B. Sc. (Mathematics) Syllabus

Department of Mathematics
Faculty of Science
The Maharaja Sayajirao University of Baroda
Vadodara 390002

Sr. No.	Course Code	Course Title	Credit
Semester – I (Principal & Subsidiary)			
1	MAT1101	Matrices	2
2	MAT1102	Algebra and Number Theory	3
3	MAT1103	Calculus	3
Semester – II (Principal & Subsidiary)			
1	MAT1201	Differential Equations	2
2	MAT1202	Abstract Algebra-I	3
3	MAT1203	Geometry	3
Semester – III (Principal)			
1	MAT1301C07	Linear Algebra	4
2	MAT1302C08	Advanced Calculus	4
Semester – IV (Principal)			
1	MAT1401C09	Elementary Analysis	4
2	MAT1402C10	Integral Calculus and Differential Equations	4
Semester – V (Principal)			
1	MAT1501C11	Abstract Algebra-II	4
2	MAT1502C12	Analysis-I	4
3	MAT1503C13	Analysis-II	4
4	MAT1504C14	Numerical Analysis and Computer Programming-I	4
5	MAT1505C15	Linear Programming	4
Elective Courses			
6	MAT1506E17	Applications of Mathematics in Finance	2
7	MAT1507E18	Operations Research: Inventory Control	2
8	MAT1508E19	Statics	2
9	MAT1509E20	Boolean Algebra	2
Core Foundation			
10	MAT1510F01	Graph Theory	2
11	MAT1511F01	Problem Solving Techniques in Mathematics	2
Semester – VI (Principal)			
1	MAT1601C16	Abstract Algebra-III	4
2	MAT1602C17	Analysis-III	4
3	MAT1603C18	Analysis-IV	4
4	MAT1604C19	Numerical Analysis and Computer Programming-II	4
5	MAT1605C20	Differential Equations	4
Optional Papers			
6	MAT1606E21	Cryptography	4
7	MAT1607E22	Mathematical Modeling	4
8	MAT1608E23	Mathematics of Insurance	4
9	MAT1609E24	Mechanics	4
10	MAT1610E25	Operations Research : Game and Queueing Theory	4
Semester – III (Subsidiary)			
1	MAT1303S07	Linear Algebra, Sequence and Series	4
2	MAT1304S08	Advanced Calculus	4
Semester – IV (Subsidiary)			
1	MAT1403S09	Linear Programming and Numerical Analysis	4
2	MAT1404S10	Integral Calculus and Differential Equations	4

Sr. No.	Course Code	Course Title	Credit
Semester – I (Elective)			
1	MAT1104	Matrices	2
2	MAT1105	Differential and Integral Calculus	2
Semester – II (Elective)			
1	MAT1204	Differential Equations and Its Applications	2
2	MAT1205	Geometry	2
Semester – III (Elective)			
1	MAT1305E05	Algebra	2
Semester – IV (Elective)			
1	MAT1405E11	Numerical Analysis	2

Sr. No.	Course Code	Course Title	Credit
Semester – III, IV (Elective (Open) Mathematics)			
1	MAT1007E06	Boolean Algebra and its Applications	2
2	MAT1008E07	Discrete Mathematics and its Applications	2
3	MAT1009E08	Graph Theory	2
4	MAT1010E09	Linear Programming	2
5	MAT1011E10	Number Theory	2

Sr. No.	Course Code	Course Title	Credit
Semester – I, II, III, IV (Foundation)			
1	MAT1004F01	Algebra	2
2	MAT1005F01	Calculus	2
3	MAT1006F01	Matrices	2
Semester – III, IV (Foundation)			
4	MTF04	Coding Theory	2
5	MTF05	Mathematical Biology	2

B. Sc. Semester – I (Principal & Subsidiary):

B. Sc. Semester-I (Principal & Subsidiary Mathematics)
Course-MAT1101: Matrices
(2 Credits)

To be effective from June 2012

Unit-1: Special types of matrices and their properties, Elementary operations and Elementary matrices, Rank of a matrix, rank of product of matrices, Invariance of rank under elementary operations, Row reduced echelon form of a matrix, Homogeneous and Non-homogeneous linear equations.

Unit-2: Eigen values and Eigen vectors of a matrix, Orthogonality of eigen vectors associated with distinct eigen values, Properties of eigen vectors of a real symmetric matrix, Diagonalization of a symmetric matrix, application to reductions of quadrics to principal axes, Cayley-Hamilton theorem (without proof).

REFERENCE BOOKS:

1. C. W. Curtis Linear Algebra, Springer, 1987.
2. J. N. Kapur and M. K. Singal, Matrices, R. Chand & Co., 1996.
3. V. Krishnamurthy, V. P. Mainra & J. L. Arora, An Introduction to Linear Algebra, East-West Press,2001.
4. Serge Lang, Introduction to Linear Algebra, Springer, 1986.
5. Shanti Narayan and P. K. Mittal, A text book of Matrices, S. Chand & Co., 2005.
6. I. K. Rana, An Introduction to Linear Algebra, Ane Books Pvt. Ltd, 2010.

B. Sc. Semester-I (Principal & Subsidiary Mathematics)
Course-MAT1102: Algebra and Number Theory
(3 Credits)

To be effective from June 2012

Unit-1: De Moivre's theorem (Proof for rational index) and its applications, n^{th} roots of a complex number, Statement of fundamental theorem of algebra, Multiple roots and test for multiplicity, Relation between roots and coefficients, Imaginary roots of an equation with real coefficients, Descarte's rule of sign, solution of cubic equations (Cardan's Method), biquadratic equations.

Unit-2: Division algorithm, gcd, lcm, primes, Fundamental theorem of arithmetic, Euclid's Lemma, Congruences: Definitions and elementary properties. Results about linear congruence equations, Chinese Remainder theorem, Euler phi-function, examples, divisibility tests.

REFERENCE BOOKS:

1. David Burton, Elementary Number Theory, Tata Mc Graw Hill Publishers, 2006.
2. S. D. Telang, Number Theory, Tata Mc Graw Hill Publishers, 2004.
3. J. V. Uspensky, Theory of Equations, Mc Graw Hill Publishers, 1948.

B. Sc. Semester-I (Principal & Subsidiary Mathematics)
Course-MAT1103: Calculus
(3 Credits)

To be effective from June 2012

Unit-1: Successive differentiation, Leibnitz's theorem, Lagrange's and Cauchy's mean value theorems and their geometrical interpretations, Increasing-decreasing functions, Indeterminate forms, L. Hospital's rules (proof for 0/0 case only), Taylor's and Maclaurin's theorems (Lagrange's form of remainder), Taylor's polynomial and approximation, Power series expansion of $\sin x$, $\cos x$, $\exp(x)$ for

$x \in R$ and of $(1+x)^m$, $\log(1+x)$ for $|x|<1$ (Assuming the validity of expansions).

Unit-2: Asymptotes, Curvature and radius of curvature for Cartesian curves, Curve tracing for $y = f(x)$ only, Reduction formulas for $\int_0^{\pi/2} \sin^m x dx$, $\int_0^{\pi/2} \cos^m x dx$, $\int_0^{\pi/2} \sin^m x \cos^n x dx$ ($m, n \in N$), Arc length, Surface area.

REFERENCE BOOKS:

1. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers, 1981.
2. Shanti Narayan, Differential Calculus, S. Chand & Co. Ltd,1996
3. Shanti Narayan, Integral Calculus, S. Chand & Co. Ltd, 1999.
4. V. M. Shah, Introductory Calculus, Acharya Book Depot,1980
5. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, Addison-Wesley Publications, 1999.

B. Sc. Semester – II (Principal & Subsidiary):

B. Sc. Semester-II (Principal & Subsidiary Mathematics)
Course-MAT1201: Differential Equations
(2 Credits)

To be effective from December 2012

Unit-1: Differential equations of first order and first degree: Geometric interpretation of first order equations, Isoclines, Homogeneous differential equations, Equations reducible to homogeneous form, linear differential equations, Bernoulli's equation, Exact differential equations, Integrating factors, Applications of first order equations: mixture problem, orthogonal trajectories.

