

4.0 Courses Information/ Outline

FIRST SEMESTER

Course contents for Communication Skills, English Structure, Islamic Studies, Pakistan Studies, Social Sciences Course as well as Technical Writing are to be drafted by the respective National Curriculum Revision Committees or Board of Studies.

BSMath-111	Calculus-I	Credit Hours 3 (3 + 0)
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Limits and continuity, derivative of a function and its applications optimization problems, mean value theorem (Taylor's theorem and the infinite Taylor series with applications) and curve sketching, anti-derivative, and integral; definite integral and applications; the fundamental theorem of calculus, inverse functions.

Recommended Books:

1. Anton H. 1999 Calculus: A new Horizon (6th edition), John Wiley, New York
2. Stewart J. 1995, Calculus (3rd edition), Brooks/Cole
3. Thomas GB, Finney AR, 2002, Calculus (10th edition), Addison Wesley Reading Ma, USA
4. Gerald B Folland, 2002, Advanced Calculus, 1st Edition Prentice Hall
5. Zia-ul-Haq, 1998 Calculus and Analytic Geometry The Caravan Book House Lahore.

BSMath-112	Discrete Structures	Credit Hours 3 (3 + 0)
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Set and relations: Basic notions, set operations, Venn diagrams, extended set operations, indexed family of sets, countable and uncountable sets, relations, cardinality, equivalence relations, congruence, partitions, partial order, representation of relations, mathematical induction.

Elementary Logic: Logics of order zero and one. Propositions and connectives, truth tables, conditionals and biconditionals, quantifiers, methods of proof, proofs involving quantifiers.

Recommended Books:

1. Rosen KH, 1999, Discrete Mathematics and its Applications (12th edition), McGraw Hill, New York.
2. Susanna S. 2000 Epp: Discrete Mathematics with applications, 2nd dition PWS Pub.
3. Elliott Mendelson, Boolean Algebra & Switching Circuits, Mc-Graw Hill Book Company.

SECOND SEMESTER

BSMath-121	Calculus-II (Perquisite Calculus)	Credit Hours 3 (3 + 0)
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Techniques of integration: Further applications of integration; parametric equations and polar coordinates; sequences and series; power series representation of functions

Recommended Books:

1. Anton H, 1999 Calculus: A New Horizon (6th edition), John Wiley, New York
2. Stewart J, 1995 Calculus (3rd edition) Brooks / Cole
3. Thomas GB, 2002, Finney AR, Calculus (10th edition), Addison-Wesley, Reading, Ma, USA
4. Zia-ul-Haq, 1998 Calculus and Analytic Geometry, The Caravan Book House, Lahore.

BSMath-122	Complex Variable, Infinite & Fourier series	Credit Hours 3 (3 + 0)
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Complex Variables: Complex Numbers, De Moivre's theorem and its applications, Exponential, logarithmic, trigonometric and hyperbolic functions of a complex variable, Separation of complex valued functions into real and imaginary parts of complex expressions.

Infinite Series: Sequences, infinite series and their convergence, Comparison, quotient, ratio and integral tests of convergence (without proof) Absolute and conditional convergence

Fourier Series: Fourier series: Fourier Sine and Cosine Series.

Recommended Books:

1. Ervin Kreyszig, Advanced Engineering Mathematics (latest edition), John Willey and Sons
2. S.M.Yusuf 1996, Mathematical Methods Ilmi Kitab Khana Kabir Street, Urdu Bazar Lahore
3. Karamat H. Dar, Irfan ul Haq and M. Ashraf Jagga, 1998, Mathematical Techniques 3rd edition The Caravan Book House, Lahore

THIRD SEMESTER

BSMath-231	Calculus III (Perquisite Calculus II)	Credit Hours 3 (3 + 0)
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This course covers vectors and analytical geometry of 2 and 3 dimensional spaces; vector-valued functions and space curves; functions of several variables; limits and continuity; partial derivatives; the chain rule; double and triple integrals with applications; line integrals.

Recommended Books:

1. Anton H. Calculus: 1999, A new Horizon (6th edition), John Wiley, New York
2. Stewart J. 1995, Calculus (3rd edition), Brooks/Cole
3. Thomas GB, Finney AR, 2002, Calculus (10th edition), Addison Wesley Reading Ma, USA
4. Zia-ul-Haq, 1998 Calculus and Analytic Geometry The Caravan Book House Lahore.

BSMath-232	Differential Equations	Credit Hours 3 (3 + 0)
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Introduction; formations, solution and applications of first order differential equations; formation and solution of higher-order-linear differential equations; differential equations with variable coefficients; Sturm-Liouville (S-L) system and boundary value problems; series solution and its limitations; the Frobenius method, solution of Bessel, the Hypergeometric, the Legendre and the Hermite equations; properties of the Bessel, the Legendre and the Hermite functions

Recommended Books:

1. Zill DG, Cullen Mr, 1997, Differential Equations with Boundary-value Problems, (3rd edition), PWS Publishing Co.
2. S.M.Yusuf Mathematical Methods 1996, Ilmi Kitab Khana Kabir Street, Urdu Bazaar Lahore
3. Karamat H. Dar, Irfan ul Haq and M. Ashraf Jagga, 1998, Mathematical Techniques, 3rd edition The Caravan Book House, Lahore.

BSMath-233	Vector Analysis	Credit Hours 3 (3 + 0)
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3-D vectors, summation convention, Kronecker delta, Levi-Civita symbol, vectors as quantities transforming under rotations with ϵ_{ijk} notation, scalar and vector-triple products, scalar and vector point function; differentiation and integration of vectors, path independence, surface integrals, volume integrals, gradient, divergence and curl with physical significance and applications, vector identities, Green's theorem in a plane, divergence theorem. Stokes' theorem, coordinate systems and their bases, the spherical polar and the cylindrical-coordinates.

