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 601	DC	**Analysis IV (Theory of PDEs)**	60	20	20	-	-	4	1	-	5

Course Objective

To introduce the students with the Theorems of the Partial Differential Equations

Course Outcomes

After the successful completion of this course students will be able to understand and apply the Theorems of the Partial Differential Equation

Course Content:

Unit I:
Partial Differential Equation (PDE): An introduction to PDE, Formation of PDE by eliminating arbitrary constants and arbitrary functions, equation solvable by direct integration.

Unit II:
Solution of Linear partial differential equations of the first order; solution of non-linear partial differential equation of the first order.

Unit III:
Homogeneous & Non homogeneous linear partial differential equations with constant coefficients, classification of linear partial differential equations.

Unit IV:
Solution of partial differential equation by separation of variable method.

Unit V:
Solution of wave and heat conduction equation.

Reference Books :

1. K. Sankara Rao:: Introduction to partial differential Equations with applications, PHI Learning.

2. K.S. Bhamra : : Partial Differential Equations, PHI Learning.
3. Lawrence C. Evans: Partial Differential Equations, American Mathematical Society.
4. M. D. Raisinghania :Ordinary and Partial Differential equation, S. Chand & Company.

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 602	DC	**Numerical Analysis**	60	20	20	-	-	4	1	-	5

Course Objective

To introduce the students with the Numerical Analysis.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the Theorems of the Numerical Analysis.

Course Content:

Unit I:
Numerical solution of Algebraic and transcendental equations Bisection method, Regula- Falsi method and modification, Newton-Raphson methods and their geometrical significance. Fixed point iteration method. Numerical Solution of simultaneous equation Guass Elimintion Method, Guass Jordan Method, Guass –Siedal Itration Method

Unit II:
Errors in Numerical computation: Approximation and errors in numerical computation. Forward and Backword differences and other operator, differences of a polynomial factorial notation, estimation of missing terms, Weierstrass approximation theorem (only statement).

Unit III:
Interpolation with equal interval, Difference table. Deduction of Newton's forward and backward interpolation formulae. Central difference interpolation, Guass forward and Backword formulae. Statements of Stirling's and Bessel's interpolation formulae.

Unit IV:
Deduction of Lagrange's interpolation formula. Divided difference. Newtons General Interpolation formula (only statement). Inverse interpolation. Numerical Differentiation and Integration

Unit V:
Algorithms and Programming for numerical methods in C.
Study of Expressions, Control Structures (if, if-else, switch, for, while, do-while), Functions, Arrays, structures and files.

Reference Books :

1. Kendall Atkinson: An Introduction to Numerical Analysis.
2. Brian Kernighan and Dennis Ritchie: The C Programming Language.
3. W.H. Press, S.A. Teukolsky, W.T. Vettering, B.P. Flannery: Numerical Recipes in C.
4. Kanitkar Yashwant, ‘Let us C’, BPB New Delhi
5. Balaguruswami, ‘Ansi C’, TMH, Delhi

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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 603	DC	**Optimization Techniques**	60	20	20	-	-	4	1	-	5

Course Objective

To introduce the students with the Optimization Techniques.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the Optimization Techniques.

Course Content:

Unit I:
Linear programming: basic formulation; geometric interpretation and convex polytope; simplex algorithm,
Unit II:
Bland's rule, duality theory, complexity of simplex method; polynomial time algorithms ellipsoidal and Karmarkar's methods
Unit III:
Network and graph problems: minimum spanning trees, shortest path, flows in networks, perfect matching problem; Gale-Shapley algorithm for stable marriage.
Unit IV:
Brief introduction to integer programming problems
Unit V:
Brief introduction to non-linear programming problems.

Reference Books :

1. C. H. Papadimitriou and K. Steiglitz: Combinational Optimization.

2. Robert J. Vanderbei: Linear Programming.

3. David Luenberger: Linear and nonlinear programming.

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 604	DC	**Classical Mechanics**	60	20	20	-	-	4	1	-	5

Course Objective

To introduce the students with the Classical Mechanics

Course Outcomes

After the successful completion of this course students will be able to understand and apply the Techniques of the Classical Mechanics

Course Content:

Unit I:

Analytical conditions of equilibrium of coplanar forces. Virtual work, Catenary.

Unit II:

Forces in three dimensions, Poinsorts central axis. Null lines and planes. Stable and unstable equilibrium.

Unit III:

Velocities and accelerations along radial and transverse directions and along tangential and normal directions. Simple harmonic motion, elastic string projectile.

Unit IV:

Motion on smooth and rough plane curves, motion in a resisting medium, motion of particles of varying mass. Central orbits, Keplar's law of motion.

Unit V:

Motion of a particle in three dimensions, moments and product of inertia.

