Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Name of the Program: B. Sc. (Mathematics Honours)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 501	DC	**Algebra IV (Sylow's Theorems and Field Theory)**	60	20	20	-	-	3	1	-	4

Course Objective

To introduce the students with the Sylow's Theory and Field Theory

Course Outcomes

After the successful completion of this course students will be able to:

1. *understand the fundamental of Sylow's Theory*
2. *apply the Sylow's Theorem in Algebra.*
3. *know the applications of Field Theory.*
4. *create and evaluate the fundamental problems of Field theory.*

Course Content:

Unit I: Euclidean domains; principal ideal domains, unique factorization domains; polynomial rings.

Unit II: Group actions, orbit stabilizer theorem, conjugacy.

Unit III: Cauchy's and Sylow's theorem and applications**.**

Unit IV: Introduction to extension fields; algebraic and transcendental elements, the irreducible polynomial over a field; simple extensions.

Unit V: Algebraic extension, finite extensions, algebraically closed fields and algebraic closures.

Reference Books:

1. John B. Fraleigh, A First Course in Abstract Algebra, Pearson.
2. Joseph A. Gallian, Contemporary Abstract Algebra, Cengage Learning.

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 501	DC	**Algebra IV (Sylow's Theorems and Field Theory)**	60	20	20	-	-	3	1	-	4

3. M. Artin: Algebra, Pearson.
4. S. D. Dummit and M. R. Foote: Abstract Algebra, Wiley Publications.
5. I. N. Herstein: Topics in Algebra, John Wiley & Sons.
6. N.S. Gopalkrishnan, University Algebra, New Age International Private Limited.
7. F. E. Hohn: Elementary Matrix Algebra, Dover Publications.

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Name of the Program: B. Sc. (Mathematics Honours)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 502	DC	**Discrete Mathematics and Number Theory**	60	20	20	-	-	3	1	-	4

Course Objective

To introduce the students with the Discrete Mathematics and Number Theory

Course Outcomes

After the successful completion of this course students will be able to:

1. *understand the fundamental of discrete mathematics.*
2. *solve the problems based on mathematics.*
3. *know the applications of number theory.*
4. *discuss and apply the basics of combinatorics.*

Course Content:

Unit I:
Algebra of Logic: Proposition and statement, compound statement, logical operations, logical connectives, truth tables, tautologies, contradiction, equivalence, duality law.

Unit II:
Boolean Algebra: Introduction to Boolean algebra, Duality, Boolean identities, minimal Boolean function, normal forms (conjunctive and disjunctive), switching circuits, simplification of circuits.

Unit III:
Combinatorics: Addition and multiplication rules, basic counting principles, Binomial and multinomial theorems, principle of inclusion and exclusion, generating functions and its applications, Recurrence relations and their formation and transformation of recurrence relation in subscript notion (difference equation).

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 502	DC	**Discrete Mathematics and Number Theory**	60	20	20	-	-	3	1	-	4

Unit IV:

Solution of recurrence relation, linear recurrence relations with constant coefficients, general solution of homogeneous linear recurrence relation of second order with constant coefficients, homogeneous solution of the homogeneous linear recurrence relation or order k with constant coefficients, total solution, particular solution.

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Unit V:

Number Theory: Diophantine equations, divisibility, primes and unique factorization; GCD and Euclidean algorithm and its extension for computing multiplicative inverses; congruences and complete residue systems, Fermat, Euler, Wilson theorems; linear congruences and the Chinese remainder theorem.

Reference Books :

1. Fred S. Roberts. Applied Combinatorics.
2. Mott J. L. , Kandel A. and Baker T. P., Discrete Mathematics for Computer Scientists and Mathematicians, Second Edition, Prentice Hall India, 1986.
3. Liu C.L., Elements of Discrete Mathematics, Second Edition, Mc Graw Hill 1985.
4. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery. An Introduction to the Theory of Numbers.
5. E. M. Wright and G. H. Hardy. An Introduction to the Theory of Numbers.

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Name of the Program: B. Sc. (Mathematics Honours)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 503	DC	**Probability Theory**	60	20	20	-	-	3	1	-	4

Course Objective

To introduce the students with the Modern Probability Theory

Course Outcomes

After the successful completion of this course students will be able to:

1. *understand the fundamental of probability theory.*
2. *know the basics of probability distributions.*
3. *discuss and classify the probability distributions.*
4. *apply the applications of probability and probability distributions.*

Course Content:

Unit I:

Classical Theory & Its Limitations: Random experiment and events, event space; Definitions: Classical or mathematical probability and its drawbacks, relative frequency or statistical probability and its drawbacks and axiomatic definitions of probability, addition theorem and conditional probability, multiplication theorem, Bayes' Theorem and independence, Boole's inequality. Geometric probability. (Examples on the relative topics)

Unit II:

Random Variables: Discrete, continuous random variables, probability mass, probability density functions, various measures of central tendency, measures of dispersion, measures of skewness and kurtosis; mathematical expectation, moments; probability generating function, characteristic function and moment generating function; Markov's inequality, Chebyshev's inequality.