Recommended Books:

1. Bourne DE, Kendall PC, Vector Analysis and Cartesian Tensors (2nd edition), Thomas Nelson
2. Shah NA, 2005 Vector and Tensor Analysis, A-One Publishers, Lahore
3. Smith GD, 1974, Vector Analysis McGraw Hill, New York
4. M. Afzal Qazi, A First Course on Vectors West Pakistan Publishing Co. Lahore

BSMath-234	Computer Language	Credit Hours 3 (2 + 0)
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Introduction to operating systems, C Language, building blocks, variables, input/output, loops (FOR WHILE DO), decisions (IF, IF ELSE, ELSE IF) construct switch statement, conditional statement function that returns a value using argument to pass data to another function, external variable, arrays and strings, pointers, structure, files and introduction, external variable, arrays and strings, pointers, structure, files and introduction to C++

Recommended Books:

1. Robert Lafore, 1997 C Programming Using Turbo C++, Sams,
2. Deitel & Deitel, 2000 C How to Program, 3rd Edition, Prentice Hall,
3. Aho, AV, Ulman JD, Foundation of Computer Science, 1995, Computer Science Press, WH Freeman, New York.
4. Hein JL, Theory of Computation; An introduction (1st edition) Jones & Bartlett, Boston

FOURTH SEMESTER

BSMath-241	Algebra I	Credit Hours 3 (3 + 0)
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Group Theory: Basic axioms of a group with examples, subgroups, order of a group, subgroups generated by subset of a group, system of generators, cyclic groups, cosets, Lagrange's theorem, introduction to permutations, even and odd permutations, cycles, lengths of cycles, transpositions, symmetric group, alternating groups, rings, fields (definitions and examples), vector spaces, subspaces, linear dependence and independence, linear span of a subset of a vector space, bases and dimensions of a vector space.

Linear Algebra: Algebra of matrices, determinants, matrix of a linear transformation, row and column operations, rank, inverse of matrices, solution of homogeneous and non-homogeneous equations, orthogonal transformation, eigen value problem with physical significance.

Recommended Books:

1. Anton H, Linear Algebra with Applications (8th edition), John Wiley, New York
2. Herstein IN, Topics in Algebra (2nd edition) John Wiley, New York
3. Hill RO, 1995, Elementary Linear Algebra with Application (3rd edition) Brooks / Cole
4. Leon SJ 2002 Linear Algebra with Applications (6th edition), Prentice Hall, Englewood Cliffs, NJ, USA
5. Nicholson WK, 1994, Elementary Linear Algebra with Applications (2nd edition), PWS Publishing Co.

BSMath-242	Numerical Methods & Linear Programming	Credit Hours 3 (3 + 0)
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Numerical Solutions of Non-Linear Equations: Errors in computation, Numerical Solutions of algebraic and transcendental equation, isolation of roots, graphical method, bisection method, iteration methods, Newton-Raphson method, method of false position.

Numerical Solutions of Simultaneous Linear Algebraic Equations: Choleski's factorization method, Jacobi Iterative method, Gauss-Seidel method (3 X 3 matrices only).

Numerical Integration: Numerical integration, Trapezoidal and Simpson's rules.

Linear Programming: Linear Programming in two dimensional space, the general linear programming, system of linear inequalities, solution spaces in linear programming, an introduction to Simplex method.

Recommended Books:

1. Atkinson KE, 1989, Introduction to Numerical Analysis (2nd edition), John Wiley, New York
2. Burden RL, Faires, JK, 1993 Numerical Analysis (5th edition), PWS Publishing Co.
3. Chapra SC, Canale RP, 1988, Numerical Methods for Engineers, McGraw Hill, New York
4. Muhammad Iqbal, (1998) An introduction to Numerical Analysis, Ilmi Kitab Khana, Kabir Street Urdu Bazar, Lahore

BSMath-243	Number Theory	Credit Hours 3 (3 + 0)
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Number Systems: Natural numbers, integers, rational numbers, real numbers, complex numbers, the equivalence and the difference of cardinality between them, De Moivre's theorem with applications, hyperbolic and logarithmic function, introduction to number theory including divisibility, the Euclidean algorithm, GCD

and LCM of 2 integers, fundamental theorem of arithmetic (UFT), properties of prime numbers, congruences with applications, arithmetic function, quadratic residues

Recommended Books:

1. Rose KH, 2000, Elementary Number theory and its Application (4th edition) Addison Wesley, Reading, Ma, USA
2. S.Manzur Hussain, (1995) Elementary Theory of Numbers The Carvan Book House, Lahore

BSMath-244	Numerical Computing	Credit Hours 3 (2 + 1)
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Use of mathematical software like MATLAB, MAPLE and MATHEMATICA for numerical calculations, graphics, algebra and calculus, solving equations, matrices, symbolic calculations, input and output, mathematical functions, power series, linear algebra etc.

Recommended Books:

1. Etter DM, Kuncicky D, Hull D, 2001, Introduction to MATLAB 6, Prentice Hall, Englewood Cliffs, NJ, USA
2. Garvan F, The Maple Book, 2002, Champan & Hall / CRC
3. Kaufmam S, 1994, Mathematics As a Tool: An Introduction with Practical Examples, Springer, New York

<u>FIFTH SEMESTER</u>		
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BSMath-351	Algebra II	Credit Hours 3 (3 + 0)
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Group Theory: Normalizers and centralizer of a subset of a group, Centre of a group, Normal subgroups, quotient groups, Conjugacy relation between elements and subgroups.

Homomorphism and isomorphism theorems, finite p-groups, internal orbits, 1st, 2nd & 3rd Sylow theorems.

Ring Theory: Types of rings, matrix rings, rings of endomorphism, polynomial rings, integral domain, characteristic of a ring, ideal, types of ideals, quotient rings, homomorphism of rings, fundamental theorem of homomorphism of rings.

Recommended Books:

1. Allenby RBJT, Rings, Fields and Groups: 1983 An introduction to Abstract Algebra, , Farleigh JB, A First Course in Abstract Algebra (7th edition) Addison Wesley, Reading, Ma, USA
2. Macdonald ID, 1975, The Theory of Groups, Oxford Clarendon Press, Ma, USA

BSMath-352	Real Analysis I	Credit Hours 3 (3 + 0)
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Supremum and infimum, completeness properties of the real numbers, limits of numerical sequences, limits and continuity, properties of continuous functions on closed bounded intervals, derivatives in one variable, the mean value theorem, sequences of functions, power series, point-wise and uniform convergence. Functions of several variables, open and closed sets and convergence of sequence in R^n : limits and continuity in several variables,

properties of continuous functions on compact sets, differentiation in n -space; the Taylor series in R^n with applications; the inverse and implicit function theorems.

Recommended Books:

1. Brabenec RL, Introduction to Real Analysis, 1997, PWS Publishing Company
2. Gaughan ED, 1997 Introduction to Analysis (5th edition), Brooks / Cole
3. Bartle RG, Sherbert DR, 1999, Introduction to Real Analysis (3rd edition) John Wiley, New York

BSMath-353

Complex Analysis I

Credit Hours 3 (3 + 0)

Analytic Function: Function of a Complex Variable, Limits, Theorems on limits, Continuity, Differentiation, Cauchy-Riemann conditions, Sufficient conditions, Analytic functions, Harmonic function, L'Hospital's Rule, Singular points and their types.