Unit-2: Linear differential equations of higher order, Linear independence, Fundamental theorem (without proof), Differential operators, Homogeneous and non-homogeneous linear differential equations with constant coefficients, Inverse operators, Operational methods for solving linear differential equations, Euler form of linear differential equations with variable coefficients.

REFERENCE BOOKS:

1. Zafar Ahsan, Differential Equations and their Applications, Prentice Hall of India, 2004.
2. Wilfred Kaplan, Elements of Differential Equations, Addison-Wesley Publishing Co., 1964.
3. Shanti Narayan, Integral Calculus, S. Chand & Co. Ltd., 1999.

B. Sc. Semester-II (Principal & Subsidiary Mathematics)
Course-MAT1202: Abstract Algebra-I
(3 Credits)

To be effective from December 2012

Unit-1: Equivalence relation and equivalence class, congruence modulo n, Definition and examples of groups, Elementary properties of a group, finite groups and their tables, Subgroups, centralizers and normalizers, subgroups generated by a set, Cyclic groups, order of an element.

Unit-2: Cosets, Lagrange's theorem, Fermat's Theorem, Euler's Theorem, Permutation group, symmetries of equilateral triangle, rectangle, circle, square, transposition

and cycles, Even and Odd permutations, Alternating Groups A_n, Homomorphisms and Isomorphisms, Cayley's theorem.

REFERENCE BOOKS:

1. Michael Artin, Algebra, Prentice Hall of India, 1994.
2. G. Birkhoff and S. Maclane, A Survey of Modern Algebra, University Press, 2003.
3. J. B. Fraleigh, A First Course in Abstract algebra, Pearson Education, Inc., 2006.
4. Joseph A. Gallien, Contemporary Abstract Algebra, Narosa Publishing House, 1998.
5. N. S. Gopalakrishnan, University Algebra, New Age International Pvt. Ltd., 2004.
6. I. N. Herstein, Topics in Algebra, Vikas Publishing house Pvt. Ltd.,2004
7. I. H. Sheth, Abstract Algebra, Prentice Hall of India, 2009.

B. Sc. Semester-II (Principal & Subsidiary Mathematics)
Course-MAT1203: Geometry

(3 Credits)

To be effective from December 2012

Unit-1: Polar co-ordinate system, Relations between polar and Cartesian coordinates, Graphs of polar equations, Aids in graphing polar equations, Polar equations of Lines, Circles and Conics, Equation of a Sphere, Intersection of a sphere and a line, Section of a sphere by a plane, Intersection of two spheres, Sphere through a given circle, Tangent plane to a sphere.

Unit-2: Cone with a given vertex and given guiding curve, Cone with vertex origin and homogeneous equation in x, y and z, Right circular cones, Cylinders with generators parallel to a given line and intersecting a conic, Right circular cylinders, Central conicoids. Identification and properties of standard quadrics namely Ellipsoids, Hyperboloids of one sheet, Hyperboloids of two sheets, Elliptic paraboloids and Hyperbolic paraboloids. Spherical and Cylindrical coordinates of space points and their relation with Cartesian coordinates.

REFERENCE BOOKS:

1. P. Balasubramanyam, K. G. Subramaniam and G.R. Venkatraman, Coordinate Geometry of Two and Three Dimension, Tata Mc Graw Hill Publ. Co., 1994
2. Gordon Fuller and Robert M. Parker, Analytic Geometry and Calculus, East-West Press Pvt. Ltd., 1967.
3. Shanti Narayan, Analytic Solid Geometry, S. Chand & Co. Ltd., 1988.

B. Sc. Semester – III (Principal):

B. Sc. Semester-III (Principal Mathematics)
Course-MAT1301C07: Linear Algebra

(4 Credits)

To be effective from June 2013

Unit-1: Definition of a field and examples, Vector spaces over a field and elementary consequences of its axioms, Subspaces, Linear span, Quotient spaces, Internal and external direct sum of vector spaces,Linear dependence and Independence. Properties of linearly independent vectors, Basis and its existence, Dimension of a vector space.

Unit-2: Inner product spaces, Schwarz inequality, Orthogonal complement and Orthonormal sets, Gram Schmidt orthogonalization process and examples. Linear transformations, Range and Kernel of a linear map, Rank-Nullity theorem, the space of linear transformations, composition of linear transformations, matrix associated with a linear map and linear map associated with a matrix.

REFERENCE BOOKS:

1. C. W. Curtis, Linear Algebra, Springer, 1984.
2. I. N. Herstein, Topics in Algebra, Vikas Publishing House Pvt. Ltd, 2004.
3. V. Krishnamurthy, V. P. Mainra & J. L. Arora, An Introduction to Linear Algebra, East-West Press,2001.
4. Serge Lang, Introduction to Linear Algebra, Springer, 1986.
5. I. K. Rana, An Introduction to Linear Algebra, Ane Books Pvt. Ltd, 2010.

B. Sc. Semester-III (Principal Mathematics)
Course-MAT1302C08: Advanced Calculus
(4 Credits)

To be effective from June 2013

Unit-1: Domain and range of a function of several variables, Limit, Continuity and Partial derivatives, Equality of mixed partial derivatives of order two, Differentiability, Mean value theorem, Total differentials, Approximation, Chain rule.

Unit-2: Euler's theorem on homogeneous function and its converse, Implicit differentiation, Jacobian formulas, Taylor's theorem, Maxima-Minima, Lagrange's method of undetermined multiplier, Tangent plane and normal line to a surface, Tangent line to a space curve, Envelopes of plane curves and of family of surfaces, Directional derivatives, Gradient, Curl, Divergence.

REFERENCE BOOKS:

1. Tom Apostol, Calculus (Volume II), Wiley Eastern Ltd, 1980.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons Inc, 1983.
3. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers, 1981.
4. Shanti Narayan, Differential Calculus, S. Chand & Co. Ltd, 1996.
5. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, Addison-Wesley Publishers, 1999.
6. David V. Widder, Advanced Calculus, Prentice-Hall of India, 1989.

B. Sc. Semester – IV (Principal):

B. Sc. Semester-IV (Principal Mathematics)
Course- MAT1401C09: Elementary Analysis
(4 Credits)

To be effective from December 2013

Unit-1: Sequences, bounded and unbounded sequences, convergent sequences, algebra of convergent sequences, convergence of monotonic real sequences, Cauchy criterion for convergence of real sequences, convergence and divergence of infinite series, series of positive terms, comparison test, integral test, alternating series, absolute convergence, ratio test and root test (statements only of test and their applications).

Unit-2: Field of complex numbers, graphical representation of subsets of C, geometrical significance of complex functions $z+\beta$, αz, z, $\bar{z}$, $\frac{1}{z}$, $\mathrm{Re}(z)$, $\mathrm{Im}(z)$, $|z|$ and $\alpha z+\beta$. Limit, continuity and differentiability of functions of complex variable. Elementary functions of complex variable: exponential, trigonometric, hyperbolic, logarithmic, inverse trigonometric.

REFERENCE BOOKS:

1. R. V. Churchill and J. W Brown, Complex variable and applications, Mc Graw Hill Publishing Company, 2009.

2. S. R. Ghorpade and B. V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.
3. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers, 1981.

B. Sc. Semester-IV (Principal Mathematics)
Course-MAT1402C10: Integral Calculus and Differential Equations
(4 Credits)

To be effective from December 2013

Unit-1: Iterated integrals and double integral, Change of order, Evaluation by using transformations, Applications to area and volume, Line integrals, Green's theorem (proof for special regions), Path independence of line integrals, Surface integrals, Stoke's theorem and its applications, Triple integrals, Gauss' theorem and its applications.

Unit-2: Differential equations of the first order but not of the first degree which are solvable for p, x and y. Clairaut's equation, singular solutions, system of linear differential equations with constant coefficients and their applications to mixture problems, simultaneous differential equations of the first order and first degree, Methods of solutions of $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$, Paffian differential equations, solution of Paffian differential equations in three variables.

REFERENCE BOOKS:

1. Zafar Ahsan, Differential Equations and their applications, Prentice-Hall of India, 2004.
2. T. Amarnath, An elementary course in partial differential equations, Narosa Publ. Co, 2000.
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons Inc, 1983.
4. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers, 1981.
5. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, Addison-Wesley Publishers, 1999.

