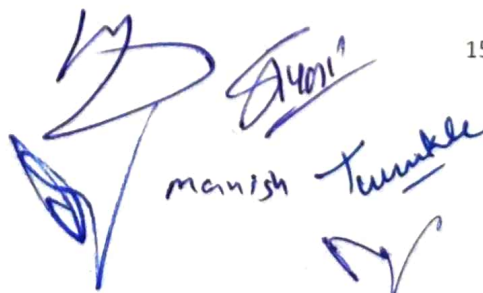
Number theoretic functions, sum and number of divisors, totally multiplicative functions.

Unit-4

Properties of the Dirichlet product, the Möbius inversion formula, the greatest integer function, Euler's phi-function.

Books Recommended:

1. David M. Burton, *Elementary Number Theory* 6th Ed., Tata McGraw-Hill Edition, Indian reprint, 2007.
2. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, *Applications of Abstract Algebra with Maple*, CRC Press, Boca Raton, 2000.
3. Neville Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Limited, Delhi, 2007.


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Semester V

Total hours-60

Credit-06

BMTD-501

L/W- 06

DSE 1A.1: Matrices

Unit-1

R , R^2 , R^3 as vector spaces over R . Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of R^2 , R^3 .

Unit-2

Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Unit-3

Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four.


Unit-4

Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices.

Books Recommended

1. A.I. Kostrikin, *Introduction to Algebra*, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of





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India Pvt. Ltd., New Delhi, 2004.

3. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.

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Total hours-60

Credit-06

BMTD-502

L/W- 06

DSE 1A.2: Mechanics

Unit-1

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body.

Unit-2

Laws of friction, Problems of equilibrium under forces including friction.

Unit-3

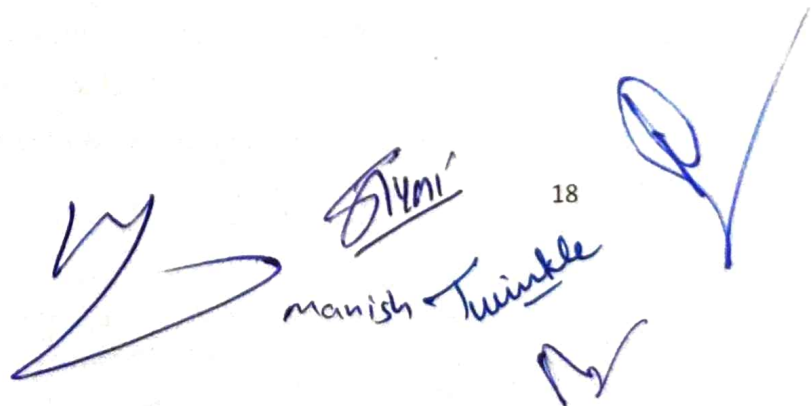
Centre of gravity, Work and potential energy. Velocity and acceleration of a particle along a curve: radial and transverse components (plane curve), tangential and normal components (space curve).

Unit-4

Simple harmonic motion, Simple Pendulum.

Books Recommended

1. A.S. Ramsay, *Statics*, CBS Publishers and Distributors (Indian Reprint), 1998.
2. A.P. Roberts, *Statics and Dynamics with Background in Mathematics*, Cambridge University Press, 2003.

The bottom of the page features several handwritten signatures and initials in blue ink. On the left, there is a large, stylized signature. In the center, the name 'Sivni' is written in a cursive script, with 'manish' and 'Twinkle' written below it. To the right of these names, the number '18' is written. Further to the right, there is another large, stylized signature. At the bottom right, there are some smaller initials.

Total hours-60

Credit-06

BMTD-503

L/W- 06

DSE 1A.3: Linear Algebra

Unit-1

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Unit-2

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation.

Unit-3

Algebra of linear transformations. Dual Space, Dual Basis, Double Dual, Eigen values and Eigen vectors, Characteristic Polynomial.

Unit-4

Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Books Recommended


1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
2. David C. Lay, *Linear Algebra and its Applications*, 3rd Ed., Pearson Education



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- Asia, Indian Reprint, 2007.
3. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005.
 4. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.
 5. Schaum's, *Linear Algebra*, McGraw-Hill, International Education Pvt Ltd.

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Total hours-60

Credit-04

BMTS-501

L/W- 04

SEC 3.1: Probability and Statistics

Unit-1

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation,

Unit-2

Moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, continuous distributions: uniform, normal, exponential.

Unit-3

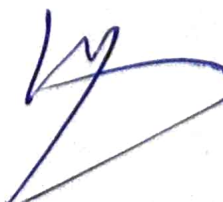
Joint cumulative distribution function and its properties, joint probability density functions.



Unit-4

Marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.

Books Recommended:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.



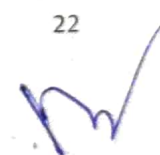
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2. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Application*, 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, *Introduction to Probability Model*, 9th Ed., Academic Press, Indian Reprint, 2007.

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Total hours-60

Credit-04

BMTS-502

L/W- 04

SEC 3.2: Mathematical Finance

Unit-1

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money.

Unit-2

Inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields. Floating-rate bonds, immunization.

Unit-3

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation)

Unit-4

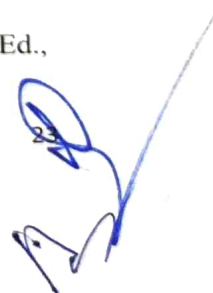
Random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set.