Elementary Functions: The Exponential function, Trigonometric functions, Logarithmic functions, Branches, Complex exponents, Inverse Trigonometric functions.

Integrals: Definite Integrals, Contours, Line Integrals, Simply and Multiply connected regions, Cauchy Integral theorem, Cauchy-Goursat theorem for the case of a triangle, closed polygon, simple closed curve and Multiply connected region, Indefinite Integrals, Cauchy Integral formula, Derivatives of Analytics functions Morera's Theorem, Cauchy Inequalities, Liouville's Theorem, Fundamental Theorem of Algebra, Maximum and Minimum modulus theorems, Rouché's theorem.

Power Series: Taylor's Series, Properties of Series, Uniform convergence, Integration and Differentiation of Power Series, Uniqueness of representations by Power Series, Multiplication and Division of Series, Zeros of analytic functions.

Recommended Books:

1. L.L Pennisi, 1976 Elements of Complex Variables, Holt Rinehart & Winston NY
2. Ruel V. Churchill, 1990 Complex Variable and Applications, McGraw-Hill (5th edition)
3. Walter Rudin, (1986) Real and Complex Analysis, McGraw-Hill International Edition
4. M. Iqbal. Fundamental of Complex Analysis, Ilmi Kitab Khana, Kabir Street Urdu Bazar, Lahore

BSMath-354

Topology

Credit Hours 3 (3 + 0)

Definitions and examples of topological and metric spaces, open and closed sets, Neighborhoods, Limit points of a set, closure of a set and its properties, Interior, exterior and boundary of a set. Definition and examples of continuous functions and homeomorphisms. Induced Topology, Topological Product.

Recommended Books:

1. G.F. Simmons. Introduction to Topology and Modern Analysis, (Revised Edition) McGraw-Hill Book Company
2. G.R. Munkers, 1975. Topology, A First Course (Revised Edition) Prentice Hall Inc,
3. S. Willard, 1970 General Topology, Addison Wesley NY.
4. Muhammad Amin, (1985) Introduction to General Topology, The Carvan Book House Lahore.
5. S.M. Yahya Introductory Set Topology (Revised Edition) The time Press Karachi

BS Math-355	Mechanics I	Credit Hours 3 (3 + 0)
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Composition and resolution of forces, Particles in equilibrium, Parallel forces, moments, couples, General conditions of equilibrium of coplanar forces, Principle of virtual work, Friction, Centre of mass and gravity

Recommended Books:

1. Synge JL, Griffith BA, Principles of Mechanics, McGraw Hill, New York
2. Goldstein H, 1980, Classical Mechanics (2nd edition) Addison Wesley
3. Chow TL, 1995, Classical Mechanics, John Wiley, New York
4. Q.K Ghori, Introduction to Mechanics (Revised Edition) West Pakistan Publishing Company Limited, Lahore

BSMath-356	Guest / Students Seminar	Credit Hours 1 (1 + 0)
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The purpose of this course is to provide a forum for the exchange of mathematical ideas between guest/faculty and Student's under the guidance of the course instructor. The instructor will arrange a weekly seminar to be given by Guest/Faculty or Students on topics or problems of general interests. This will not only provide the students a platform for expression and demonstration of their abilities but will also prepare them for the challenges which are likely to be faced by them in their practical life.

SIXTH SEMESTER

BSMath-361	Algebra III	Credit Hours 3 (3 + 0)
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Vector Space: Sums and direct sums of subspaces of a finite dimensional vector space, Dimension theorem, linear transformations, null space, image space of a linear transformation, rank and nullity of a linear transformation, relation between rank, nullity and dimension, change of basis, inner product spaces, projection of a vector along another vector, norm of a vector, Cauchy Schwartz inequality, Orthogonal and orthonormal basis, similar matrices and diagonalization of a matrix, Home (V,W), dimension and basis of home (V,W), dual basis, annihilators.

Recommended Books:

1. Axle SJ, 1996, Linear Algebra Done Right, Undergraduate Texts in Mathematics Springer, New York.
2. Birkhoff G, MacLane S. A Survey of Modern Algebra (4th edition) AKP Classics
3. Perry WL, 1988, Elementary Linear Algebra, McGraw-Hill, New York.

BSMath-362	Real Analysis II	Credit Hours 3 (3 + 0)
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Series of numbers and their convergence. Series of function and their convergence,. Dabroux upper and lower sums and integrals: Dabroux integrability, Riemann, sums and the Riemann integral, Riemann integration in R^2 , change of order variables of integration. Riemann integration in R^3 , and R^n , Riemann-Steiltjes integration, Functions of bounded variation. The length of a curve in R^n , Lebsegue integration.

Recommended Books:

1. Fulks W, Advanced Calculus, John Wiley, New York
2. Apostol T.M.I 1978 Introduction to Mathematical Analysis, Addison Wesley,
3. E.G.Phillips A Course of Analysis
4. W.Rudin Principle of Mathematical Analysis (Revised Edition) McGraw Hill

BSMath-363	Complex Analysis II	Credit Hours 3 (3 + 0)
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Residues and Poles: Residues, Residue theorem, poles, quotients of analytic functions, Cauchy principal value of integrals, Evaluation of improper real integrals, Improper integrals involving Trigonometric functions, Definite integral of Trigonometric functions, Integration around a branch point.

Mapping by Elementary Function: Linear functions, The function Z^n , the function $\frac{1}{Z}$ the point at infinity

The Linear Fractional Transformation, special Linear Fractional Transformations, The function $Z^{1/2}$, The transformation $w = e^z$, The Transformation $w = \sin z$

Conformal Mapping: Rotation of tangents, conformal mapping, Conjugate Harmonic functions, inverse function, Transformation of Harmonic functions, Jacobian of a Transformation, Transformation of boundary conditions

Recommended Books:

1. L.L. Pennisi, , 1976 Elements of Complex Variables, holt Rinehart & Winston NY
2. Ruel V. Churchill, 1990 Complex Variable and Applications, McGraw-Hill (5th edition)
3. Walter Rudin, 1986 Real and Complex Analysis, McGraw-Hill International Edition
4. M. Iqbal Fundamental of Complex Analysis, Ilmi Kitab Khana, Kabir Street, Urdu Bazar Lahore

BSMath-364	Topology II	Credit Hours 3 (3 + 0)
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Separation Axioms, Hausdorff, Spaces, Regular Spaces, Completely Regular Spaces, Normal Spaces, Metric Spaces, Properties of Metric Spaces, Metrizable, Compact Spaces, Open Cover, Finite Intersection Property, Locally Compact Spaces, Compactness in Metric Spaces, Connected Spaces, Topological Product of Connected Spaces, Locally Connected Spaces, Pathwise and Arcwise Connected Spaces, Complete Metric Spaces, Concept of Category and Bair's Category theorem.