B. Sc. Semester – V (Principal):

B. Sc. Semester-V (Principal Mathematics)
Course-MAT1501C11: Abstract Algebra-II
(4 Credits)

To be effective from June 2014

Unit-1: Isomorphic groups, a counting principle, Normal subgroups and quotient groups, Fundamental theorem of homomorphism, Isomorphism theorems, Definition and examples of automorphisms, Inner automorphisms, Automorphism and inner automorphism groups, Automorphism group of finite and infinite cyclic groups, Application of quotient groups to automorphism groups, Cauchy's and Sylow's theorem for abelian groups.

Unit-2: Conjugacy relation, Cauchy's and Sylow's theorem for non-abelian groups, discussion of Sylow subgroups, External and internal direct product of a finite number of groups, Fundamental theorem on finite abelian groups, discussion of number of non-isomorphic finite abelian groups.

REFERENCE BOOKS:

1. Michael Artin, Algebra, Pearson Education, 2010.
2. G. Birkhoff and S. Maclane, A Survey of Modern Algebra, University Press, 2003.
3. J. B. Fraleigh, A First Course in Abstract algebra, Pearson Education Inc, 2006.
4. Joseph A. Gallien, Contemporary Abstract Algebra, Narosa Publishing House, 1998.
5. N. S. Gopalakrishnan, University Algebra, New Age International Pvt. Ltd, 2004.

6. I. N. Herstein, Topics in Algebra, Vikas Publishing house Pvt. Ltd., 2004.
7. C. Musili, Introduction to Rings and Modules, Narosa Publishing House, 1994.
8. I. H. Sheth, Abstract Algebra, Prentice-Hall of India, 2009.

B. Sc. Semester-V (Principal Mathematics)
Course- MAT1502C12: Analysis-I
(4 Credits)

To be effective from June 2014

Unit-1: Order relation and ordered set, lub and glb of an ordered set, Properties of lub and glb, gaps in the rational number system, least upper bound property, Ordered field and their properties, Existence theorem of an ordered field R (to be assumed without proof), Archimedean property of R, Dense property of Q in R, Existence of n^{th} root of positive reals, Extended real number systems, C is not an ordered field, Dictionary order, Unions, intersections and Cartesian products of arbitrary families of sets, Set mappings f and f^{-1} of a function f and their properties, Finite sets, Countable sets and uncountable sets, Well ordering theorem for N, Well ordered sets.

Unit-2: Definition and various examples of metric spaces, Neighbourhood of a point, Limit point, Interior point, Isolated point, Open sets and closed sets, Perfect sets, Dense sets, Closure of a set, Compact sets in a metric space and their properties, Compactness of k-cell, Heine-Borel theorem, Weierstrass theorem, Perfect sets in R^k, Cantor set, Connected sets in a metric space, Separable metric space.

REFERENCE BOOKS:

1. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, 1980.
2. S. R. Ghorpade and B. V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.
3. Richard Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd, 1970.
4. S. C. Malik, Mathematical Anaylsis, Wiley Eastern Ltd, 1992.
5. J. R. Munkres, Topology-A First Course, Prentice-Hall of India, 2000.
6. I. K. Rana, Numbers to Analysis, World Scientific,1998
7. Walter Rudin, Principles of Mathematical Analysis, Mc Graw Hill book Co, 1976.

B. Sc. Semester-V (Principal Mathematics)
Course-MAT1503C13: Analysis-II
(4 Credits)

To be effective from June 2014

Unit-1: Upper and lower limit of a sequence, some special sequences, convergence and divergence of a series, comparison test, series of non-negative terms, Cauchy's condensation test, number e, root and ratio test, summation by parts, Leibnitz's test, addition and multiplication of series, Rearrangements, Riemann's theorem. (Proofs of test using upper limit)

Unit-2: Power series and its convergence, Abel's theorem, Exponential, Logarithmic and Trigonometric functions, Algebraic completeness of complex field. Trigonometric Fourier series and examples, Dirichlet Kernel and convergence of Fourier series, Localization theorem, Fejer Kernel and summability of Fourier series, Orthonormal system and Fourier series, Bessel's inequality and Parseval's theorem.

REFERENCE BOOKS:

1. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, 1980.

2. S. R. Ghorpade and B. V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.
3. Richard Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd, 1970.
4. Walter Rudin, Principles of Mathematical Analysis, Mc Graw Hill book Co, 1976.

B. Sc. Semester-V (Principal Mathematics)
Course-MAT1504C14: Numerical Analysis and Computer Programming-I
(4 Credits)

To be effective from June 2014

Unit-1: Notions of round off, truncation and other errors, Solution of an equation in one variable by Bisection method, Regula Falsi method, Newton–Raphson's method and General iteration method, Convergence and order of convergence for these methods. Graeffe's root squaring method. Solution of linear system of equations by Gauss elimination method, Crout's method, Gauss–Seidel iterative method. Solution of nonlinear system of equations by Newton–Raphson's method. Numerical solution of ordinary differential equation by Picard's method, Taylor series method and Runge–Kutta method.

Unit-2: Definition of preliminary language constructs. Simple and formatted input/output functions. Various operators and Precedence of operators. Simple programs. Library functions, Header files. Statements and blocks. Control statements: if-else, switch, break, continue, goto. Loops: for, while, do-while and programs using loop statements. Ternary operator. Arrays. Structures, Unions. Macros and preprocessors.

Practical: Relevant computer laboratory practical of writing and running the programs in the above topics using C++ will be given.

REFERENCE BOOKS:

1. P. C. Biswal, Numerical Analysis, Prentice-Hall of India, 2008.
2. F. B. Hildebrand, Introduction to Numerical Analysis, Tata Mc Graw Hill Publishers, 1979.
3. E. V. Krishnamurthy and S. K. Sen, Computer-based Numerical Algorithm, East-West Press, 1976.
4. Robert Lafore, Object Oriented Programming with C++, Galgotia Publications Pvt. Ltd, 2009.
5. Stanley B. Lippman and Josee Lajoie, C++ primer, AWAL International Student Edition, 2005.
6. S. S. Sastry, Introductory methods of Numerical Analysis, Prentice-Hall of India, 2006.
7. H. C. Saxena, Finite differences and Numerical Analysis, S. Chand and Co, 2005.
8. J. N. Sharma, Numerical Methods for Engineers and Scientists, Narosa Publishing House, 2008.

B. Sc. Semester-V (Principal Mathematics)
Course-MAT1505C15: Linear Programming
(4 Credits)

To be effective from June 2014

Unit-1: General discussions of Linear programming problems and formulation, Graphical method of solving two variable problem, convex sets, General Linear Programming Problem, Slack and Surplus variables, L.P.P. in a standard form, Properties of a solution, Generating extreme point solutions, Development of minimum feasible solution, Simplex method.

Unit-2: Artificial basis technique, Revised Simplex method, Duality theory for the unsymmetric and symmetric dual problems, Transportation problem, Methods for finding initial basic feasible solution: North-west corner rule, Matrix minima method,

Vogel's approximation method, Optimal solution: MODI Method, Assignment problem: Hungarian Method. Special cases of maximization, unbalanced and prohibited transportation and assignment problems.

REFERENCE BOOKS:

1. S. I. Gass, Linear programming, Mc Graw Hill Book Company, 1985.
2. K. V. Mittal and C. Mohan, Optimization methods in Operations Research and System Analysis, New Age International Publications,1996.
3. Kanti Swaroop, Man Mohan and P.K. Gupta, Operations Research, Sultan Chand and Sons, 2005.
4. Hamdy A. Taha, Operations Research: An Introduction, McMillan Publishing Company, 2007.

B. Sc. Semester-V (Principal Mathematics)

Course-MAT1506E17: Applications of Mathematics in Finance (Elective Paper)

(2 Credits)

To be effective from June 2014

Unit-1: Financial Management – An overview. Nature and scope of Financial Management. Goals of Financial Management and main decisions of financial management. Difference between investment, speculation and gambling.

Unit-2: Time value of Money – Interest rate and discount rate. Present value and future value – discrete case as well as continuous compounding case. Annuities and its kinds.