Books Recommended:

1. David G. Luenberger, *Investment Science*, Oxford University Press, Delhi, 1998.
2. John C. Hull, *Options, Futures and Other Derivatives*, 6th Ed., Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross, *An Elementary Introduction to Mathematical Finance*, 2nd Ed., Cambridge University Press, USA, 2003.



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Total hours-60

Credit-04

BMTS-503

L/W- 04

SEC 3.3: Mathematical Modeling

Unit-1

Applications of differential equations: the vibrations of a mass on a spring, mixture problem.

Unit-2

Free damped motion, forced motion, resonance phenomena, electric circuit problem, mechanics of simultaneous differential equations.

Unit-3




Applications to Traffic Flow. Vibrating string, vibrating membrane.

Unit-4

Conduction of heat in solids, gravitational potential, conservation laws.

Books Recommended:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

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Semester VI

Total hours-60

Credit-06

BMTD-601

L/W- 06

DSE 1B.1: Numerical Methods

Unit-1

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method.

Unit-2

Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.

Unit-3

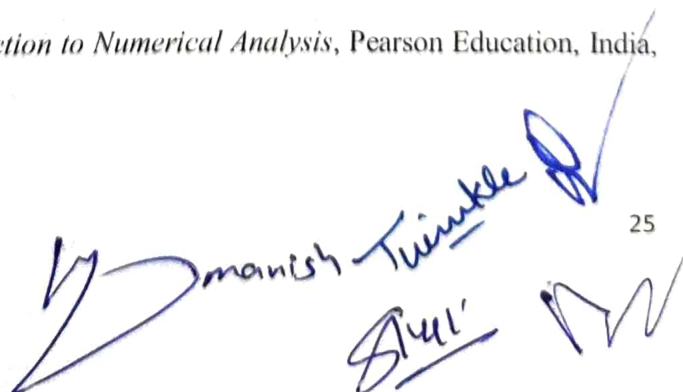
Lagrange and Newton interpolation: linear and higher order, finite difference operators.

Unit-4

Numerical differentiation: forward difference, backward difference and central Difference. Integration: trapezoidal rule, Simpson's rule, Euler's method.

Recommended Books




1. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.


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2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.

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Total hours-60

Credit-06

BMTD-602

L/W- 06

DSE 1B.2: Complex Analysis

Unit-1

Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas,

Unit-2

Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions,

Unit-3

Definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Unit-4

Liouville's theorem and Taylor and Laurent series, and its examples.

Books Recommended

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw – Hill International Edition, 2009.
2. Joseph Bak and Donald J. Newman, *Complex analysis*, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

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Total hours-60

BMTD-603

Credit-06

L/W- 06

DSE 1B.3: Linear Programming

Unit-1

Linear Programming Problems, Graphical Approach for Solving some Linear Programs. Convex Sets, Supporting and Separating Hyperplanes.

Unit-2

Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format.

Unit-3

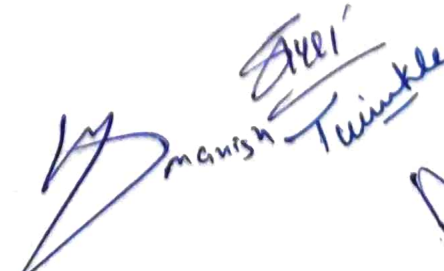
Introduction to artificial variables, two-phase method, Big-M method and their comparison.

Unit-4

Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual.

Recommended Books

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 8th Ed., Tata McGraw Hill, Singapore, 2004.
3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.


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Total hours-60

Credit-04

BMTS-601

L/W- 04

SEC 4.1: Boolean Algebras

Unit-1

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements.

Unit-2

Lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms.

Unit-3

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials.

Unit-4

Minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Books Recommended:

1. B A. Davey and H. A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

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Total hours-60

BMTS-602

Credit-04

L/W- 04

SEC 4.2: Transportation and Game Theory

Unit-1

Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution.

Unit-2

Algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit-3

Game theory: formulation of two person zero sum games, solving two person zero sum games

Unit-4

Games with mixed strategies, graphical solution procedure.

Books Recommended:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

Handwritten signatures and text:
A large signature on the left, the name "Manish" written in the middle, and another signature on the right. The word "Twinkle" is written in a decorative, cursive font above the right signature.

Total hours-60

BMTS-601

Credit-04

L/W- 04

SEC4.3: Graph Theory

Unit-1

Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits.

Unit-2

Eulerian circuits, Hamiltonian cycles, the adjacency matrix.

Unit-3





Weighted graph, travelling salesman's problem.

Unit-4

Shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

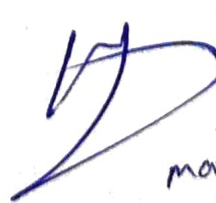
Books Recommended:

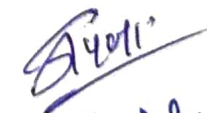
1. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory* 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.
2. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian Sreprint, 2004.

 Manish  Anshu  Anshu  Anshu

Note:-

- (i) Each course will carry 100 marks.
- (ii) In each course, sessional test will carry 30 marks, which includes; one test of 1 hour duration/assignment (paper/poster) presentation etc. suitable for the course and shall carry 20 marks, 5 marks shall be given for participation in academic activities/discipline and 5 marks for attendance in the class.
- (iii) In each course, the end semester examination shall be of 70 marks.


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