Recommended Books:

1. G.F. Simmons. Introduction to Topology and Modern Analysis, (Revised Edition) McGraw-Hill Book Company

2. G.R.Munkers, 1975 Topology, A First Course (Revised Edition) Prentice Hall Inc,
3. S.Willard , 1970 General Topology, Addison Wesley NY
4. Muhammad Amin, 1985 “Introduction to General Topology” The Caravan Book House Lahore
5. S.M. Yahya, Introductory Set Topology (Revised Edition) The time Press Karachi

BSMath-365	Mechanics II	Credit Hours 3 (3 + 0)
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Fundamental laws of Newtonian mechanics,. Motion in a straight line, Uniformly accelerated and resisted motion, Velocity and acceleration and their components in Cartesian and polar coordinates, tangential and normal components, radial and transverse, Relative motion, Angular velocity, Conservative forces, projectiles, Central forces and orbits, Simple harmonic motion, damped and forced vibrations, elastic strings and springs.

Recommended Books:

1. F. Chorlton, 1983, Textbook of Dynamics, Ellis Horwood Ltd
2. L.A Pars, 1953, Introduction to Dynamics, Cambridge University Press.
3. Q.K. Ghorl, Introduction to Mechanics (Revised Edition) West Pakistan Publishing Company Limited, Lahore

BSMath-366	Guest/Student Seminar	Credit Hours 1 (1 + 0)
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See Course Math-356

SEVENTH SEMESTER

BSMath-471	Functional Analysis I	Credit Hours 3 (3 + 0)
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Metric Spaces: A quick review, completeness and convergence, completion

Normed Spaces: Linear spaces, Normed spaces, Difference between a metric and Normed space, Banach spaces, Bounded and continuous linear operators and functionals, Dual spaces, Finite dimensional spaces, F. Riesz Lemma, the Hahn-Banach Theorem, The HB theorem for complex spaces. The HB theorem for Normed spaces, The open mapping theorem. The closed graph theorem, Uniform boundness principle and its applications

Banach-Fixd-point Theorem: Application in Differential and Integral equations

Recommended Books:

1. A.E. Taylor and D.C. Lay, 1980 Introduction to Functional Analysis, John Wiley & Sons,
2. G.F. Simmons, Introduction to Topology and Modern Analysis (Revised Edition) McGraw-Hill Book Company
3. Curtain RF, Pritchard AJ, Functional Analysis with Applications, John Wiley, New York
4. Friedman A, 1982, Foundations of Modern Analysis, Dover
5. Kreyszig E, Introductory Functional Analysis with Application, John Wiley, New York
6. Rudin W, 1973 Functional Analysis, McGraw Hill New York.

BSMath-472

Mathematical Statistics I

Credit Hours 3 (3 + 0)

Frequency distributions, Measures of dispersion, Skewness and Kurtosis.

Probability; Total and compound probability, Conditional Probability, Baye's formula and Baye's theorem of probability, Geometrical problem, Mathematical expectation, Moment generating function, Cumulants and Cumulant generating function, Discrete probability distributions; The Binomial distribution, The Hyper geometric distribution, The Poisson's distribution, Uniform distribution, Geometric distribution and Negative Binomial distribution, The Hyper geometric distribution, The Poisson's distribution, Uniform distribution, Geometric distribution and Negative Binomial distribution. Continuous distribution. The normal distribution, The Uniform distribution, Gamma distribution, Beta distributions and Cauchy distribution, Bivariate distribution

Recommended Books:

1. Uspensky, J.V An Introduction to Theory of Probability, McGraw-Hill
2. Freund J, Mathematical Statistics, Prentice Hall
3. Weatherburn C.E, A First Course in Mathematical Statistics, Cambridge University Press
4. Wilks S.S. Elementary Statistical Analysis, Princeton University Press
5. Kenney and Keeping, Mathematical Statistics
6. Feller W, Probability Theory and Applications
7. M.Graybill, An Introduction to Mathematical Probability

BSMath-473

Guest/Student's Seminar

Credit Hours 1 (1 + 0)

See Course Math-356

BSMath-XXX

Elective Course

Credit Hours 3 (3 + 0)

See List of BS Elective

BSMath-XXX	Elective Course	Credit Hours 3 (3 + 0)
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See List of BS Elective

BSMath-XXX	Elective Course	Credit Hours 3 (3 + 0)
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See List of BS Elective

EIGHTH SEMESTER

BSMath-481	Functional Analysis II	Credit Hours 3 (3 + 0)
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Hilbert Spaces: Inner product space, Hilbert space, orthogonal and orthonormal sets, orthogonal complements, Gramschmidt orthogonalization process, representation of functional, Riesz representation theorem, Weak and Weak Convergence

Finite Dimensional Spectral Theory: The Definition of Spectrum of an Operator and Some Examples, Spectral Properties of Self adjoint Operators, The Spectral Mapping Theorem for Finite Dimensional Hilbert Spaces

Recommended Books:

1. A.E Taylor and D.C. Lay , 1980 Introduction to Functional Analysis, John Wiley & Sons
2. G.F. Simmons, Introduction to Topology and Modern Analysis (Revised Edition) McGraw-Hill Book Company
3. Curtain RF, Pritchard AJ, Functional Analysis with Applications, John Wiley, New York
4. Friedman A, 1982, Foundations of Modern Analysis, Dover
5. Kreyszig E, Introductory Functional Analysis with Application, John Wiley, New York

6. Rudin W, 1973, Functional Analysis, McGraw Hill New York.

BSMath-482	Mathematical Statistics II	Credit Hours 3 (3 + 0)
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Correlation and Regression, Correlation and Rank Correlation, Simple and Multiple Linear Regression, Least Square estimates, Standard Errors of Estimates, Coefficient of Determination and Multiple determination. Multiple and partial correlations. Fitting of Curves up to Second degree parabolas.

Sampling: Sampling with and without replacement, sampling distribution and Standard error, Sampling distribution of the mean. Central limit theorem, χ^2 Distribution and its properties, Students T-distribution and interrelations between T and F-distributions, Point and interval estimates.