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 503	DC	**Probability Theory**	60	20	20	-	-	3	1	-	4

Unit III:

Bernoulii trials and binomial law, Poisson trials; some discrete and continuous distributions: Bernoulli, Binomial and Poisson; uniform, normal, Gamma, Cauchy distribution; Functions of a random variable and their probability distribution and examples.

Unit IV:

Probability Distributions on $\mathbb{R}^n$: Random vectors, Probability distribution of a random vector, functions of random vectors and their probability distributions, moments, generating functions, correlation coefficient, conditional expectation, the principle of least squares, regression.

Unit V:

Convergence and Limit Theorems: sequence of random variables, convergence in distribution, convergence in probability, almost sure convergence, convergence in rth mean, weak and strong law of large numbers, Borel-Cantelli lemma, limiting characteristic functions, central limit theorem (statement only).

Reference Books :

1. William Feller: An Introduction to Probability Theory and its Applications, Wiley & Sons.
2. David Stirzaker and Geoffrey Grimmett: Probability and Random Processes, Oxford University Press.
3. V. K. Rohatgi and A. K. Md. Ehsanes Saleh: An Introduction to Probability and Statistics, Wiley & Sons.
4. Rick Durett: Probability Theory & Examples, Cambridge University Press.
5. S.C. Gupta and V.K. Kapoor: Fundamental of Mathematical Statistics, Sultan Chand and sons.

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Name of the Program: B. Sc. (Mathematics Honours)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 504	DC	Discrete Mathematics and Graph Theory	60	20	20	-	-	3	1	-	4

Course Objective

To introduce the students with the Discrete Mathematics and Graph Theory

Course Outcomes

After the successful completion of this course students will be able to

1. *understand and apply the basics of the Discrete Mathematics.*
2. *understand and discuss the structure Lattice and its types.*
3. *know the fundamentals of graphs.*
4. *create and evaluate the fundamental problems of in discrete mathematics and graph theory.*

Course Content:

UNIT – I

Discrete Numeric Functions: Introduction to Discrete Numeric functions, Manipulation of Numeric functions, Convolution of Numeric functions, Generating functions, Application of Generating functions.

UNIT – II

Relations: Partial ordered relation, Total ordered relation, Partial ordered set, Chain, Antichain, Hass Diagram, Maximal and Minimal elements, least upper bonds.

UNIT – III

Lattices: Lattice, Sub lattices, Distributive inequality, Lattice homomorphism, Lattice isomorphism, complete lattice, Complemented lattice, Distributive lattice.

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Name of the Program: B. Sc. (Mathematics Honours)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 504	DC	**Discrete Mathematics and Graph Theory**	60	20	20	-	-	3	1	-	4

Unit IV

Graphs: Finite Graphs, Incidence and degree, isomorphism, Subgraphs and union of graphs, connectedness, walk, path and circuits, weighted graphs, shortest path in weight graphs, Eulerian graphs, matrix representation of graphs and digraphs.

Unit V

Trees; distance and centers in a tree, Rooted trees and binary trees, Spanning tree, Euler's formula, Cut sets.

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Texts:

1. Fred S. Roberts. Applied Combinatorics.
2. Mott J. L. , Kandel A. and Baker T. P., Discrete Mathematics for Computer Scientists and Mathematicians, Second Edition, Prentice Hall India, 1986.
3. Liu C.L., Elements of Discrete Mathematics, Second Edition, Mc Graw Hill 1985.
4. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery. An Introduction to the Theory of Numbers.
5. E. M. Wright and G. H. Hardy. An Introduction to the Theory of Numbers
6. Frank Harary. Graph Theory.
7. Douglas West. Introduction to Graph Theory.

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Name of the Program: B. Sc. (Mathematics Honours)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 505	DC	**Theory of ODEs**	60	20	20	-	-	3	1	-	4

Course Objective

To introduce the students with the Ordinary Differential Equations.

Course Outcomes

After the successful completion of this course students will be able to:

1. *understand the fundamental of differential equations*
2. *know the fundamental of power series*
3. *discuss and use the methods of solving differential equations*
4. *create and justify the applications of power series.*

Course Content:

Unit I:

First Order ODE: Separation of variables, Homogeneous Equations; Linear Equations; Equations reducible to Linear Equation.

Unit II:

Solution of first order & first degree ordinary differential equation for Exact differential equations, Solution of Ordinary differential equation of first order and higher degree (solvable for p, x and y, Clairauts equation).

