Chaudhary Bansi Lal University

(A State University established under Haryana Act No. 25 of 2014)

SCHEME AND SYLLABI

for

TWO YEAR POSTGRADUATE PROGRAMME

M.Sc. MATHEMATICS

(1st and 2nd Semester)

As per NEP 2020

WITH EFFECT FROM THE SESSION 2025-26

Department of Mathematics
Chaudhary Bansi Lal University,
Prem Nagar-127031
Bhiwani
Haryana, India

Date of PGBOS&R: July 22, 2025

Vision and Mission of the University

Vision

To be known as a university having capacity to transform the society through continual innovations in education, research, creativity and entrepreneurship in the domain of higher education.

Mission

To create an environment in which new ideas, research and scholarship flourish and from which the leaders and innovators of tomorrow emerge.

To use local resources and environment as testing laboratory by the faculty and the students for generating new ideas and solutions of local problems.

To provide a challenging and rigorous curriculum which is global in outlook and simultaneously provides an understanding of the needs of society and industry.

To collaborate with leading academic and research institutes around the world to strengthen the education and research ecosystem.

To integrate ICT into teaching-learning processes and administrative systems for enhancing their effectiveness.

To create forums and to encourage students to participate in curricular and extra-curricular activities, to showcase and hone their talent and creativity.

To promote continuous engagement with stakeholders at all levels i.e. students, faculties, administration, alumni, industries, management of affiliated institutions, government regulatory bodies and community for their support, new ideas and feedback.

Vision and Mission of the Department

Vision

•To provide an environment where students can learn and become competent users of Mathematics and Mathematical applications in real life, industry and other disciplines.

- **To impart quality education combining academics with joy of discovery and inculcation of the spirit of research through innovative teaching and research methodologies.**

Mission

- **To provide quality education to the students to prepare them as a good academician to serve the society better.**
- **To achieve high standards of excellence in generating and propagating knowledge in Mathematics with research and academic excellence.**

Programme Learning Outcomes

PLO No.	Component	Outcomes
PLO 1.	Basic Knowledge and critical thinking	Capable of delivering basic disciplinary knowledge and able to understand critically the results.
PLO 2.	In- depth knowledge and problem solving abilities	Capable of describing advance knowledge gained during the programme and applying acquired knowledge to solve the problems.
PLO 3.	Creativity, analytical innovation and computation skills	Capable to identify, formulate, investigate and analyse the scientific problems innovatively to design through mathematical software and solutions to real life problems.
PLO 4.	Research aptitude and global competency	Ability to cultivate a research aptitude and use information to solve demanding research issues in the relevant and related fields globally.
PLO 5.	Holistic, multidisciplinary skill enhancement	Ability to learn through a multidisciplinary & holistic approach in various subjects, acquiring specialized talents and advanced methods consequently applying them to enhanced humanity.
PLO 6.	Ethical and professional responsibility	Encourage a moral, professional mind-set and the capacity to connect to societal issues.
PLO 7.	Leadership and team work abilities	The capacity to learn, collaborate with multidisciplinary teams and even take charge of a group.

Date of PGBOS&R: July 22, 2025

Scheme and Syllabus of Two Year Post Graduate Programme (Semester I and Semester II) M.Sc. in Mathematics:2025-26

Courses			Credits Distribution			Total Credits	Total Workload	Marks				
	Nomenclature of Course	Course Code	L	T	P		Total Contact Hours	Theory		Practical		Total Marks
								Internal	External	Internal	External	
SEMESTER-I (23 Credits)												
CC-1 4 credits	Real Analysis-I	25PN-MTH101	4	0	0	4	4	30	70	-	-	100
CC-2 4 credits	Modern Algebra	25PN-MTH102	4	0	0	4	4	30	70	-	-	100
CC-3 4 credits	Ordinary Differential Equations	25PN-MTH103	4	0	0	4	4	30	70	-	-	100
CC-4 4 credits	Mechanics	25PN-MTH104	4	0	0	4	4	30	70	-	-	100
PC-1 3 credits	Programming in FORTRAN 90/95	25PN-MTH105	0	0	3	3	6	-	-	20	50	70
Any one of the following												
DEC-1 4 credits	Mathematical Statistics	25PN-MTH106	4	0	0	4	4	30	70	-	-	100
	Mathematical Modeling	25PN-MTH107	4	0	0	4	4	30	70	-	-	100
	Discrete Mathematics	25PN-MTH108	4	0	0	4	4	30	70	-	-	100