Recommended Books:

1. Uspensky, J.V, An Introduction to Theory of Probability, McGraw-Hill
2. Freund J, Mathematical Statistics, Prentice Hall
3. Weatherburn C,E,A First Course in Mathematical Statistics, Cambridge University Press
4. Wilks S.S. Elementary Statistical Analysis, Princeton University Press
5. Kenney and Keeping, Mathematical Statistics
6. Feller W, Probability Theory and Applications
7. M.Graybill, An Introduction to Mathematical Probability
8. DeGroot MH, Schervish MJ, 2002, Probability and Statistics (3rd edition) Addison-Wesley, Reading, Ma, USA
9. Johnson RA, 1994, Probability and Statistics for Engineers, Prentice Hall, Englewood Cliffs, NJ, USA
10. Papoulis A, 1991, Probability, Random Variables and Stochastic Process (3rd edition) McGraw Hill, New York
11. Sincich T, 1990, Statistics by Examples, Dellen Publication Company

BSMath-483	Guest / Student's Seminar	Credit Hours 1 (1 + 0)
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See Course Math-356

BSMath-XXX	Elective Course	Credit Hours 3 (3 + 0)
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See List of BS Elective

BSMath-XXX	Elective Course	Credit Hours 3 (3 + 0)
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See List of BS Elective

BSMath-XXX	Elective Course	Credit Hours 3 (3 + 0)
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See List of BS Elective

BS ELECTIVES

BSMath-474	Numerical Analysis I	Credit Hours 3 (3 + 0)
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Solutions of non-linear equations: the Bisection method, fixed point iteration, the method of false position, the Newton Raphson's method, Rate of convergence of iterative methods.

Solution of linear system equations, Iterative methods (Jacobi, Gauss Seidel, S.O.R)

Eigen Value Problems: The power method and inverse power method, Jacobi's method, Given's method and Householder's method

Interpolation: Lagrange Interpolation, Divided Differences, Newton Forward Difference formula, Newton Backward formula, Aitken's and Inverse Interpolations, Cubic splines, Finite Difference Operators (Forward, Backward, Central and Shift)

Recommended Books:

1. R.L. Burden and J. Douglas Faires, 2000, Numerical Analysis Brooks / Cole Publishing Co:
2. C.E. Froberg, 1974, Introduction to Numerical Analysis, Addison Wesley Co:
3. M.K. Jain 1993, Numerical Methods for Scientific & Engineering Computation Wiley Eastern Limited.
4. Dr. Faiz Ahmad and M. Afzal Rana, 1995, Elements of Numerical Analysis National Book Foundation

BSMath-484	Numerical Analysis II	Credit Hours 3 (3 + 0)
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Numerical Differentiation: Forward formulas, Central Difference formulas, Error in Numerical differentiation, Extrapolation to the limit

Numerical Integration: The rectangular, Trapezoidal and Simpson's One-Third and Three-Eight's Romberg Integration, Method of undetermined coefficients

Difference & Differential equations: Formation of difference equations, Numerical Solution of Linear (Homogeneous and Non-homogeneous) difference equations with constant coefficients, Euler's methods, Taylor's methods, Runge-Kutta Method, Milne-Simpson method, Adam-Bashforth-Moulton Method for solving Initial value problems along with convergence and instability Criteria, Finite Difference method and the shooting method for Boundary value problems.

Recommended Books:

1. R.L. Burden and J. Douglas Faires, 2000, Numerical Analysis Brooks / Cole Publishing Co:
2. C.E. Froberg, 1974, Introduction to Numerical Analysis, Addison Wesley Co:
3. M.K. Jain, 1993, Numerical Methods for Scientific & Engineering Computation Wiley Eastern Limited.
4. Dr. Faiz Ahmad and M. Afzal Rana, 1995, Elements of Numerical Analysis National Book Foundation

BSMath-475	Measure Theory & Integration I	Credit Hours 3 (3 + 0)
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Lebesgue measure, Outer measure, Measurable set and Lebesgue measure. A non-measurable set, measurable function. The Lebesgue Integral: The Lebesgue integral of a bounded function. The general Lebesgue integral, Lebesgue integral and its relation to Riemann integral, Convergence in measure

Recommended Books:

1. H.L. Royden: 1968, Real analysis, The McMillian Co:
2. D. de. Barra, 1981, Measure Theory & Integration, Ellis Horwood Ltd
3. P.R. Halmos, 1950, Measure theory, von Nostrand NY
4. A. Mukherjea, 1978, Real and Functional Analysis, Plenum and K.Pothoven Press
5. Seymour Lipschutz, Set Theory and Related Topics, Mc-Graw Hill Publishing Co.

BSMath-485	Measure Theory & Integration II	Credit Hours 3 (3 + 0)
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Measure space, Measurable functions, Integration, General convergence theorems, Signed measures, The Radon-Nikodym theorem, The L_p space, Outer measure and measurability, the extension theorem, The Lebesgue Stieltjes integral, product measure, Inner Measure.

Recommended Books:

1. H.L. Royden: 1968, Real analysis, The McMillian Co:
2. D. de. Barra, 1981, Measure Theory & Integration, Ellis Horwood Ltd
3. P.R. Halmos, 1950, Measure theory, von Nostrand NY
4. A. Mukherjea, 1978, Real and Functional Analysis, Plenum and K.Pothoven Press
5. Seymour Lipschutz, Set Theory and Related Topics, Mc-Graw Hill Publishing Co.

BSMath-476	Advance Calculus	Credit Hours 3 (3 + 0)
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Metric Space, Limits & continuity, Derivatives, applications of the derivatives and Mean value theorems, Applications of Mean value theorems, differential.

Definite Integral, elementary properties, improper integrals, Gamma and Beta function, Some elementary applications of definite integral (Buffon, Needle problem, arc length, Picard existence theorem)

Differentiation of functions of several variables, partial & directional derivative, differential and differentiation under integral sign, implicit function theorems and its application, lagrange multipliers, Bronchistochoorne problem, vibrating string.

Recommended Books:

1. W.L. Voxman & R.H. Goetschel, Advanced Calculus An Introduction to Modern Analysis Jr.Marcel Dekker, Inc, N.Y.
2. Murray R. Spiegel Advanced Calculus McGraw Hill International Book Co: Singapore

BSMath-486	Advance Calculus II	Credit Hours 3 (3 + 0)
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Infinite sequences, upper and lower limits, Infinite series, tests for convergence, absolute and conditional convergence, Sequences and series of functions, Uniform Convergence, Taylor's theorem, Taylor and Maclaurm Power Series, Uniform convergence of power series.

Fourier Series: Periodic functions. Fourier series, Dirichlet condition. Odd and even function, Half range Fourier sine or cosine series. Parseval's identity, Differentiation and integration of Fourier series, Complex notation for Fourier series, Boundary value problems, Orthogonal functions.

Fourier Integrals: The Fourier integral, Equivalent forms of Fourier's integral theorem, Fourier transforms, Parseval's identities for Fourier integrals, The convolution theorem.