REFERENCE BOOKS:

1. Prasanna Chandra, Investment Analysis and Portfolio Management, Tata McGraw Hill, 2008.
2. Aswath Damodaran, Corporate Finance–Theory and Practice, John Wiley and Sons, 2001.
3. C. D. Daykin. T. Petikainen and M. Pesonen, Practical Risk Theory for Actuaries, Chapman and Hall, 1994.
4. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice-Hall of India, 2007.
5. A. K. Gupta and T. Varga, An Introduction to Actuarial Mathematics, Kluwer Academic Publisher, 2002.
6. Rajesh Kothari and Bobby Dutta, Contemporary Financial Management, Macmillan India Ltd., 2005.
7. Jim Mc Menamin, Financial Management: An Introduction, Oxford University Press, 2000.
8. Sheldon M. Ross, An elementary Introduction to Mathematical Finance, Cambridge University Press, 2003.

B. Sc. Semester-V (Principal Mathematics)

Course-MAT1507E18: Operations Research: Inventory Control (Elective Paper)

(2 Credits)

To be effective from June 2014

Unit-1: General discussions of Operations Research (OR), origin and development of OR, modeling in OR, general solution methods for OR models, methodology of OR and applications of OR. Inventory: Associated costs and inventory control, Deterministic inventory situations without and with shortages.

Unit-2: Determining buffer stocks and reorder level, Multi-item deterministic problems: Limitation on inventory, limitation on floor space and limitation on investment,

Probabilistic inventory Problems: Single period problems without setup cost and with uniform and Instantaneous demand.

REFERENCE BOOKS:

1. D. T. Phillips, A. Ravindra, J. Solberg, Operation Research Principles and Practice, John Wiley and sons,2000.
2. S. D. Sharma, Operations Research, Kedar Nath Ram Nath & Company.
3. Kanti Swaroop, Man Mohan, P.K. Gupta, Operations Research, Sultan Chand and Sons, 2005.
4. Hamdy A. Taha, Operations Research: An Introduction, Mc Millan Publishing Company, 2007.

B. Sc. Semester-V (Principal Mathematics)
Course-MAT1508E19: Statics (Elective Paper)
(2 Credits)

To be effective from June 2014

Unit-1: Introduction, Velocity and acceleration, gradient vector, Fundamental laws of Newtonian Mechanics, Equilibrium of a particle and system of particles, The moment of a vector about a line, Varignon's Theorem , Conditions of equilibrium of a system of particles, Equipollent system of forces, Couples, Reduction of a general plane force system, Work and potential energy, The principle of virtual work.

Unit-2: Mass centers and center of gravity, Theorems of Pappus, Gravitation, Friction, Flexible cable and its differential equation, The suspension bridge, The common catenary, Cables in contact with smooth and rough curves.

REFERENCE BOOKS:

1. Sunil Dutta, Mechanics, Prentice Hall of India, 2010.

John L. Synge and Byron A. Griffith, Principles of Mechanics, Mc Graw Hill Book Company, 1970.

B. Sc. Semester-V (Principal Mathematics)
Course-MAT1509E20: Boolean Algebra (Elective Paper)
(2 Credits)

To be effective from June 2014

Unit-1: Binary relation, Properties of binary relation, Partially ordered sets, Hasse diagram, Lattices, Chains, Principle of duality, Basic properties of algebraic systems defined by lattices, Distributive and Complete lattice, Boolean algebra.

Unit-2: Atoms of a Boolean algebra and its properties, Uniqueness of finite Boolean algebras, Boolean expressions and Boolean functions, Applications to logic, Gates and digital circuits.

REFERENCE BOOKS:

1. Narsingh Deo, Graph theory with applications to Engineering and Computer Science, Prentice-Hall of India, 1993.
2. C. L. Liu, Elements of Discrete Mathematics, McGraw Hill International Editions, 1985.
3. J. P. Trembley and R. Manohar, Discrete Mathematical Structure with applications to Computer Science, Mc Graw Hill Book Company, 2001.

B. Sc. Semester-V (Principal Mathematics)
Course-MAT1510F01: Graph Theory (Core Foundation)
(2 Credits)

To be effective from June 2014

Unit-1: Definition and elementary properties of graphs, Isomorphism of graphs, Subgraphs, Walks, Paths and circuits, Connected graphs, Euler graphs, Operations on graphs, Hamiltonian circuits, Definition and properties of tree.

Unit-2: Centers in a tree, Rooted and Binary tree, Spanning trees, Fundamental circuits, cut set and its properties, Planar graphs and Kuratowski's two graphs, Representation of planar graphs.

REFERENCE BOOKS:

1. Narsingh Deo, Graph theory with applications to Engineering and Computer Science, Prentice-Hall of India, 1993.
2. J. P. Trembley and R. Manohar, Discrete Mathematical Structure with applications to Computer Science, Mc Graw Hill Book Company, 2001.

B. Sc. Semester-V (Principal Mathematics)
Course-MAT1511F01: Problem Solving Techniques in Mathematics (Core Foundation)
(2 Credits)

To be effective from June 2014

Unit-1: **Abstract Algebra:** determinants, roots of equations and congruencies, groups, rings, fields.

Analysis: limit, continuity (with uniform continuity), and differentiability of a real-valued function of one real variable (or more real variables), mean-value theorems for derivatives and integrals, problems of finding extrema, higher order derivatives, Riemann integral, sequences and series of numbers and functions, Taylor's series, nth roots of a complex number, analytic function of a complex variable, contour integral, residue.

Unit-2: **Linear Algebra:** Vector spaces, linear transformations, matrices.

Geometry: lines, circles, conics, triangles, quadrilaterals, polygons in the plane; polyhydra, planes, spheres, cones, cylinders, conicoids in the space; convex regions in the plane and the space.

REFERENCE BOOKS:

1. I. N. Herstein, Topics in Algebra, Vikas Publishing House Pvt. Ltd., 2004.
2. I. H. Sheth, Abstract Algebra, Prentice-Hall of India, 2009.
3. Richard Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., 1970.
4. Walter Rudin, Principles of Mathematical Analysis, Mc Graw Hill book Co, 1976.
5. V. Krishnamurthy, V. P. Mainra & J. L. Arora, An Introduction to Linear Algebra, East-West Press, 2001.
6. Hema Vasavada, Analytic Geometry of Two and Three Dimensions, Second Edition, Published by Hema Vasavada, Near New Tank, Nana Bazar, Vallabh Vidyanagar, 1998.
7. P. Balasubramanyam, K. G. Subramanyam and G. R. Venkatraman, Coordinate Geometry of Two and Three Dimension, Tata Mc Graw Hill Publ. Co., 1994.
8. Shanti Narayan, Analytic Solid Geometry, S. Chand & Co. Ltd., 1988.

B. Sc. Semester – VI (Principal):

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1601C16: Abstract Algebra-III
(4 Credits)

To be effective from December 2014

Unit-1: Definition and examples of a ring, Integral domains, Division rings and Fields, Ring homomorphism and isomorphism, Ideals and Quotient rings, Maximal ideals and Fields, Field of quotient of an integral domain, Euclidean ring, gcd, units and prime elements in an Euclidean ring, Unique factorization theorem.

Unit-2: The ring of Gaussian integers, Polynomial ring $F[x]$ and its properties, Polynomials over the rational field, Primitive polynomials, The Eisenstein criterion, Polynomial ring over commutative rings, Unique factorization domains.

REFERENCE BOOKS:

1. Michael Artin, Algebra, Prentice-Hall of India, 1994.
2. G. Birkhoff and S. Maclane, A Survey of Modern Algebra, University Press, 2003.
3. J. B. Fraleigh, A First Course in Abstract algebra, Pearson Education, Inc., 2006.
4. Joseph A. Gallien, Contemporary Abstract Algebra, Narosa Publishing House, 1998.
5. N. S. Gopalakrishnan, University Algebra, New Age International Pvt. Ltd, 2004.
6. I. N. Herstein, Topics in Algebra, Vikas Publishing house Pvt. Ltd., 2004.
7. C. Musili, Introduction to Rings and Modules, Narosa Publishing House, 1994.
8. I. H. Sheth, Abstract Algebra, Prentice-Hall of India, 2009.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1602C17: Analysis-III
(4 Credits)

To be effective from December 2014

Unit-1: Convergent sequences in a metric space and their properties, Subsequences and Cauchy sequences in a metric space, Complete metric spaces, Limit of functions and continuous functions in metric spaces, Continuity and compactness, Uniformly continuous functions, Continuity and connectedness, Intermediate value theorem.

