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 (Matrix Algebra-I)**	60	20	20	-	-	4	1	-	5

Course Objective

To introduce the students with the Algebra of the Matrices.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the basics of the Algebra of the Matrices.

Course Content:

Unit I:
Linear transformations and their matrices; row and column spaces of a matrix; rank and nullity of a matrix; rank factorisation; system of linear equations.

Unit II:
Eigenvalues and eigenvectors; algebraic and geometric multiplicities; characterization of diagonalizable matrices; characteristic and minimal polynomial;

Unit III:
Caley-Hamilton Theorem. Bilinear forms, inner products, Gram-Scmidt orthogonalization process; orthogonal spaces; direct sum

Unit IV:
Quadratic forms, positive and negative definite matrices; extrema of positive definite quadratic forms.

Unit V:
Definition of unitary, hermitian, normal, real symmetric and orthogonal matrices. Statement of spectral theorems for real symmetric matrices.

Reference Books :

1. A. Ramachandra Rao and P. Bhimasankaram: Linear Algebra.
2. K. Ho_man and R. Kunze: Linear Algebra.
3. F. E. Hohn: Elementary Matrix Algebra.
4. P. R. Halmos: Finite Dimensional Vector Spaces.

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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 502	DC	**Discrete Mathematics and Number Theory**	60	20	20	-	-	4	1	-	5

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 understand and apply the basics of the Discrete Mathematics and Number Theory.

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).

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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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	-	-	4	1	-	5

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 understand and apply the basics of the Modern Probability Theory.

Course Content:

Unit I:
Classical Theory & Its Limitations: Random experiment and events, event space; classical definition of probability and its drawbacks, statistical regularity, frequency definition and its drawbacks. Probability Axioms: Basics from measure theory, probability measure, probability space, continuity theorem in probability, exclusion-inclusion formula,

Unit II:
Conditional probability & Baye's rule, Boole's inequality, Independence of events, Bernoulii trials and binomial law, Poisson trials, Probability on finite sample spaces, Geometric probability. Random variables and Their Probability Distributions: Random variables, Probability distribution of a random variable, discrete and continuous random variable, some discrete and continuous distributions on IR: Bernoulli, Binomial and Poisson; uniform, normal, Gamma, Cauchy and X^2 distribution;

Unit III
Functions of a random variable and their probability distribution. Characteristics and Generating Functions: Expectation, moments, measures of central tendency, measures of dispersion, measures of skewness and kurtois, Markov & Chebycheff's inequality, probability generating function, moment generating function, characteristic function. Probability Distributions on R^n:

Unit IV:
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.
2. David Stirzaker and Geoffrey Grimmett: Probability and Random Processes.
3. V. K. Rohatgi and A. K. Md. Ehsanes Saleh: An Introduction to Probability and Statistics.
4. Rick Durett: Probability Theory & Examples.

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 504	DC	**Geometry - II**	60	20	20	-	-	4	1	-	5

Course Objective

To introduce the students with the n-dimensional Geometry.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the basics of the n-dimensional Geometry.

Course Content:

Unit I:
Review of calculus of several variables. Proof of Inverse Function Theorem and Implicit Function Theorem. Differential forms in R^n.

Unit II:
Exterior derivative of forms. Closed and exact forms. Surfaces in R^3, tangent plane and normal. Orientation of a surface. Forms on surfaces.

Unit III:
Integration on surfaces. Stokes formula. Generalization to regular level-surfaces in R^n. Definition of differentiable manifolds. Surfaces as two dimensional manifolds.

Unit IV:
Tangent space and derivative of maps between manifolds. First fundamental form. Second fundamental form and the Gauss map.

Unit V:
Mean curvature and scalar curvature. Statement of the Gauss- Bonnet theorem.

Reference Books :

1. M.P. do Carmo: Differential Geometry of Curves and Surfaces.
2. J. A. Thorpe: Eelementary Topics in Di_erential Geometry.
3. Spivak: Calculus on manifolds.

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 505	DC	**Mathematical Methods**	60	20	20	-	-	4	1	-	5

Course Objective

To introduce the students with the Mathematical Methods.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the basics of the Mathematical Methods.

Course Content:

Unit I:

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

Complementary function, particular integral, method of undetermined coefficient, method of variation of parameters.

Unit III:

Second Order Linear ODE with Variable Coefficients: Method of reduction of order, method of variation of parameter. Power Series Solutions: Series solution of first order ODE, second order linear ODE, ordinary and regular singular points, power series solution of second order linear ode around regular singular points.

Unit IV:

Laplace Transformations: Introduction to integral transformations, Laplace transforms properties of Laplace transforms, convolutions, inverse formula for Laplace transforms, solving differential equations using Laplace transforms.

Unit V:

Partial Differential Equation(PDE): An introduction and formation of PDE. Method of characteristics to solve first order PDEs.

Reference Books :

1. G.F. Simmons: Differential Equation with Applications and Historical Notes.

2. A.C. King, J. Billingham and S.R. Otto: Differential Equations: Linear, Nonlinear, Ordinary, Partial.

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMAH 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 understand and apply the Techniques of the Advance 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:
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.

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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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMAH 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 Discrete Mathematics and Number Theory.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the Techniques of the Advance Discrete Mathematics and Number Theory.

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:
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/.