Recommended Books:

1. W.L. Voxman & R.H. Goetschel, Advanced Calculus An Introduction to Modern Analysis Jr. Marcel Dekker, Inc, N.Y.
2. Murray R. Spiegel Advanced Calculus McGraw Hill International Book Co: Singapore

BSMath-477	Differential Geometry I	Credit Hours 3 (3 + 0)
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Space curves, Osculating plane, the moving trihedron, Serret-Frenet formulae, Osculating circle, The concept of surface curves, Spherical and Cylindrical helices, Spherical indicatrix, Involute and Evolutes

Recommended Books:

1. E. Weatherburn, Differential Geometry of Three Dimensions 1961, Cambridge University Press
2. Millman & Parker, Elements of Differential Geometry, 1977, Prentice Hall
3. D.J. Struik, Lectures on Classical Differential Geometry 1962, Marcel Dekker, Inc
4. Vaisman, I, First Course in Differential Geometry 1984, Marcel Dekker, Inc
5. Wilmore T.J. An Introduction to Differential Geometry, Clarendon Press, Oxford

BSMath-487	Differential Geometry II	Credit Hours 3 (3 + 0)
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First fundamental form of a surface. The second fundamental form, Normal curvature, Principal directions and principal curvatures, Gaussian and mean curvature, Euler's Theorem, Gauss-Weingarten and Gauss-Godazzi equations

Recommended Books:

1. E. Weatherburn, 1961, Differential Geometry of Three Dimensions Cambridge University Press
2. Millman & Parker, 1977, Elements of Differential Geometry, Prentice Hall
3. D.J. Struik, 1962, Lectures on Classical Differential Geometry Marcel Dekker, Inc
4. Vaisman, I, 1984, First Course in Differential Geometry Marcel Dekker, Inc
5. Wilmore T.J. An Introduction to Differential Geometry, Clarendon Press, Oxford

BSMath-478	Partial Differential Equations	Credit Hours 3 (3 + 0)
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Formulation of equation, Linear First order equation, Quasi Linear First order Equation, Method of Lagrange, Cauchy problem for First order equations, Linear second order equation in two independent variables, Normal forms, Hyperbolic, Parabolic and Elliptic equations, Cauchy problem for linear second order equations in two independent variables, Adjoint operator, Self adjoint differential operator for equation in two variables, Laplace's equation, Separation of variables, One dimensional wave equation.

Recommended Books:

1. R. Dennermeyer., Introduction to Partial differential Equations and Boundary value problems McGraw Hill Co.
2. I.N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Co.
3. C.R. Chester, Techniques in Partial Differential Equations, McGraw Hill Co.
4. R.I. Laberman, Elementary applied Partial Differential equations with Fourier Series and Boundary Value problems, Prentice Hall Inc.
5. W.E. Willimans, I, Partial Differential Equations, Clarendon Press, Oxford

BSMath-488	Integral Equations	Credit Hours 3 (3 + 0)
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Classification of Integral Equations, Volterra Integral Equations, Relation between Linear differential equation and Volterra Integral equations, Solutions of the Integral equations of second kind in series, the method of successive approximation and substitution, Method of Laplace transform, Iterated Kernels, Reciprocal Kernels, Volterra Solutions of the Fredholm's equations, Fredholm's two fundamental relations, Fredholm's solutions of the integral equations when $D(\lambda) = 0$, Solutions of the homogeneous equation when $D(\lambda) = 0$, $D'(\lambda) \neq 0$, Solutions of the homogeneous equation when $D(\lambda) = 0$, Characteristic constants and fundamental functions,

Associated homogeneous integral equations, Kernel's of the form $\sum a_1(x)b_1(y)$, Existence of at least one

characteristic constant for a symmetric Kernel, Orthogonality of fundamental function for symmetric Kernel, Schmidt's solution of the non-homogeneous integral equations

Recommended Books:

1. W.V. Lovitt, Linear Integral Equations, Dover Pub. Inc
2. A.J. Jerri, 1985, Introduction to Integral equations with Applications Marcel Dekker Inc
3. R.P. Kanwal, 1971, Linear Integral Equations, Academic Press, N.Y
4. H. Hochstadt, 1973, Integral Equations, John Wiley, N.Y

BSMath-479	Electromagnetism I	Credit Hours 3 (3 + 0)
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Equations of electrostatic and magnetostatic boundary conditions, Boundary value problems and methods of solution, Electrostatics and magnetostatics of macroscopic medium, Dipoles and Multipole, Dielectrics, Steady currents and their interaction, Varying Currents, Electromagnetic induction, Maxwell's equations

Recommended Books:

1. V.C.A. Ferraro, 1950, Electromagnetic Theory, ELBS London
2. Loryain & Corson 1970, Electromagnetic Fields and Waves Toppan Co: Ltd
3. C.A. Coulson, 1951, Electricity, Liver & Boyd Edinburgh
4. A.S. Ramsey, 1952 Electricity & Magnetism, Cambridge University Press
5. J.R Reitz, F.J Milford & Christy, Foundation of Electromagnetic Theory

BSMath-489	Electromagnetism II	Credit Hours 3 (3 + 0)
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Energy, Momentum (Poynting) vectors and stress tensor of electromagnetic fields, Wave propagation, Waves in a conducting medium, reflection and dispersion, Lorentz formula, Wave guide and cavity resonators, Spherical waves, Field of uniformly moving charged particle, Field of an oscillating dipole, Diffraction of electromagnetic waves.

Recommended Books:

1. C.C.A. Ferraro, 1950, Electromagnetic Theory, ELBS London
2. Lorain & Corson 1970, Electromagnetic Fields and Waves Toppan Co: Ltd
3. C.A. Coulson, 1951, Electricity, Liver & Boyd Edinburgh
4. A.S. Ramsey, 1952 Electricity & Magnetism, Cambridge University Press
5. J.R Reitz, F.J Milford & Christy, Foundation of Electromagnetic Theory

BSMath-4710	Dynamics	Credit Hours 3 (3 + 0)
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Particle Dynamics: Projectile motion under gravity, constrained particle motion, angular momentum of a particle Orbital Motion: Motion of a particle under a central force, use of reciprocal polar co-ordinates, use of pedal co-ordinates and equations, Kepler's Laws of planetary motion.

Motion of a system of particles: Linear momentum of a system of particles, angular momentum and rate of change of angular momentum of a system, use of centroid, moving origins, impulsive forces, elastic impact,

Introduction to Rigid Body Dynamics: Moments and products of inertia, the theorems of parallel and perpendicular axes, angular momentum of a rigid body about a fixed point and about fixed axes, principal axes, Kinetic energy of a rigid body rotating about a fixed point, general motion of a rigid body, momental ellipsoid, equimomental system, coplanar distribution.