Unit-2: Discontinuities, Monotonic functions and types of discontinuities, Fixed point and contraction principle, Local maximum and Local Minimum, Generalized mean value theorem, Continuity of derivatives, The metric space $C[a, b]$ and its completeness, Equicontinuous families, Totally boundedness and Arzela's theorem.

REFERENCE BOOKS:

1. S. R. Ghorpade and B. V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.
2. Richard Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd, 1964.
3. S. C. Malik, Mathematical Anaylsis, Wiley Eastern Ltd., 1992.
4. J. R. Munkres, Topology-A First Course, Prentice-Hall of India, 2000.
5. I. K. Rana, Numbers to Analysis, World Scientific.1998.
6. Walter Rudin, Principles of Mathematical Analysis, Mc Graw Hill book Co., 1976.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1603C18: Analysis-IV
(4 Credits)

To be effective from December 2014

Unit-1: Riemann integral, Definition and existence of Riemann – Stieltje's integral, its properties, The integral as a limit of a sum, Change of variable, Integration and differentiation, Fundamental theorem of Calculus, Integration by parts, First and Second Mean-Value theorems, Integral of vector-valued functions, Functions of bounded variation.

Unit-2: Rectifiable curves, Convergence of improper integrals, Gamma and Beta functions, Relation between them, Stirling's formula, Pointwise convergence of sequences and series of function, Discussion of main problem, Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation.

REFERENCE BOOKS:

1. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, 1985.
2. S. R. Ghorpade and B. V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.
3. Richard Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd, 1964.
4. Walter Rudin, Principles of Mathematical Analysis, Mc Graw Hill book Co., 1976.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1604C19: Numerical Analysis and Computer Programming-II
(4 Credits)

To be effective from December 2014

Unit-1: Ordinary differences, Newton's forward and backward interpolation formulas. Divided differences, Newton's divided difference interpolation and Lagrange's interpolation formulas, Central difference, Gauss's and Stirling's central difference interpolation, Error analysis of interpolation, Numerical differentiation by Newton's Forward, Backward and Stirling's formula. General quadrature and derivation of Trapezoidal, Simpson's and Weddle's rules. Error analysis in Quadrature.

Unit-2: Functions. Functions with reference variables. Programs for numerical methods using functions. Default arguments signature of function, Functions and arrays, Functions and structures, Pointers and addresses, Pointers and arrays, Pointers and functions, Function overloading and operator overloading, Scope of variables, External, Local, Static and register variables, Conditional compilation directives, Typedef statement.

Practical: Relevant computer laboratory practical of writing and running the programs in the above topics using C++ will be given.

Following Numerical Method programs will be discussed:

Bisection Method, Regula Falsi Method, Newton Raphson Method, Lagrange's Interpolation Method, Trapezodial Rule, Programs for Maclaurin's series expansion for $\sin x$, $\cos x$ and $\exp(x)$.

REFERENCE BOOKS:

1. P. C. Biswal, Numerical Analysis, Prentice-Hall of India, 2008.
2. F. B. Hildebrand, Introduction to Numerical Analysis, Tata Mc Graw Hill Publishers, 1988.
3. E. V. Krishnamurthy and S. K. Sen, Computer-based Numerical Algorithm, East-West Press, 1976.
4. Robert Lafore, Object Oriented Programming with C++, Galgotia Publications Pvt. Ltd., 2006.

5. Stanley B. Lippman and Josee Lajoie, C++ primer, AWAL International Student Edition, 2005.
6. S. S. Sastry, Introductory methods of Numerical Analysis, Prentice-Hall of India, 2006.
7. H. C. Saxena, Finite differences and Numerical Analysis, S. Chand and Co., 2005.
8. J. N. Sharma, Numerical Methods for Engineers and Scientists, Narosa Publishing House, 2008.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1605C20: Differential Equations
(4 Credits)

To be effective from December 2014

Unit-1: The Laplace transform, property of Laplace transform, inverse Laplace transform, the convolution, solution of linear differential equation and system of linear differential equation using Laplace transform, Linear equations with variable coefficients, initial value problem for the homogeneous equation, solution of homogeneous equation, the Wronskian and linear independence, reduction of order of a homogeneous equation, the non-homogeneous equation.

Unit-2: Partial differential equation of first order, origin of the first order partial differential equation, classification of first order partial differential equation, classification of integrals, Linear partial differential equations of first order, integral surface passing through a given curve, surface orthogonal to a given system of surfaces, non-linear partial differential equation of the first order, the Cauchy problem, the method of the characteristics, compatible system of first order equations, Charpits method, special types of first order equations.

REFERENCE BOOKS:

1. T. Amarnath, An Elementary Course in Partial Differential Equations, Narosa Publishing House, 2000.
2. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice-Hall of India, 1989.
3. S. L. Ross, Differential Equations, John Weily and Sons, 1984.
4. Ian Sneddon, Elements of Partial Differential Equations, Mc Graw Hill International, 1972.
5. D. Somasundaram, Ordinary Differential Equations–A First Course, Narosa Publishing House, 2009.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1606E21: Cryptography (Optional Paper)
(4 Credits)

To be effective from December 2014

Unit-1: Introduction and Basic Number Theoretic Ciphers, Secure Communications, Shift Ciphers, Substitution Ciphers, Block Ciphers, Some Modern Ciphers, Hill cryptosystem, public key encryption, RSA encryption and decryption, primality testing, integer factorization and digital signatures.

Unit-2: Diffie Hellman key exchange, the knapsack cryptosystem, the ElGamal cryptosystem, elliptic curves, elliptic curve cryptography through examples, Elliptic Curves, Elliptic Curve Cryptosystems.

REFERENCE BOOKS:

1. David Burton, Elementary Number Theory, Tata McGraw Hill Publishers, 2006.
2. Neal Koblitz, A Course in Number Theory and Cryptography, Springer, 1994.
3. Thomas Koshy, Elementary Number Theory with Applications, Academic Press, 2007.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1607E22: Mathematical Modeling (Optional Paper)
(4 Credits)

To be effective from December 2014

Unit-1: Introduction: motivation and classification of mathematical models, population models: Malthusian and logistic model, Smith's model, Gompertz growth model, difference equation for logistic model, logistic model for a non-isolated population, derivation of logistic model with time delay, a simple prey-predator model.

Unit-2: Optimal exploitation models: logistic models with constant harvesting rate, growth of predetor-prey populations with harvesting, growth of population in competitions under harvesting, optimization problem in harvesting of fishes, optimal utilization of forests, epidemic models: deterministic models without removal, deterministic model with removal, control of an epidemic.

REFERENCE BOOKS:

1. Martin Braun, Differential Equations and their Applications, Springer, 1993.
2. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press, 1985.
3. J. N. Kapur, Mathematical Modeling, Wiley Eastern Pvt. Ltd., 1988.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1608E23: Mathematics of Insurance (Optional Paper)
(4 Credits)

To be effective from December 2014

Unit-1: Insurance Fundamentals – Insurance defined. Meaning of loss. Chances of loss, peril, hazard and proximate cause in insurance, Costs and benefits of insurance to the society and branches of insurance – life insurance and various types of general insurance. Insurable loss exposures – features of loss that is ideal for insurance. Mortality and survival Time, Actuarial Functions of Mortality and Mortality Tables.

Unit-2: Stochastic cash flows, Pure Endowments, Life Insurances, Endowments, Life Annuities. Determination of claims for General insurance – Using Poisson Distribution and Negative Binomial Distribution. Determination of the amount of Claims in General Insurance – Compound aggregate claim model and its properties, and claims of reinsurance.

