

University of Kalyani



CBCS CURRICULUM FOR SEMESTERIZED UNDER-GRADUATE COURSE
IN
Mathematics (GENERAL)

WITH EFFECT FROM THE ACADEMIC SESSION
2018-19

CBCS CURRICULUM FOR SEMESTERIZED UNDER-GRADUATE COURSE IN Mathematics (PROGRAMME/GENERAL)

INTRODUCTION:

The University Grants Commission (UGC) has taken various measures by means of formulating regulations and guidelines and updating them, in order to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions in India. The various steps that the UGC has initiated are all targeted towards bringing equity, efficiency and excellence in the Higher Education System of country. These steps include introduction of innovation and improvements in curriculum structure and content, the teaching-learning process, the examination and evaluation systems, along with governance and other matters. The introduction of Choice Based Credit System is one such attempt towards improvement and bringing in uniformity of system with diversity of courses across all higher education institutes in the country. The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising of core, elective, skill enhancement or ability enhancement courses. The courses shall be evaluated following the grading system, is considered to be better than conventional marks system. This will make it possible for the students to move across institutions within India to begin with and across countries for studying courses of their choice. The uniform grading system shall also prove to be helpful in assessment of the performance of the candidates in the context of employment.

Outline of the Choice Based Credit System being introduced:

1. **Core Course (CC):** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the student's proficiency/skill is termed as an Elective Course.

2.1 **Discipline Specific Elective Course (DSEC):** Elective courses that are offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Generic Elective Course (GEC):** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

3. Ability Enhancement Courses/ Skill Enhancement Courses:

3.1 **Ability Enhancement Compulsory Course (AECC):** Ability enhancement courses are the courses based upon the content that leads to Knowledge enhancement. They (i) Environmental Science, (ii) English Communication) are mandatory for all disciplines.

3.2 **Skill Enhancement Course (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

CBCS CURRICULUM FOR SEMESTERIZED UNDER-GRADUATE COURSE IN Mathematics (GENERAL)

A. TOTAL Number of courses in UG-CBCS (B.A./B.Sc. GENERAL):

Types of course	Core course (CC)	Elective course		Ability Enhancement Course		TOTAL
		Discipline specific elective course (DSE)	Generic elective course (GE)	Ability Enhancement compulsory course (AECC)	Skill Enhancement course (SEC)	
No. of course	12	6(BSc)/4(BA/B.Com)	2((BA/B.Com)	2	2	24
Credit/course	6	6	6	2	2	120

TABLE-1: DETAILS OF COURSES OF B.A./ B.SC. (GENERAL) UNDER CBCS

S. No.	Particulars of Course	Credit Point	
1.	Core Course: 14 Papers	Theory + Practicl	Theory + Tutoril
1.A.	Core Course: Theory (12 papers)	12x4 = 48	12x5 = 60
1.B.	Core Course (Practical/Tutorial)*(12 papers)	12x2 = 24	12x1 = 12
2.	Elective Courses: (6 papers)		
A.	DSE (6 papers for B.Sc./ 4 papers for B.A. & B.Com.)	6x4 = 24	4x5 = 20
B.	DSE(Pract./ Tutor.)* (6 papers for B.Sc./4 for B.A. & B.Com.)	6x2 = 12	4x1 = 4
C.	GE (Interdisciplinary) (2 papers for B.A. & B.Com.)	--	2x5 = 10
D.	GE (Pract./Tutor.)* (4 papers) (2 papers for B.A. & B.Com.)	--	2x1 = 2
<i>#Optional Dissertation/ Project Work in place of one DSE paper (6 credits) in 6th semester</i>			
3. Ability Enhancement Courses			
A.	AECC(2 papers of 2 credits each) ENVS, English Communication / MIL	2x2 = 4	2x2 = 4
B.	Skill Enhancement Course(SEC) (4 papers of 2 credits each)-----	4x2 = 8	4x2 = 8
Total Credit:		120	120
## Wherever there is a practical, there will be no tutorial and vice- versa.			