Date of PGBOS&R: July 22, 2025

Semester-I

Name of the Course: Real Analysis-I	**Course Code : 25PN-MTH101**	**Credits:4**
Maximum Marks **Theory: 30(Internal)+70(External)=100**	**Time of Examinations: 3 Hours**	

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1 Understand the concepts of continuity, uniform continuity and their related theorems.
CLO2 Describe the concepts of limit, continuity and differentiability of real valued function of two variables.
CLO3 Explain maxima, minima and saddle pointes of two variables and Lagrange's method of multipliers.
CLO4 Understand Riemann integral and fundamental theorems of integral calculus.

Section – I

Continuity, Sequential continuity, Properties of continuous functions, Uniform continuity, Chain rule of differentiability. Mean value theorems: Rolle's Theorem and Lagrange's mean value theorem and their geometrical interpretations. Taylor's Theorem with various forms of remainders, Darboux intermediate value theorem for derivatives, Reduction formulae. Rectification, Intrinsic equations of curve.

Section – II

Limit and continuity of real valued functions of two variables. Partial differentiation. Total Differentials: Composite functions & Implicit functions. Change of variables. Homogenous functions & Euler's theorem on homogeneous functions. Taylor's theorem for functions of two variables.

Section - III

Differentiability of real valued functions of two variables. Schwarz and Young's theorem. Implicit function theorem. Maxima, Minima and saddle points of two variables. Lagrange's method of multipliers Jacobian.

Section – IV

Riemann integral, Integrability of continuous and monotonic functions, The Fundamental theorem of integral calculus. Mean value theorems of integral calculus.

References

1. Gabriel Klaumber: Mathematical Analysis, Mrcel Dekkar, Inc., New York, 1975.
2. R.R. Goldberg: Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970.
3. Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
4. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
5. Shanti Narayan: A Course in Mathemtical Analysis, S.Chand and company, New Delhi.
6. Murray, R. Spiegel: Theory and Problems of Advanced Calculus, Schaum Publishing co., New York.

Date of PGBOS&R: July 22, 2025

Semester-I

Name of the Course: Modern Algebra	**Course Code: 25PN-MTH102**	**Credits:4**
Maximum Marks **Theory: 30(Internal)+70(External)=100**	**Time of Examinations: 3 Hours**	

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO 1 Demonstrate understanding of the idea of a group, subgroup, cyclic groups, normal groups and quotient groups.

CLO 2 Understand and apply the concepts of homomorphism, isomorphism, automorphisms and inner automorphisms of a group.

CLO 3 Understand rings, subrings, ring homorphisms and field of quotients,

CLO4 Demonstrate capacity for mathematical reasoning through analysing, proving and explaining concepts from advanced algebra.

Section – I

Definition of a group with example and simple properties of groups, Subgroups and Subgroup criteria, Generation of groups, cyclic groups, Cosets, Left and right cosets, Index of a sub-group coset decomposition, Largrage's theorem and its consequences, Normal subgroups, Quotient groups**.**

Section – II

Homoomorphisms, isomophisms, automorphisms and inner automorphisms of a group. Automorphisms of cyclic groups, Permutations groups. Even and odd permutations. Alternating groups, Cayley's theorem, Center of a group and derived group of a group..