REFERENCE BOOKS:

1. Aswath Damodaran, Corporate Finance–Theory and Practice, John Wiley and Sons, 2001.
2. C. D. Daykin. T. Petikainen and M. Pesonen, Practical Risk Theory for Actuaries, Chapman and Hall, 1994.
3. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice Hall of India, 2006.
4. A. K. Gupta and T. Varga, An Introduction to Actuarial Mathematics, Kluwer Academic Publisher, 2002.
5. Rajesh Kothari and Bobby Dutta, Contemporary Financial Management, Macmillan India Ltd., 2005.
6. Jim Mc Menamin, Financial Management: An Introduction, Oxford University Press, 2000.
7. Sheldon M. Ross, An elementary Introduction to Mathematical Finance, Cambridge University Press, 2003.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1609E24: Mechanics (Optional Paper)
(4 Credits)

To be effective from December 2014

Unit-1: The ingredients of Mechanics, Frames of reference, Velocity and acceleration gradient vector, Fundamental laws of Newtonian Mechanics, Newtonian frame of reference. Tangential and normal components of velocity and acceleration, radial and transverse components of velocity and acceleration, The Hodograph, Motion of a particle and a system of particles, Principle of energy, D' Alembert's principle, Frames of reference with uniform translational velocity and acceleration, Frames of reference relating with constant angular velocity.

Unit-2: Projectiles without resistance, the simple pendulum, The harmonic oscillators, Effect of a disturbing force, Damped oscillations, Forced oscillations, General motion under a central force: Cartesian equations and the law of direct distance, Differential equation of the orbit of a particle moving under an attractive central force, Apsides and Apsidal angles, determination of a orbit, Kepler's laws, The two body problem. Moment of inertia: theorem of parallel axes, Theorem of perpendicular axes, Kinetic energy and angular momentum, Konig's theorem, Rigid body rotating about a fixed axis, The compound pendulum, Cylinder rolling down an inclined plane.

REFERENCE BOOKS:

1. Sunil Dutta, Mechanics, Prentice Hall of India, 2010.
2. John L. Synge and Byron A. Griffith, Principles of Mechanics, Mc Graw Hill Book Company, 1970.

B. Sc. Semester-VI (Principal Mathematics)
Course-MAT1610E25: Operations Research: Game and Queueing Theory (Optional Paper)
(4 Credits)

To be effective from December 2014

Unit-1: Game Theory: Competitive Games, two person zero sum games, maximin and minimax criterion (based on pure strategies), Saddle points and the value of the game. Games without Saddle point : Mixed strategy solution of 2×2 games, Fundamental theorem of rectangular games, Expectation function of $m\times n$ rectangular games and the minimax - maximin theorem for it, Graphical Solution of $2\times n$ and $m\times 2$ games. Dominance properties in games, Algebraic method of solving a game, Symmetric games, Games and linear programming.

Unit-2: Queueing Theory: Queueing system and its elements, Operating characteristics of queueing systems. The Poisson queueing system: queueing systems with single service channel with finite/infinite capacity and its characteristics. Queueing system with more than one parallel service channels with finite/infinite capacity and its characteristics.

REFERENCE BOOKS:

1. D. T. Phillips, A. Ravindra, J. Solberg, Operation Research Principles and Practice, John Wiley and sons,2000.
2. S. D. Sharma, Operations Research, Kedar Nath Ram Nath & Company.
3. Kanti Swaroop, Man Mohan, P.K. Gupta, Operations Research, Sultan Chand and Sons, 2005.
4. Hamdy A. Taha, Operations Research: An Introduction, Mc Millan Publishing Company, 2007.

B. Sc. Semester – III (Subsidiary):

B. Sc. Semester-III (Subsidiary Mathematics)
Course-MAT1303S07: Linear Algebra, Sequence and Series
(4 Credits)

Effective from June 2013

Unit-1: Vector spaces (Real/Complex) and elementary consequences of its axioms, Subspaces, Linear span, Intersection and Direct sum of subspace, Linear dependence and Independence. Bases and dimension, Inner product in C^n, Length of a vector and Angle between two vectors, Schwarz inequality, Orthogonality and Gram-Schmidt orthogonalization process, Orthonormal basis.

Unit-2: Linear transformations, range and kernel of a linear map, Rank-Nullity Theorem. Convergence of monotone real sequences, Cauchy criterion, Convergence and Divergence of infinite Series, Series of positive terms, Comparison tests, Integral test, Alternating series, Absolute convergence, Ratio test and Root test.

REFERENCE BOOKS:

1. Tom Apostol, Calculus (Volume II), Wiley Eastern Ltd, 1980.
2. Kenneth Hoffman and Ray Kunze, Linear Algebra, Prentice-Hall of India, 2\e, 2009.
3. V. Krishnamurthy, V. P. Mainra & J. L. Arora, An Introduction to Linear Algebra, East-West Press, 2001.
4. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers,6/e, 1981.

B. Sc. Semester-III (Subsidiary Mathematics)
Course-MAT1304S08: Advanced Calculus
(4 Credits)

Effective from June 2013

Unit-1: Domain and range of a function of severable variables, Limit, Continuity and Partial derivatives, Equality of mixed partial derivatives of order two (without proof), Differentiability, Total differentials, Approximation, Chain rule (without proof), Euler's theorem on homogeneous function.

Unit-2: Jacobian formulas, Implicit differentiation, Taylor's theorem, Maxima-Minima, Lagrange's method of undetermined multipliers, Gradient, Curl and Divergence. Directional derivatives. Tangent plane and normal line to a surface, Tangent line to a space curve, Envelopes of plane curves and of family of surfaces, Power series, Binomial series and Fourier series.

REFERENCE BOOKS:

1. Tom Apostol, Calculus (Volume II), Wiley Eastern Ltd, 1980.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons Inc., 1983.
3. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers, 1981.
4. Shanti Narayan, Differential Calculus, S. Chand & Co. Ltd., 2005.
5. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, Addison-Wesley Publishers, 1999.
6. David V. Widder, Advanced Calculus, Prentice-Hall of India, 1989.

B. Sc. Semester – IV (Subsidiary):

B. Sc. Semester-IV (Subsidiary Mathematics)
Course-MAT1403S09: Linear Programming and Numerical Analysis
(4 Credits)

Effective from December 2013

Unit-1: General discussions of Linear programming problems and their illustrations, Linear inequalities, Graphical method of solving two variable problem, convex sets, Problem of Linear Programming, Slack and Surplus variables, L.P.P. in a standard form, Properties of a solution, Simplex method and its computational procedure, Artificial basis technique, Transportation problem, Assignment problem.

Unit-2: Forward and backward differences, Newton's forward and backward interpolation formulas, Lagrange's interpolation formula with error analysis, Gauss's and Stirling's central difference interpolation formulas, Solution of equations in one variable by Bisection method, Regula Falsi method, Newton-Raphson's method. Solution of system of linear equations by Gauss elimination method, Gauss-Seidel iterative method, Numerical differentiation by Newton's forward and backward formulas and by Stirling's formula, General quadrature formula, Trapezoidal rule, Simpson's rule with error analysis, Numerical solution of differential equations by fourth order Runge-Kutta method.

REFERENCE BOOKS:

1. P. C. Biswal, Numerical Analysis, Prentice-Hall of India, 2008.
2. S. I. Gass, Linear programming, Mc Graw Hill Book Company, 1985.
3. F. B. Hildebrand, Introduction to Numerical Analysis, Tata Mc Graw Hill Publishers, 1987.
4. K. V. Mittal and C. Mohan, Optimization methods in Operations Research and System Analysis, New Age International Publications, 2004.
5. G. Shankar Rao, Numerical Analysis, New Age International Pvt. Ltd, 2006.
6. S. S. Sastry, Introductory methods of Numerical Analysis, Prentice-Hall of India, 2006.
7. Ralp G. Stanton, Numerical methods for science and Engineering, Prentice-Hall of India, 1967.
8. Kanti Swaroop, Man Mohan and P.K. Gupta, Operations Research, Sultan Chand and Sons, 2005.
9. Hamdy A. Taha, Operations Research: An Introduction, McMillan Publishing Company, 2007.