TABLE-2: SEMESTER WISE DISTRIBUTION OF COURSES & CREDITS IN B.A./B.SC. (GENERAL)

Courses / (Credits)	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-Vi	Total No. of Courses	Total credit
CC-1,2,3 (6)	3 (1A,2A,3A)	3 (1B,2B,3B)	3 (1C,2C,3C)	3 (1D,2D,3D)			12	72
DSE - 1,2,3 (6)	-	-	-	-	3 (1A,2A,3A)	3 (1B,2B,3B)	6	36
GE (6)	--	--	--	--	--	--	--	--
AECC (2)	1	1					2	04
SEC (2)			1	1	1	1	4	08
Total No. of Course/ Sem	4	4	4	4	4	4	24	--
Total Credit /Semester	20	20	20	20	20	20	--	120

TABLE-3: SEMESTER & COURSEWISE CREDIT DISTRIBUTION IN B.A./ B.SC.(GENERAL)
(6 Credit: 75 Marks)

SEMESTER-I			
Course Code	Course Title	Course wise Class (L+T+P)	Credit
MATH-G-CC-T-01	Differential Calculus	5:1:0	6
Other Discipline		Core	6
Other Discipline		Core	6
AECC-T-01	Environmental Studies	2:0:0	2
Total	4 courses	Total	20
SEMESTER-II			
Course Code	Course Title	Course Nature	Credit
MATH-G-CC-T-02	Differential Equations	5:1:0	6
Other Discipline		Core	6
Other Discipline		Core	6
AECC-T-02	English/Modern Indian Language	2:0:0	2
Total	4 courses	Total	20
SEMESTER-III			
Course Code	Course Title	Course Nature	Credit
MATH-G-CC-T-03	Real Analysis	5:1:0	6
Other Discipline		Core	6
Other Discipline		Core	6
MATH-G-SEC-T-01	A. Logic and Sets B. Computer Graphics (Choose any one)	2:0:0	2
Total	5 courses	Total	20
SEMESTER-IV			
Course Code	Course Title	Course Nature	Credit
MATH-G-CC-T-04	Algebra	5:1:0	6
Other Discipline		Core	6
Other Discipline		Core	6
MATH-G-SEC-T-02	A. Graph Theory B. Operating System (Linux) (Choose any one)	2:0:0	2
Total	5 courses	Total	20
SEMESTER-V			
Course Code	Course Title	Course Nature	Credit
MATH-G-DSE-T-01	A. Matrices and Linear Algebra B. Complex Analysis (Choose any one)	5:1:0	6
Other Discipline		DSE	6
Other Discipline		DSE	6
MATH-G-SEC-T-03	C. Theory of Equations D. Analytical Geometry (Choose any one)	2:0:0	2
Total	4 courses	Total	20
SEMESTER-VI			
Course Code	Course Title	Course Nature	Credit
MATH-G-DSE-T-02	A. Linear Programming B. Numerical Methods (Choose any one)	5:1:0	6
Other Discipline		DSE	6
Other Discipline		DSE	6
MATH-G-SEC-T-04	A. Probability and Statistics B. Boolean Algebra (Choose any one)	2:0:0	2
Total	4 courses	Total	20
Total (All semesters)	26 courses	Total	120

Detail Course & Contents of Mathematics (General) syllabus

B.A./B.Sc.. Mathematics (GENERAL)

SEMESTER-I

Course: MATH-G-CC-T-01

Course title: Differential Calculus

Core Course; Credit-6; Full Marks-75

COURSE CONTENT:

6 Credits (5+1) (Theory + Tutorial)

Limit and Continuity (ϵ and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem On homogeneous functions.

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

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

SUGGESTED READINGS/REFERENCES:

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.

B.A./B.Sc.. Mathematics (GENERAL)

SEMESTER-II

Course: MATH-G-CC-T-02

Course title: Differential Equations

Core Course; Credit-6; Full Marks-75

COURSE CONTENT:

6 Credits (5+1) (Theory + Tutorial)

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p . Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties.

Solving a differential equation by reducing its order.

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

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

Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

SUGGESTED READINGS/REFERENCES:

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

B.A./B.Sc.. Mathematics (GENERAL) SEMESTER-III

Course: MATH-G-CC-T-03

Course title: Real Analysis

Core Course; Credit-6; Full Marks-75

COURSE CONTENT:

6 Credits (5+1) (Theory + Tutorial)

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

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

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

SUGGESTED READINGS/REFERENCES:

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P.Ltd., 2000.
3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series-* Undergraduate Texts in Mathematics, Springer Verlag, 2003.