Section - III

Introduction to rings, subrings, integral domains and fields, Characteristics of a ring. Ring homomorphisms, ideals (principle, prime and Maximal) and Quotient rings, Field of quotients of an integral domain.

Section – IV

Euclidean rings, Polynomial rings, Polynomials over the rational field, The Eisenstein's criterion, Polynomial rings over commutative rings, Unique factorization domain, R unique factorization domain implies so is R[X1 , X2,……Xn]

References:

1. Herstein I.N,1975. Topics in Algebra, Wiley Eastern Ltd., New Delhi.
2. Bhattacharya P.B., Jain S.K., Nagpal S.R., 2003, Basic Abstract Algebra (2nd edition), Cambridge University Press.
3. Sahai V., Bist V., 2013, Linear Algebra, Narosa Publishing House.
4. Luther I.S., Passi I.B.S., 1905, Algebra, Vol.-II, Narosa Publishing House.
5. Gallian J.A., 1999, Abstract Algebra, Narosa Publishing House.

Date of PGBOS&R: July 22, 2025

Semester-I

Name of the Course: Ordinary Differential Equations	**Course Code: 25PN-MTH103**	**Credits:4**
Maximum Marks **Theory: 30(Internal)+70(External) =100**	**Time of Examinations: 03 Hours**	

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO 1: Many fundamental laws of physics and chemistry can be formulated as differential equations.

CLO 2:. Learn to illustrate the concept of identification of differential equations, some analytical techniques to find solutions.

CLO 3 Demonstrate and understand the autonomous system and stability theory.

CLO 4: Use various methods to get qualitative information about the general behaviour of the solutions of various problems.

Section-I

Preliminaries: Initial value problem and equivalent integral equation. Lipschitz condition, Picard Fundamental existence and uniqueness theorem for dy/dt= f(t,y), Dependence of solutions on initial conditions and parameters, Solution of initial-value problems by Picard method.

Sturm Theory: Adjoint systems, Self-Adjoint Equations of the Second order, Abel's Formula, Sturm Separation and Comparison theorems, Lagrange's identity and Green's formula for second order differential equations,

Section-II

Linear systems, Matrix method for homogeneous first order system of linear differential equations, Fundamental set of solutions, Fundamental matrix of solutions, Wronskian of solutions, Basic theory of the homogeneous linear system, Abel-Liouville formula, Nonhomogeneous linear system. SLBVP, Properties of eigenvalues and eigen functions, Pruffer transformation,

Section-III

Nonlinear differential systems, Phase plane, Path, Critical points, Autonomous systems, Isolated critical points, Path approaching a critical point, Path entering a critical point, Types of critical points- Center, Saddle points, Spiral points, Node points, Stability of critical points, Asymptotically stable points, Unstable points, Critical points and paths of linear systems. Almost linear systems.

Section-IV

Nonlinear conservative dynamical system, Dependence on a parameter, Liapunov function and Liapunov's method to determine stability for nonlinear systems, Periodic solutions and Floquet theory for periodic systems, Limit cycles, Bendixson non-existence theorem, Poincare-Bendixson theorem(Statement only), Index of a critical point.

References:

1. Boyce W.E. and Diprima R.C., Elementary Differential Equations and Boundary Value Problems, John Wiley and Sons, Inc., New York, 2009, 9th edition.
2. Coddington E.A. and Levinson N., Theory of Ordinary Differential Equations, Tata McGraw Hill, 2017.
3. Deo S.G., Lakshmikantham V. and Raghavendra V., Textbook of Ordinary Differential Equations, Tata McGraw Hill, 2017.
4. Goldberg J. and Potter M.C., Differential Equations – A System Approach, Prentice Hall, 1998
5. Hartman P., Ordinary Differential Equations, John Wiley & Sons, 1987.
6. Ross S.L., Differential Equations, John Wiley and Sons Inc., New York, 1984.
7. Simmons G.F., Differential Equations, Tata McGraw Hill, New Delhi, 2003.
8. Somasundram D., Ordinary Differential Equations, A First Course, Narosa Pub. Co., 2016.
9. J. M. Gelfand and S. V. Fomin, Calculus of Variations, Prentice Hall, New Jersy, 1963.