B. Sc. Semester-IV (Subsidiary Mathematics)
Course-MAT1404S10: Integral Calculus and Differential Equations
(4 Credits)

Effective from December 2013

Unit-1: Iterated integrals and double integral, Change of order, Evaluation by using transformations, Applications to area and volume, Line integrals, Path independence of line integrals, Green's theorem (proof for special regions). Triple integrals, Surface integrals, Stokes's theorem (without proof) and its applications, Gauss' theorem (without proof) and its applications, Beta and Gamma functions.

Unit-2: Differential equations of the first order but not of the first degree which are solvable for p, x and y. Clairaut's equation, singular solutions, system of linear differential equations with constant coefficients and their applications to mixture problems, simultaneous differential equations of the first order and first degree, Methods of

solutions of $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$, Paffian differential equations, solution of Paffian differential equations in three variables.

REFERENCE BOOKS:

1. Zafar Ahsan, Differential Equations and their applications, Prentice-Hall of India, 2004.
2. T. Amarnath, An Elementary Course in Partial Differential Equations, Narosa Publ. Co., 1997.
3. Tom Apostol, Calculus (Volume II), Wiley Eastern Ltd., 1980.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons Inc., 1983.
5. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers, 1981.
6. Shanti Narayan, Differential Calculus, S. Chand & Co. Ltd., 2005.
7. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, Addison-Wesley Publishers, 1999.
8. David V. Widder, Advanced Calculus, Prentice-Hall of India, 1989.

B. Sc. Semester – I (Elective):

B. Sc. Semester-I (Elective Mathematics)
Course-MAT1104: Matrices
(2 Credits)

To be effective from June 2012

Unit-1: Special types of matrices and their properties, Elementary operations and Elementary matrices, Rank of a matrix, rank of product of matrices, Invariance of rank under elementary operations, Row reduced echelon form of a matrix, Homogeneous and Non-homogeneous linear equations.

Unit-2: Eigen values and Eigen vectors of a matrix, Orthogonality of eigen vectors associated with distinct eigen values, Properties of eigen vectors of a real symmetric matrix, Diagonalization of a symmetric matrix, application to reductions of quadrics to principal axes, Cayley-Hamilton theorem (without proof).

REFERENCE BOOKS:

1. J. N. Kapur and M. K. Singal, Matrices, R. Chand & Co., 1996.
2. V. Krishnamurthy, V. P. Mainra & J. L. Arora, An Introduction to Linear Algebra, East-West Press,2001.
3. Shanti Narayan and P. K. Mittal, A text book of Matrices, S. Chand & Co., 2005.

B. Sc. Semester-I (Elective Mathematics)
Course-MAT1105: Differential and Integral Calculus
(2 Credits)

To be effective from June 2012

Unit-1: Successive differentiation and Standard forms, Leibnitz's theorem (without proof), Rolle's Theorem (without proof), Lagrange's and Cauchy's mean value theorems (without proof) and their geometrical interpretations, Increasing-decreasing functions.

Unit-2: Taylor's and Maclaurin's theorems (without proof), Power series expansion of $\sin x$, $\cos x$, $\exp(x)$ for $x \in R$ and of $(1+x)^m$, $\log(1+x)$ for $|x|<1$ (Assuming

the validity of expansions)Reduction formulas for $\int_0^{\pi/2} \sin^m x dx$, $\int_0^{\pi/2} \cos^m x dx$, $\int_0^{\pi/2} \sin^m x \cos^n x dx$ $(m, n \in N)$, Arc length, Surface area.

REFERENCE BOOKS:

1. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers, 1981.
2. Shanti Narayan, Differential Calculus, S. Chand & Co. Ltd,1996
3. Shanti Narayan, Integral Calculus, S. Chand & Co. Ltd, 1999.
4. V. M. Shah, Introductory Calculus, Acharya Book Depot,1980
5. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, Addison-Wesley Publications, 1999.

B. Sc. Semester – II (Elective):

B. Sc. Semester-II (Elective Mathematics)
Course-MAT1204: Differential Equations and Its Applications
(2 Credits)

To be effective from December 2012

Unit-1: Differential equations of first order and first degree: Exact equations, Linear equations, Bernoulli's equation, Applications of First order equations: Growth and Decay, Half-life, Age of Fossil, Compound interest, Mixture problem, One dimensional heat flow, Electric circuits, Applications in Economics.

Unit-2: Linear differential equations of higher order. Homogeneous equations, Differential operators, Method of solving homogeneous equations, Non-homogeneous equations, Inverse operators, Method of solving non-homogeneous equations, Method of variation of parameters, Euler's equations. Applications of higher order equations: Simple pendulum, Damped and Forced motions, Microeconomic market models, Price and supply model.

REFERENCE BOOKS:

1. Zafar Ahsan, Differential Equations and Their Applications, Prentice Hall of India, 2004.
2. Dennis G.Zill and Michael R. Cullen, Differential Equations (with Boundary-Value Problems), Brooks/Cole Publishing Company, 2005.

B. Sc. Semester-II (Elective Mathematics)
Course-MAT1205: Geometry
(2 Credits)

To be effective from December 2012

Unit-1: Polar co-ordinate system in two dimensions, Relations between polar and Cartesian coordinates, Graphs of polar equations, Aids in graphing polar equations, Sketching of limacons, lemniscates, rose curves and spirals, Polar equations of Lines, Circles and Conics and sketching them.

Unit-2: Equation of a Sphere, Section of a sphere by a plane, Intersection of two spheres, Sphere through a given circle, Intersection of a sphere and a line, Tangent plane to a sphere, Right circular cones, Right circular cylinders.

REFERENCE BOOKS:

1. P. Balasubramanyam, K. G. Subramaniam and G.R. Venkatraman, Coordinate Geometry of Two and Three Dimension, Tata Mc Graw Hill Publ. Co., 1994
2. Gordon Fuller, Analytic Geometry, 5th edition, Addison-Wesley, 1979.

3. Gordon Fuller and Robert M. Parker, Analytic Geometry and Calculus, East-West Press Pvt. Ltd., 1967.
4. Shanti Narayan, Analytic Solid Geometry, S. Chand & Co. Ltd., 1988.

B. Sc. Semester – III (Elective):

B. Sc. Semester-III (Elective Mathematics)
Course-MAT1305E05: Algebra
(2 Credits)

To be effective from June 2013

Unit-1: Field of complex numbers, graphical representation of subsets of complex plane, geometrical significance of complex functions $z+\beta$, αz, z, $\bar{z}$, $\frac{1}{z}$, $\mathrm{Re}(z)$, $\mathrm{Im}(z)$, $|z|$ and $\alpha z+\beta$, exponential and trigonometric functions.

Unit-2: De Moivre's theorem and its applications, n^{th} roots of a complex number, Statement of fundamental theorem of algebra, Multiple roots and test for multiplicity, Relation between roots and coefficients, Imaginary roots of an equation with real coefficients.

Practical using mathematical software's for the geometrical visualization of some of the above topics will be given.

REFERENCE BOOKS:
1. R. V. Churchill and J. W Brown, Complex variable and applications, Mc Graw Hill Publishing Company.
2. J. V. Uspensky, Theory of Equations, Mc Graw Hill Publishers.

B. Sc. Semester – IV (Elective):

B. Sc. Semester-IV (Elective Mathematics)
Course-MAT1405E11: Numerical Analysis
(2 Credits)

To be effective from December 2013

Unit-1: Error, absolute error, relative error, rounding-off a number. Solution of equations in one variable by Bisection method, Regula falsi method, Newton-Raphson's method. Difference operators Δ, δ, ∇, μ, shift operator E and relations among them. Differences of a polynomial, Newton's forward and backward interpolation formulae, Lagrange's interpolation formula.

Unit-2: Gauss's and Stirling's central difference interpolation formulae, Solution of system of linear equations by Gauss elimination method, Gauss – Seidel iterative method, Numerical differentiation by Newton's forward and backward formulae(without derivation), General quadrature formula(without derivation), Trapezoidal rule, Simpson's 1/3 rule, Numerical solution of first order and first degree ordinary differential equations by Picard's method and fourth order Runge-Kutta method.