Recommended Books:

1. F. Chorlton, 1983, Textbook of Dynamics, Ellis Horwood Ltd
2. L.A Pars, 1953, Introduction to Dynamics, Cambridge University Press.
3. A.S. Ramsey, 1952 Electricity & Magnetism, Cambridge University Press
4. J.L.Synge and B.A. Griffith, 1970, Principle of Mechanics, McGraw Hill Book Co.
5. S.L.Loney Dynamics of Particle and Rigid Bodies

BSMath-4810	Hydrodynamics	Credit Hours 3 (3 + 0)
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Bernoulli's Theorem: Equation of continuity, equation of motion, Velocity Potential and Stream lines, irrotational motion, impulsive motion, flow and circulation, complex potential, streaming motion past a circular cylinder, Blasius theorem and Kutta Joukowski theorem, Sources, sinks and doublets, Motion of circular cylinder, Rectilinear vortices, vortex sheet and vortex filaments, Stokes stream function, sphere in a uniform stream, waves Surface waves, Progressive waves, group velocity, Stationary waves, waves at interface, Long waves.

Recommended Books:

1. L.M. Milne-Thomson, Theoretical hydrodynamics

BSMath-4711	Quantum Mechanics I	Credit Hours 3 (3 + 0)
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Inadequacy of Classical Mechanics, Black body radiation, Photoelectric Effect, Compton Effect, Bohr's theory of atomic structure, Wave Particle duality, De-Broglie's postulate. The Uncertainty Principle. Uncertainty of position and momentum, statement and proof of the uncertainty principle, Energy-time uncertainty. Eigenvalues and Eigenfunctions Operators and Eigenfunctions, Linear Operators, Operator formalism in Quantum Mechanics, Orthonormal system, Hermitian operators and their properties, Simultaneous Eigen-functions, Parity operators, Postulate of quantum mechanics, Schrödinger Wave, Equation, Motion in One Dimension, Step potential, Potential Barrier, Potential Well, harmonic Oscillator, Motion in Three Dimensions, Angular Momentum, Pauli Exclusion Principle, hydrogen atom.

Recommended Books:

1. R.L.White, 1966, Basic Quantum Mechanics, McGraw Hill Book Co. N.Y
2. L.I. Schiff, 1955, Quantum Mechanics, McGraw hill Kogakusha Ltd
3. P.T.Mathews, 1955, Introduction to Quantum Mechanics, McGraw Hill Book Co.
4. Dicke & Wittke, 1966, Introduction to Quantum Mechanics, Addison Wesley Publishing Co.
5. F.Mandl, 1966, Quantum Mechanics, Butterworth, London 7th Impression
6. P.M. Mathews. K.V Venkatesan. 1984, A Text Book of Quantum Mechanics 8th Reprint Tata McGraw Hill Publishing Co: Limited, New Delhi
7. P.A.M.Dirac, Introduction to Quantum Mechanics
8. Riazuddin and Fayyazuddin, 1990, Introduction to Quantum Mechanics, World Scientific

BSMath-4811	Quantum Mechanics II	Credit Hours 3 (3 + 0)
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Heisenberg equations of motion and equivalence of Schrodinger and Heisenberg physical pictures. Scattering theory, Born approximation, Partial wave analysis, Optical theorem. Time dependent & time independent perturbation theory, Selection rules, Klein-Gordon equation, Dirac's equation, Spin angular momentum

Recommended Books:

1. R.L.White, 1966, Basic Quantum Mechanics, McGraw Hill Book Co. N.Y
2. L.I. Schiff, 1955, Quantum Mechanics, McGraw hill Kogakusha Ltd
3. P.T.Mathews, 1955, Introduction to Quantum Mechanics, McGraw Hill Book Co.
4. Dicke & Wittke, 1966, Introduction to Quantum Mechanics, Addison Wesley Publishing Co.
5. F.Mandl, 1966, Quantum Mechanics, Butterworth, London 7th Impression
6. P.M. Mathews. K.V Venkatesan. 1984, A Text Book of Quantum Mechanics 8th Reprint Tata McGraw Hill Publishing Co: Limited, New Delhi
7. P.A.M.Dirac, Introduction to Quantum Mechanics
8. Riazuddin and Fayyazuddin, 1990, Introduction to Quantum Mechanics, World Scientific

Transformation: Frame of reference, inertial and non-inertial frames of reference, Galilean transformation, Transformation of position, velocity, and acceleration, Rotating System: Uniformly rotating frame of reference, effect of rotation of the earth on g, Foucault's pendulum, Coriolis force, Motion relative to earth, Relativistic Approach, Michelsons-Morley experiment, Einstein's theory of relativity, Lorentz Transformations, Lorentz-Fitzgerald contraction Time dilation, Relativity of mass and its derivation, energy mass relation, energy momentum relation, four force, four velocity, four acceleration, four momentum, relativistic kinetic energy, relativistic equation of motion

Recommended Books:

1. Becker, 1954, Theoretical Mechanics, McGraw-Hill N.Y
2. Synge and Griffith, 1970, Principles of mechanics, McGraw Hill Tokyo
3. Sears & Brehme, 1968, Introduction to the Theory of Relativity, Addison Wesley
4. Derek & Lawden, An Introduction to Tensor & Relativity Science Paper Books
5. Synge, Relativity Vol: I
6. A.P. French: Special Relativity, The ELBS Nelson
7. Asghar Qadir, 1989 Relativity, An Introduction to the Special Relativity,

Maxwell's equations in tensor forms, gravity as a metric phenomenon, the red shift, Field equations in free space, the Riemann curvature tensor; the Bianchi identities; the Einstein field equations; the Riemann tensor and fields of geodesics. The Schwarzschild solution; the perihelion shift of Mercury; the trajectory of a light ray in Schwarzschild field; significance of the three tests of general relativity, Further consequences of the field equations; the equations of motion; conservation law in general relativity, Variational principle in general relativity, variational principles in general relativity.