Date of PGBOS&R: July 22, 2025

Semester-I

Name of the Course: Mechanics	**Course Code: 25PN-MTH104**	**Credits:4**
Maximum Marks **Theory: 30(Internal)+70(External)=100**	**Time of Examinations: 3 Hours**	

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):
After completing this course, student is expected to learn the following:
CLO1: Understand the notion of moment & product of inertia and its applications
CLO2: Use the Lagrangian and Hamiltonian functions to formulate the equation of motion for mechanical systems
CLO3: Understand Poisson Bracket along with principle of least action.
CLO4: Understand the concept of attraction and potential along with equipotential surfaces

Section – I

Moments and products of Inertia, Theorems of parallel and perpendicular axes, Angular momentum of a rigid body about a fixed point and about a fixed axes, Principal axes, Kinetic energy of a rigid body rotating about a fixed point, Momental ellipsoid- Equimomental systems, Coplanar distributions. Euler's dynamical equations for the motion of a rigid body about a fixed point, Further properties of Rigid body motion under no forces.

Section – II

Generalized co-ordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic systems. Lagrange's equations for a simple holonomic dynamical system, Lagrange's equations for conservative and impulsive forces. Kinetic energy as a quadratic functions of velocities. Generalized potential, Energy equation for conservative fields. Hamilton's canonical variables. Donkin's theorem. Hamilton canonical equations. Cyclic coordinates. Routh's procedure.

Section – III

Poisson Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Hamilton's Principle. Principle of Least action. Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Hamilton-Jacobi equation. Jacobi theorem. Method of Separation of variables. Lagrange Brackets, Canonical Transformations, Condition of canonical character of a transformation in terms of Lagrange and Poisson brackets. Invariance of Lagrange and Poisson brackets under canonical transformations.

Section – IV

Gravitation: Attraction and potential of rod, disc, spherical shells and sphere. Laplace and Poisson equations. Work done by self-attracting systems. Distributions for a given potential. Equipotential surfaces. Surface and solid harmonics. Surface density in terms of surface harmonics.

References:
1. F. Chorlton, A Text Book of Dynamics, CBS Publishers & Dist., New Delhi. 2004.
2. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow. 1975.
3. F. B. Hildebrand, Method of Applied Mathematics, Dover Publications,2012.

Date of PGBOS&R: July 22, 2025

Semester-I

Name of the Course: Programming in FORTRAN 90/95	**Course Code: 25PN-MTH105**	**Credits:3**
Maximum Marks **Practical: 20(Internal)+50(External)=70**	**Time of Examinations: 3 Hours**	

Course Learning Outcomes (CLO):

CLO1: Students would be able to understand Fortran programming
CLO2: Be familiar with the concepts of loops, arrays, and functions.
CLO3: Students would be able to create algorithm and program to solve a real world problem.

Practical/ Computational Work

Practical: 20(Internal)+50(External)=70

There will be five questions in all, and the students must attempt any three questions. The question paper will set on the spot jointly by the internal and external examiners.
Distribution of Marks will be as follows:

i) Written Practical/ Lab work : 25 Marks
ii) Viva-voce and practical record: 25 Marks

Introduction to Programming: Problem solving using Algorithms and Flowcharts.
Introduction to FORTRAN 90: Character Set, Constants and Variables, Data Types, Subscripted Variables and Simple Fortran Functions, Fortran Operators: types and precedence, Format Free Read Command, Format Free Print Command, Formatted Input and Output, Format Statement, Data object declaration, type declaration statement, Implicit Statement.