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-III
Course: MATH-G-SEC-T-1A
Course title: Logic and Sets
Skill Enhancement Course; Credit-2; Full Marks-25

COURSE CONTENT:

2 Credits (Theory)

Unit 1. Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, quantifiers, binding variables and negations.

Unit 2. Sets, subsets, set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Unit 3. Difference and Symmetric difference of two sets. Set identities, generalized union and intersections. Relation: Product set. Composition of relations, types of relations, partitions, equivalence Relations with example of congruence modulo relation. Partial ordering relations, n-ary relations.

SUGGESTED READINGS/REFERENCES:

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

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-III
Course: MATH-G-SEC-T-1B
Course title: Computer Graphics
Skill Enhancement Course; Credit-2; Full Marks-25

COURSE CONTENT:

2 Credits (Theory)

Unit 1. Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices.

Unit 2. Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling anti-aliasing.

Unit 3. Two-dimensional viewing: Coordinate systems, linear transformations, line and polygon clipping algorithms.

SUGGESTED READINGS/REFERENCES:

1. Hearn and M.P. Baker, Computer Graphics, 2nd Ed., Prentice–Hall of India, 2004.
2. J.D. Foley, A van Dam, S.K. Feiner and J.F. Hughes, Computer Graphics: Principals and Practices, 2nd Ed., Addison-Wesley, MA, 1990.
3. D.F. Rogers, Procedural Elements in Computer Graphics, 2nd Ed., McGraw Hill Book Company, 2001.
4. D.F. Rogers and A.J. Admas, Mathematical Elements in Computer Graphics, 2nd Ed., McGraw Hill Book Company, 1990.

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-IV
Course: MATH-G-CC-T-04
Course title: Algebra
Core Course; Credit-6; Full Marks-75

COURSE CONTENT:

6 Credits (5+1) (Theory + Tutorial)

Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group $U(n)$ of units under multiplication modulo n . Cyclic groups from number systems, complex roots of unity, circle group, the general linear group $GL_n(n, R)$, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group $Sym(n)$, Group of quaternions.

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

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

SUGGESTED READINGS/REFERENCES:

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.

4. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-IV
Course: MATH-G-SEC-T-2A
Course title: Graph Theory
Skill Enhancement Course; Credit-2; Full Marks-25

COURSE CONTENT: 2 Credits (Theory)

Unit 1. Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs.

Unit 2. Eulerian circuits, Eulerian graph, semi-Eulerian graph, theorems, Hamiltonian cycles, theorems

Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph,

Unit 3. Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.

SUGGESTED READINGS/REFERENCES:

1. B.A. Davey and H.A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. R.J. Wilson, *Introduction to graph theory*, Pearson
3. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.
4. Rudolf Lidl and Gunter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-IV
Course: MATH-G-SEC-T-2B
Course title: Operating System (Linux)
Skill Enhancement Course; Credit-2; Full Marks-25

COURSE CONTENT: 2 Credits (Theory)

Unit 1. Linux – The operating system: Linux history, Linux features, Linux distributions, Linux's relationship to Unix, overview of Linux architecture, installation, start up scripts, system processes (an overview), Linux security.

Unit 2. The Ext2 and Ext3 file systems: General characteristics of the Ext3 file system, file permissions. User management: types of users, the powers of root, managing users (adding and deleting): using the command line and GUI tools.

Unit 3. Resource management in Linux: file and directory management, system calls for files process Management, signals, IPC: Pipes, FIFOs, System V IPC, message queues, system calls for processes, memory management, library and system calls for memory.

SUGGESTED READINGS/REFERENCES:

1. Arnold Robbins, Linux Programming by Examples The Fundamentals, 2nd Ed., Pearson Education, 2008.
2. Cox K, Red Hat Linux Administrator's Guide, PHI, 2009.
3. R. Stevens, UNIX Network Programming, 3rd Ed., PHI, 2008.
4. Sumitabha Das, UNIX Concepts and Applications, 4th Ed., TMH, 2009.
5. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, Linux in a Nutshell, 6th Ed., O'Reilly Media, 2009.
6. Neil Matthew, Richard Stones, Alan Cox, Beginning Linux Programming, 3rd Ed., 2004.