REFERENCE BOOKS:
1. Erwin Kreysizg, Higher Engineering Mathematics, John Wiley & Sons Inc., 2007.
2. S. S. Sastry, Introductory methods of Numerical Analysis, Prentice-Hall of India, 2006.
3. H. C. Saxena, Finite Differences and Numerical Analysis, S. Chand & Co. Ltd., 1988.

B. Sc. Semester – III, IV (Elective (Open) Mathematics)

B. Sc. Semester-III, IV (Elective (Open) Mathematics)
Course- MAT1007E06: Boolean Algebra and its Applications
(2 Credits)

To be effective from June 2013

Unit-1: Binary relation, Properties of binary relation, Partially ordered sets, Hasse diagram, Lattices, Chains, Principle of duality, Basic properties of algebraic systems defined by lattices, Distributive and Complete lattice, Boolean algebra.

Unit-2: Atoms of a Boolean algebra and its properties, Uniqueness of finite Boolean algebras (without proof), Boolean expressions and Boolean functions, Applications to logic, Gates and digital circuits.

REFERENCE BOOKS:

1. Narsingh Deo, Graph theory with applications to Engineering and Computer Science, Prentice-Hall of India, 1993.
2. C. L. Liu, Elements of Discrete Mathematics, McGraw Hill International Editions, 1985.
3. J. P. Trembley and R. Manohar, Discrete Mathematical Structure with applications to Computer Science, Mc Graw Hill Book Company, 2001.

B. Sc. Semester-III, IV (Elective (Open) Mathematics)
Course-MAT1008E07: Discrete Mathematics and its Applications
(2 Credits)

To be effective from June 2013

Unit-1: Induction and Recursion: Mathematical Induction, Recursively defined sequences, Solving recurrence relations. Principles of counting: The principle of inclusion – exclusion, The addition and multiplication rules, The Pigeonhole principle and its applications.

Unit-2: Permutations and Combinations, Probability theory, Repeated experiments, counting and probability, The Euclidean Algorithm, The RSA Public-Key Cryptosystem.

REFERENCE BOOKS:

1. E. G. Goodaire and M. M. Parmenter, Discrete Mathematics with Graph Theory, Prentice-Hall of India, 2007.
2. R. Johnsonbaugh, Discrete Mathematics, Prentice Hall International, 1997.
3. W. D. Wallis, A Beginner's Guide to Discrete Mathematics, Birkhauser, 2003.

B. Sc. Semester-III, IV (Elective (Open) Mathematics)
Course- MAT1009E08: Graph Theory
(2 Credits)

To be effective from June 2013

Unit-1: Definition and elementary properties of graphs, Isomorphism of graphs, Subgraphs Walks, Paths and circuits, Connected graphs, Euler graphs, Operations on graphs, Hamiltonian circuits, Definition and properties of tree, Centers in a tree, Rooted and Binary tree.

Unit-2: Spanning trees, fundamental circuits, Cut set and its properties, Planar graphs and Kuratowski's two graphs, Representation of planar graphs, Geometric and combinatorial duals, Chromatic number, Chromatic polynomial, Matchings.

REFERENCE BOOKS:

1. Narsingh Deo, Graph theory with applications to Engineering and Computer Science, Prentice-Hall of India, 1993.

2. J. P. Trembley and R. Manohar, Discrete Mathematical Structure with applications to Computer Science, Mc Graw Hill Book Company, 2001.

B. Sc. Semester-III, IV (Elective (Open) Mathematics)
Course- MAT1010E09: Linear Programming
(2 Credits)

To be effective from June 2013

Unit-1: General discussions of Linear programming problems and their illustrations, Graphical method of solving two variable problem, Convex sets and their properties, Feasible solution, optimum solution, Slack and Surplus variables, L.P.P. in a standard form, Properties of a solution (without proof), Simplex method and its computational procedure, Artificial basis technique.

Unit-2: Transportation problem, Methods for finding initial basic feasible solution: North-west corner rule, Matrix minima method, Vogel's approximation method, optimal solution: MODI Method. Assignment problem: Hungarian Method.

REFERENCE BOOKS:

1. S. I. Gass, Linear programming, Mc Graw Hill Book Company, 1985.
2. Kanti Swaroop, Man Mohan and P.K. Gupta, Operations Research, Sultan Chand and Sons, 2005.
3. Hamdy A. Taha, Operations Research: An Introduction, McMillan Publishing Company, 2007.

B. Sc. Semester-III, IV (Elective (Open) Mathematics)
Course- MAT1011E10: Number Theory
(2 Credits)

To be effective from June 2013

Unit-1: Division algorithm, gcd and lcm of more than two integers, The Linear Diophantine equation, primes, Composite numbers, Fundamental theorem of arithmetic, Euclid's Theorem.

Unit-2: Congruences: Definitions and elementary properties. Results about linear congruence equations, Applications of congruences: Euler's theorem, Fermat's Little theorem, Wilson's theorem (without proof), Divisibility test, Chinese Remainder theorem (without proof).

REFERENCE BOOKS:

1. Donald M. Burton, Elementary Number Theory, Allyn and Bacon Inc, 2006.
2. S. D. Telang, Number Theory, Tata Mc Graw Hill Publishers, 2004.

B. Sc. Semester – I, II, III, IV (Foundation)

B. Sc. Semester-I, II, III, IV (Foundation Mathematics)
Course- MAT1004F01: Algebra
(2 Credits)

To be effective from June 2012

Unit-1: Trigonometric functions and Standard formulas for trigonometric functions, Algebra of complex numbers, graphical representation of subsets of complex plane, geometrical significance of complex functions $z+\beta$, αz, z, $\bar{z}$, $\frac{1}{z}$, $\mathrm{Re}(z)$, $\mathrm{Im}(z)$, $|z|$ and $\alpha z+\beta$.

Unit-2: De Moivre's theorem (without proof) and its applications, n^{th} roots of a complex number, Statement of fundamental theorem of algebra, Multiple roots and test for multiplicity, Relation between roots and coefficients, Imaginary roots of an equation with real coefficients.

REFERENCE BOOKS:

1. R. V. Churchill and J. W Brown, Complex variable and applications, Mc Graw Hill Publishing Company.
2. J. V. Uspensky, Theory of Equations, Mc Graw Hill Publishers.

B. Sc. Semester-I, II, III, IV (Foundation Mathematics)
Course- MAT1005F01: Calculus
(2 Credits)

To be effective from June 2012

Unit-1: Concept of a limit, Continuity and derivative of elementary functions, Rules of differentiation (without proof), Chain rule (without proof). Derivative of implicit functions, Derivative of parametric functions, Applications of Derivatives: Increasing decreasing functions, maxima and minima, Concavity/ convexity of a function.

Unit-2: Standard integration formulae, Integration by the method of substitution, Integration by parts, Integration by the method of partial fractions, Properties of definite integrals (without proof), application to Integration : Area under a curve as a definite integral, Volume and area of surface of revolution.

REFERENCE BOOKS:

1. Louis Leithold, The Calculus with Analytic Geometry, Harper-Collins Publishers, 1981.
2. Shanti Narayan, Differential Calculus, S. Chand & Co. Ltd,1996
3. Shanti Narayan, Integral Calculus, S. Chand & Co. Ltd, 1999.
4. V. M. Shah, Introductory Calculus, Acharya Book Depot,1980
5. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, Addison-Wesley Publications, 1999.

B. Sc. Semester-I, II, III, IV (Foundation Mathematics)
Course- MAT1006F01: Matrices
(2 Credits)

To be effective from June 2012

Unit-1: Introduction to complex numbers, Matrices, Addition and multiplication of Matrices, Special types of matrices and their properties, Determinants of order 2, 3 and 4, Inverse of a matrix, Cayley-Hamilton theorem (without proof).

Unit-2: Elementary operations and Elementary matrices, Rank of a matrix, Invariance of rank under elementary operations, Row reduced echelon form of a matrix, Homogeneous and Non-homogeneous linear equations.

REFERENCE BOOKS:

1. J. N. Kapur and M. K. Singal, Matrices, R. Chand & Co., 1996.
2. V. Krishnamurthy, V. P. Mainra & J. L. Arora, An Introduction to Linear Algebra, East-West Press, 2001.
3. Shanti Narayan and P. K. Mittal, A text book of Matrices, S. Chand & Co., 2005.