Conditional and control commands: IF- THEN - ENDIF Construct, IF - THEN - ELSE - ENDIF Construct, Logical IF Commands, Arithmetic IF Commands, CASE Construct; Transfer Commands, Loops in Fortran: Do Construct, Nested DO-Loops; CONTINUE Statement, Implied Do, Intent, Save, Exit, Stop, Data, Equivalence, Common, Parameter and Cycle Statement.

Arrays: Introduction, Array Storage: 1-D, 2-D and 3-D Arrays, Dimension Statement, Dynamic Allocation of Arrays. Functions and Subroutine: Statement Function, Library Functions, Function Subprograms, Dummy arguments, Actual arguments, Calling Functions and Subroutine.

File Manipulation: The OPEN & CLOSE statements, File INPUT/OUTPUT, READ & WRITE statements for sequential and Direct Access File, Formatted and Unformatted READ/WRITE statements. Pointers in Fortran.

List of Practicals

Following is the list of programmes to be performed on Fortran 95:

1. Solving mean, median, standard deviation, variance, correlation
2. Demonstrate basic structure of FORTRAN Program.
3. Demonstrates the use of arrays for data analysis-max, min, and average
4. Program to demonstrate use of formatted output.
5. Demonstrates the use of arrays with Fortran 90 specifications.
6. To find largest (or smallest) of three numbers. Computation of LCM and GCD.
7. To find the transpose of a matrix, addition and multiplication of two matrices.
8. Find the roots of quadratic equation, Area, volume of given figure.
9. Use of control statements, eg, IF, DO loop statement etc.
10. Calculate the SIN and COS of an angle given in degrees.
11. Example of a BUBBLE SORT.
12. Example of a SELECTION SORT using Fortran 90/95.

References:

1. Metcalf M., Reid J., Cohen M., 1999, FORTRAN 90/95 Explained, Oxford University Press, 2nd Revised edition.
2. Rajaraman V., 2009, Computer Programming in FORTRAN 90 and 95, PHI Learning. New Delhi.
3. Anders G.E., Fisk C.S.R., 1995, Spreadsheet Accounting Tutorial and Applications, McGraw-Hill.
4. Shelly G.B., Cashman T.J., Quasney J.S., 2000, Microsoft Excel 2000: Comprehensive Concepts and Techniques, Cashman Series.
5. Lambert J., Cox J., 2010, Microsoft Office Professional 2010 step by step, Microsoft Press U.S.
6. Nyhoff L., Leestma S., 1999, Introduction to Fortran 90., Prentice Hall.

Date of PGBOS&R: July 22, 2025

Semester-I

Name of the Course: Mathematical Statistics	**Course Code: 25PN-MTH106**	**Credits:4**
Maximum Marks **Theory: 30(Internal)+70(External)=100**	**Time of Examinations: 3 Hours**	

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1: Students will learn about the concept of probability, statistical distributions.

CLO2: Students will be able to illustrate the concept of testing of hypothesis.

CLO3: Students gets to learn the application of mathematics and its relation to the real world.

Section – I

Probability: Classical, Statistical and axiomatic approach, Addition theorem, Boole's inequality, Conditional probability and multiplication theorem, Independent events, Bayes' theorem and its applications.
Random variable, discrete and continuous random variables, probability mass and density functions, distribution function.

Section – II

Joint, marginal and conditional distributions. Mathematical Expectation and its properties. Variance, Covariance, Moment generating function. Discrete distributions: Binomial, Poisson and geometric distributions with their properties.

Section – III

Continuous distributions: Uniform, Normal, Gamma and Exponential distributions and their properties. Chebychev's inequality, Central Limit Theorem. Weak Law of Large Numbers.

Section – IV

Point and interval estimation, Unbiasedness, Sufficiency, Consistency and Efficiency. Testing of Hypothesis, Null and alternative hypotheses, Simple and composite hypotheses, types of errors, Level of significance, Power of the Test, Critical Region. One tailed and two tailed tests, t-test, Chi-square test and F-test.