B.A./B.Sc.. Mathematics (GENERAL) SEMESTER-V

Course: MATH-G-DSE-T-1A

Course title: Matrices and Linear Algebra

Discipline specific Elective Course; Credit-6; Full Marks-75

COURSE CONTENT:

6 Credits (5+1) (Theory + Tutorial)

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

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

matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

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

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

Double Dual, Eigen values and Eigen vectors, Characteristic Polynomial. Isomorphisms, Isomorphism

SUGGESTED READINGS/REFERENCES:

1. S. H. Friedberg, A. L. Insel and L. E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
2. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.
3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
4. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
6. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.

B.A./B.Sc.. Mathematics (GENERAL) SEMESTER-V

Course: MATH-G-DSE-T-1B

Course title: Complex Analysis

Discipline specific Elective Course; Credit-6; Full Marks-75

COURSE CONTENT:

6 Credits (5+1) (Theory + Tutorial)

Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy- Riemann equations, sufficient conditions for differentiability.

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions.

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

Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples.

Laurent series and its examples, absolute and uniform convergence of power series.

SUGGESTED READINGS/REFERENCES:

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

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-V
Course: MATH-G-SEC-T-3A
Course title: Integral Calculus
Skill Enhancement course; Credit-2; Full Marks-25

COURSE CONTENT:

2 Credits (Theory)

Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals. Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations.

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

SUGGESTED READINGS/REFERENCES:

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

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-V
Course: MATH-G-SEC-T-3B
Course title: Vector Calculus
Skill Enhancement course; Credit-2; Full Marks-25

COURSE CONTENT:

2 Credits (Theory)

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

Gradient, divergence and curl with applications

Vector integration. Line, Surface and Volume integrals.

SUGGESTED READINGS/REFERENCES:

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

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-VI
Course: MATH-G-DSE-T-2A
Course title: Linear Programming
Discipline specific Elective Course; Credit-6; Full Marks-75

COURSE CONTENT: 6 Credits (5+1) (Theory + Tutorial)

Introduction to linear programming problems. Theory of simplex method, graphical solution, convex sets, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method. Big-M method and their comparison.

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

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

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

SUGGESTED READINGS/REFERENCES:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 2006.
4. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.

B.A./B.Sc.. Mathematics (GENERAL)
SEMESTER-VI
Course: MATH-G-DSE-T-2B
Course title: Numerical Methods
Discipline specific Elective Course; Credit-6; Full Marks-75

COURSE CONTENT: 6 Credits (5+1) (Theory + Tutorial)

Algorithms. Convergence. Errors: relative, absolute. Round off. Truncation.

Unit 2. Transcendental and polynomial equations: Bisection method, Newton's method, secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Rate of convergence of these methods.

Unit 3. System of linear algebraic equations: Gaussian elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis. LU decomposition

Unit 4. Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.

Numerical differentiation: Methods based on interpolations, methods based on finite differences.

Unit 5. Numerical Integration: Newton Cotes formula, Trapezoidal rule, Simpson's $1/3^{\text{rd}}$ rule, Simpson's $3/8^{\text{th}}$ rule, Weddle's rule, Boole's Rule. Midpoint rule, Composite trapezoidal rule, composite Simpson's $1/3^{\text{rd}}$ rule, Gauss quadrature formula.

The algebraic eigen value problem: Power method.

Approximation: Least square polynomial approximation.

Unit 6. Ordinary differential equations: The method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.

SUGGESTED READINGS/REFERENCES:

1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering
3. Computation, 6th Ed., New age International Publisher, India, 2007.
4. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
5. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
6. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
7. Scarborough, James B., Numerical Mathematical Analysis, Oxford and IBH publishing co.
8. Yashavant Kanetkar, Let Us C, BPB Publications.

B.A./B.Sc.. Mathematics (GENERAL) SEMESTER-VI

Course: MATH-G-SEC-T-4A

Course title: Probability and Statistics

Skill Enhancement Course; Credit-2; Full Marks-25

COURSE CONTENT:

2 Credits (Theory)

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

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

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.

SUGGESTED READINGS/REFERENCES:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Application*, 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, *Introduction to Probability Model*, 9th Ed., Academic Press, Indian Reprint, 2007.

B.A./B.Sc.. Mathematics (GENERAL) SEMESTER-VI

Course: MATH-G-SEC-T-4B

Course title: Boolean Algebra

Skill Enhancement Course; Credit-2; Full Marks-25

COURSE CONTENT:

2 Credits (Theory)

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms.

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

SUGGESTED READINGS/REFERENCES:

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