Unit III:

Higher Order Linear ODE with Constant Coefficients: Complementary function, particular integral, method of undetermined coefficient, method of variation of parameters, Homogeneous differential equation with constant coefficient, Simultaneous differential equations.

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 505	DC	**Theory of ODEs**	60	20	20	-	-	3	1	-	4

Unit IV:

Second Order Linear ODE with Variable Coefficients: by known integral, removal of first derivative, change of independent variable and variation of parameters.

Unit V:

Power Series solution of second order linear ODE; Solutions of Legendre's differential equation and Bessel's differential equations.

Reference Books:

1. G.F. Simmons: Differential Equation with Applications and Historical Notes, McGraw-Hill.
2. A.C. King, J. Billingham and S.R. Otto: Differential Equations: Linear, Nonlinear, Ordinary, Partial, Cambridge University Press.
3. D.A. Murray, Introductory Course in Differential Equations, Orient Long man, India.

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Name of the Program: B. Sc. (Mathematics Honours)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 506(1)	DC	**Elective I:** **Linear and Matrix Algebra II**	60	20	20	-	-	3	0	-	3

Course Objective

To introduce the students with the Advance Linear and Matrix Algebra

Course Outcomes

After the successful completion of this course students will be able to:

1. *apply the fundamentals of linear algebra.*
2. *apply the fundamental of matrix algebra.*
3. *discuss the applications of linear and matrix algebra.*
4. *evaluate the fundamental problems of linear and matrix algebra.*

Course Content:

Unit I:
Companion form; rational form and Jordan form of a matrix (without proof); Lower and upper bounds for rank of product of two matrices.

Unit II:
Elementary operations and elementary matrices, Echelon form, Normal form, Hermite canonical form and their use (sweep-out method) in solving linear equations and in finding inverse.

Unit III:
LDU-decomposition. Formulae of determinant and inverse of a partitioned matrix; idempotent matrices; left inverse and right inverse of full-rank rectangular matrices; generalized inverse.

Unit IV:

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 506(1)	DC	**Elective I:** **Linear and Matrix Algebra II**	60	20	20	-	-	3	0	-	3

Proof of spectral theorem for complex Hermitian and real symmetric matrices; singular value decomposition; polar decomposition.

Unit V: Simultaneous diagonalization of commuting Hermitian/real symmetric matrices.

Reference Books:

1. M. Artin: Algebra.

2. S. D. Dummit and M. R. Foote: Abstract Algebra.

3. I. N. Herstein: Topics in Algebra.

4. C. R. Rao: Linear Statistical Inference and Its Applications.

5. A. Ramachandra Rao and P. Bhimasankaram: Linear Algebra.

6. K. Ho_man and R. Kunze: Linear Algebra.

7. F. E. Hohn: Elementary Matrix Algebra.

8. P. R. Halmos: Finite Dimensional Vector Spaces.

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Name of the Program: B. Sc. (Mathematics Honours)

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 506(2)	DC	**Elective I:** **Discrete Mathematics and Number Theory II**	60	20	20	-	-	3	0	-	3

Course Objective

To introduce the students with the advance Discrete Mathematics and Number Theory

Course Outcomes

After the successful completion of this course students will be able to:

1. *apply the fundamentals of discrete mathematics.*
2. *apply the fundamental of number theory.*
3. *discuss the applications of cryptography.*
4. *evaluate the fundamental problems of discrete mathematics, number theory and cryptography.*

Unit I:
Public key cryptography: primality testing using Rabin-Miller algorithm, idea of hardness of factoring and discrete logarithm; basics of Diffie-Hellman Key Agreement and RSA cryptosystem and digital signatures.

Unit II:
Cyclotomic polynomials, arithmetic functions, Mobius inversion formula, zeta functions; continued fractions, periodic continued fractions.

Unit III:
Quadratic irrationalities; Brahmagupta-Pell Equation; four squares theorem; Fermat descent.

Unit IV:

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 506(2)	DC	**Elective I:** **Discrete Mathematics and Number Theory II**	60	20	20	-	-	3	0	-	3

Graph Theory: Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments.

Unit V:

Trees; rooted trees and binary trees, planar graphs, Euler's formula, statement of Kuratowski's theorem, dual of a planer graph, independence number and clique number, chromatic number, statement of Four-color theorem, dominating sets and covering sets.

Reference Books :

1. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery. An Introduction to the Theory of Numbers.
2. E. M. Wright and G. H. Hardy. An Introduction to the Theory of Numbers.
3. Open Courseware from MIT. http://ocw.mit.edu/courses/mathematics/18-781-theory-of-numbers-spring- 2012/lecture-notes/.