References:

1. 1. A.M. Mood, Graybill F.A. and Boes D.C., Introduction to the theory of Statistics, McGraw Hill Book Company, 2001.
2. J.E. Freund, Mathematical Statistics, Prentice Hall of India, 2014.
3. M. Speigel, Probability and Statistics, Schaum Outline Series.
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi,2014.
5. H.C. Taneja, Statistical Methods for Engineering & Sciences, I. K.International,2009.
6. Gun A.M, Gupta M.K, Dasgupta , Fundamental of Statistics Vol. 1 & 2, World Press,2016

Date of PGBOS&R: July 22, 2025

Semester-I

Name of the Course: Mathematical Modeling	**Course Code: 25PN-MTH107**	**Credits:4**
Maximum Marks **Theory: 30(Internal)+70(External)=100**	**Time of Examinations: 3 Hours**	

Note:

Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1: Be familiar the concept of mathematical modeling.

CLO2: Derive solutions of various problems using different techniques to describe and explore real world data and phenomena.

CLO3: Learn about application of mathematics using ODE in various fields.

CLO4: Solving real life problems using mathematical modelling.

Section – I

Mathematical modeling: need, techniques, classification and illustrations; Mathematical modeling through ordinary differential equations of first order. Linear growth and Decay models. Non-Linear and Decay models.

Section – II

Epidemic spreading and compartment Population Dynamics, Epidemics models; mathematical mode1ing through systems of ordinary differential equations; mathematical mode1ing in economic, medicine, arm-race, battle.

Section – III

Mathematical modeling through ordinary differential equations of second order Planetary motion, Circular motion and motion of Satellites. Higher order (linear) models. Mathematical modeling through difference equations: Need, basic theory; mathematical modeling in probability theory, economics, finance, population dynamics and genetics.

Section – IV

Mathematical modeling through partial differential equations: simple models, mass-balance equations, variational principles, probability generating function, traffic flow problems, initial & boundary conditions.

References:

1. J.N. Kapur: Mathematical Modeling, Wiley Eastern Ltd., 1990
2. B. Albright;Mathematical Modeling with Excel, Jones & Bartlett,2010

Date of PGBOS&R: July 22, 2025

Semester-I

Name of the Course: Discrete Mathematics	**Course Code: 25PN-MTH108**	**Credits:4**
Maximum Marks **Theory: 30(Internal)+70(External)=100**	**Time of Examinations: 3 Hours**	

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1: Understand and apply discrete numeric functions, generating functions, and solve recurrence relations using both algebraic and generating function methods.

CLO2: Analyze algebraic structures such as groups, rings, and lattices, and demonstrate understanding of their fundamental properties.

CLO3: Apply Boolean algebra to simplify logic expressions and design efficient digital circuits using Karnaugh maps and switching theory.

CLO4: Develop problem-solving skills in number theory, including divisibility, modular arithmetic, and congruences.

Section – I

Discrete numeric functions, Generating functions, recurrence relations with constant coefficients. Homogeneous solution, particular relations, total rotation, Solution of recurrence relation by the method of generating functions.

Section-II

Semigroups, Lattices and their properties, lattice as algebraic system, Bounded, Complement and distributive lattices.

Section-III

Boolean algebra, definition and examples, properties, duality, distributive and complemented Calculus. Design and implementation of digital networks, switching circuits, Karnaugh map.

Section-IV

The division algorithm, different bases, the equation ax + by = n, the bracket function and binomial coefficients, the ¢-function, the order of an integer modulo m, periodic decimals.

Books Recommended:

1. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
3. Seymour Lipschutz, Finite Mathematics (International edition 1983), McGraw-Hill Book Company, New York.
4. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hilll Book Co.
5. Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.
6. Thomas Koshy, Elementary Number Theory with Applications, Academic Press is an imprint of Elsevier, London, 2007.
7. Neal H. McCoy, The Theory of Numbers, The Macmillan Company, New York Collier-Macmillan Limited, London, 1966.

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