Recommended Books:

1. Adler, Bazin & Schiffer, An Introduction to General Relativity, McGraw Hill
2. Sokolnikoff, S, Tensor Analysis, Theory and Applications, Wile.
3. Lawden, D.D, Introduction to Tensor Calculus and Relativity, Matheum & Co
4. Sear & Brehme, Introduction to Tensor Calculus and Relativity, Matheum & Co
5. W.Rindler, Essential Relativity
6. C.Moller, Introduction to Relativity

Introduction, Formulation and graphical solution of two variables linear programmes, Simplex method, Method of Penalty, the two-phase technique, Sensitivity analysis, Dual Simplex method, Duality, Sensitivity and parametric Analysis, Transportation and Assignment Models, Linear Programming: Advanced Topics

Recommended Books:

1. H.A.Taha, 1982 Introduction to Operations Research, 3rd Edition McMillan Publishing Co. N.Y.
2. G.Hadley; Introduction to Linear Programming
3. Gillett, B.E, Introduction to Operations Research, Tata McGraw Hill publishing Co. Ltd, New Delhi
4. Hillier, G.D. & Lieberman, 1974, G. J Operators Research, CBS Publishers and Distributors, New Delhi

BSMath-4813**Operations Research II****Credit Hours 3 (3 + 0)**

Matrix definition of the standard LP problem, Foundation of Linear Programming, Revised simplex Method, Bounded variables, Decomposition Algorithm, Parametric, Linear Programming, Application of integer Programming, Cutting plane, the Fractional (pure integer) algorithms, mixed algorithm, Game theory, graphical solutions of two person zero sum games, mixed strategies, Graphical solution of (2 X n) and (m X n) games by linear programming.

Recommended Books:

1. H.A.Taha, 1982 Introduction to Operations Research, 3rd Edition McMillan Publishing Co. N.Y.
G.Hadley; Introduction to Linear Programming
2. Gillett, B.E, Introduction to Operations Research, Tata McGraw Hill publishing Co. Ltd, New Delhi
3. Hillier, G.D. & Lieberman, 1974, G. J Operators Research, CBS Publishers and Distributors, New Delhi

BSMath-4714**Optimization Theory I****Credit Hours 3 (3 + 0)**

Statement of the problem, condition for optimality, concept of direction of search, alternating direction and steepest descent methods, conjugate direction method, conjugate gradient method, Newton's method, Quasi Newton Equation, derivation of updating formulae of Quasi-Newton's equation. The Gauss-Newton method. The levenberg marquart method. The corrected Guass Newton method. Methods for large scale problems.

Recommended Books:

1. Gill, P.E. Murray E & Wright, 1981, H.H. Practical Optimization Academic Press
2. Fletcher, R, 1980, Practical Methods of Optimization Vol: I & II, John Wiley and Sons
3. David G. Luenberger, 1986, Optimization by Vector Space Methods, John Wiley & Sons
4. Gotfried BS, Weisan J, 1973, Introduction to Optimization Theory, Prentice Hall, Englewood Cliffs, NJ, USA
5. S.S. Rao, 1984 Optimization Theory and Application, Wiley Eastern Ltd

BSMath-4814**Optimization Theory II****Credit Hours 3 (3 + 0)**

Theory of constrained optimization, methods for minimizing a general function subject to linear equality constraints, active set strategies for linear inequality constraints, special forms of the objectives functions, Lagrange multiplier estimates, Changes in working set, Barriers function methods, Penalty functions methods, Methods based on Lagrangian functions reduced gradient and gradient projection method

Recommended Books:

1. Gill, P.E. Murray E & Wright, 1981, H.H. Practical Optimization Academic Press
2. Fletcher, R, 1980, Practical Methods of Optimization Vol: I & II, John Wiley and Sons
3. David G. Luenberger, 1986, Optimization by Vector Space Methods, John Wiley & Sons
4. Gotfried BS, Weisan J, 1973, Introduction to Optimization Theory, Prentice Hall, Englewood Cliffs, NJ, USA
5. Bazaraa, M.S and Shetty, 1979 C.M. Nonlinear Programming: Theory and Algorithms, John Wiley & Sons
6. S.S. Rao, 1984 Optimization Theory and Application, Wiley Eastern Ltd

BSMath-4715	Mathematical Modeling	Credit Hours 3 (3 + 0)
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Concept of model, modeling and simulation, functions, linear equations, linear differential equations, non linear differential equations and integral equations as models, introduction to simulation techniques,

Ordinary Differential Equations: Modeling with first order differential equations; Newton's law of cooling, radioactive decay; motion in a gravitational field; population growth; mixing problem; Newtonian mechanics; Modeling with second order differential equations; vibrations; application to biological system; modeling with period or impulse forcing functions; Modeling with systems of first order differential equations; competitive hunter model; predator prey model

Partial Differential Equations: Methodology of mathematical modeling; objective, background, approximation and idealization, model validation, compounding Modeling wave phenomena (wave equation); shallow water waves, uniform transmission line, traffic flow, RC circuits. Modeling the heat equation and some application to heat conductin problems in roads, Lamina cylinders etc, modeling the potential equation (Laplace equation), application in fluid mechanics, gravitational problems, Equation of continuity.

Recommended Books:

1. Giordano FR, Weir MD, 1994, Differential Equations; A modeling approach, Addison Wesley, Reeding, Ma USA
2. Jerri AJ, 1985, Introduction to Integral Equations with Applications, Marcel Dekker, New York
3. Myint UT, Debnath L, 1987, Partial Differential Equations for Scientists and Engineers (3rd edition) North Holland Amsterdam

BSMath-4815	Special Function	Credit Hours 3 (3 + 0)
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Simple properties of the Gamma Function and related functions (Beta Function, Incomplete Gamma function, Digamma and Polygamma function) Definition and Generating function of Legendre polynomials, Recurrence relation and Legendre differential equation. Rodrigue's formula, An integral representation of Legendre polynomials and orthogonality Hermite polynomials and laguerre polynomials. Definition and Generating function of the Bessel functions. Recurrence relation, Differential equation solvable with Bessel functions. An integral form for Bessel function and orthgonolity. The Laplace transforms and applications to differential equations.

Recommended Books:

1. Larry C. Andrews, 1985 Special Function for Engineers and Applied Mathematics, MacMillan Publishing Co:
2. N.W. Lebedev, 1972 special Functions and their Applications, Dover Publishing Inc,
3. B. Spain and M.G. Smith, 1970 Functions of Mathematical Physics, Van Nostrand Reinhold Comp,
4. Willam E.Boyce and Richard C.Diprima, 1986 Elementary Differential Equations and Boundary value problems, John Wiley and Sond

BSMath-4716	Project	Credit Hours 3 (3 + 0)
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Each selected student will undertake a project on a topic mutually agreed upon by him / her and respective advisor. The project shall be carried over to eighth semester.

BSMath-4816	Project Continue	Credit Hours 3 (3 + 0)
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Those students who had offered project in seventh semester will continue the same project, However, they will be required to complete the same before the commencement to eighth semester final examination