Reference Books :

1. R.S. Verma, Statics, Pothishala Private Limited .
2. Loney, S.L, The Elementary on the Dynamics of a Particle and the Rigid Bodies, GK Publications (p)LTD 2012.
3. M. Ray, Dynamics, S. Chand.
4. M. Ray and H.S. Sharma, Dynamics of Rigid Bodies
5. Bansal & Sharma ,Dynamics of a Rigid Body, ,JPH,Jaipur,2009

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 605	DC	**Elective - II**	60	20	20	-	-	4	0	-	4

***** The list Electives mentioned at last.

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 606	DC	**Elective - III**	60	20	20	-	-	4	0	-	4

The list of the Elective Subjects

Elective: Linear and Matrix Algebra II

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.

Elective: Discrete Mathematics and Number Theory II

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.

Elective: Theory of Computing

Course Objective

To introduce the students with the Theory of Computing.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the concepts of the Theory of Computing.

Unit I:
Automata and Languages: Finite automata, regular languages, regular expressions, closure properties, equivalence of deterministic and non-deterministic finite automata, pumping lemma, minimisation of finite automata.

Unit II:
Context-free languages: context-free grammars, closure properties, pumping lemma for CFL, push down automata.

Unit III:
Computability: Turing machines and computable functions, universality, halting problem, recursive and recursively enumerable sets.

Unit IV:
Complexity: Time complexity of deterministic and nondeterministic Turing machines;

Unit V:
Basic idea of the classes P and NP; notion of NP-completeness and brief idea of reducibility among NP-complete problems

Elective: Analysis

Course Objective

To introduce the students with the Fourier Analysis.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the concepts of the Fourier Analysis.

Unit I:
Fourier series,

Unit II:
Fourier Transform,

Unit III:
Laplace Transform.

Unit IV:
Solution to Differential Equations using Laplace Transforms.

Unit V:
Solution to Differential Equations using Fourier Transforms

Elective: Game Theory

Course Objective

To introduce the students with the Game Theory.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the concepts of the Game Theory.

Unit I:
Decision making and conflict; two-person, zero-sum game; pure and mixed strategy; saddle point and its existence.

Unit II:
Optimal strategy and value of the game; maximum and minimax solution. Games in normal form: notions of domination; rationalisable strategies. Nash equilibrium: existence, properties and applications.

Unit III:
Games in extensive form: credibility and sub-game perfect Nash equilibrium. Introduction to bargaining and repeated games.

Unit IV:
Cooperative game theory: concept of core and nucleolus; Bondareva-Shapely theorem; relation to linear programming (if time permits);

Unit V:
Power indices; stable marriage and the Gale Shapley algorithm.

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Elective: Statistics

Course Objective

To introduce the students with the Fundamentals of the Statistics.

Course Outcomes

After the successful completion of this course students will be able to understand and apply the concepts of the Statistics.

Unit I:
Descriptive statistics: Population and sample; frequency distribution and applications; cumulative graph and histogram. Measures of central tendency: mean, median, mode, quartiles.

Unit II:
Measures of dispersion: mean deviation; root mean square; variance and standard deviation; moments and moment generating functions; characteristic function; skewness and kurtosis.

Unit III:
Sample characteristics; sampling distribution; X^2, t and F distributions. Sufficient statistic, likelihood function, Fisher-Neyman factorisation theorem, ancillarity and Basu's theorem. Maximum likelihood estimation; unbiased estimator; Cramer-Rao theorem;

Unit IV:
Uniformly minimum variance unbiased estimator; Hypothesis testing: Type-I, Type-II errors, Neyman-Pearson theorem; likelihood ratio testing; interval estimation.

Unit V:
Bivariate samples, sample correlation co-efficient, least square curve fitting, regression lines.

Reference Books :

Reference Texts for Algebra I-IV and Matrix Algebra:

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.

9. R. B. Ash: Abstract Algebra: The Basic Graduate Year. Free download from http://www.math.uiuc.edu/ rash/Algebra.html.

Reference Texts for Analysis I-III and Metric Topology:

1. W. Rudin: Principles of Mathematical Analysis.

2. Tom Apostol: Mathematical Analysis.

3. Tom Apostol: Calculus I and II.

4. Terence Tao : Analysis I.

5. W. Rudin: Real and Complex Analysis.

Reference Texts for Computer Programming and Data Structures:

1. Brian Kernighan and Dennis Ritchie: The C Programming Language.

2. Ellis Horowitz and Sartaj Sahani: Fundamentals of Data Structures.

Reference Texts for Geometry I and II:

1. M.P. do Carmo: Di_erential Geometry of Curves and Surfaces.

2. J. A. Thorpe: Eelementary Topics in Di_erential Geometry.

3. Spivak: Calculus on manifolds.

Reference Texts for Complex Analysis:

1. Elias M. Stein, Rami Shakarchi: Complex Analysis.

2. Lars Ahlfors: Complex Analysis.

3. T. W. Gamelin: Complex Analysis.

4. J.B.Conway: Functions of One Complex Variable.

Reference Texts for Discrete Mathematics and Number Theory:

I. Number Theory:

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/.

II.Combinatorics and Graph Theory:

1. Fred S. Roberts. Applied Combinatorics.

2. Frank Harary. Graph Theory.

3. Douglas West. Introduction to Graph Theory.

Reference Texts for Probability Theory:

1. William Feller: An Introduction to Probability Theory and its Applications.

2. David Stirzaker and Geo_rey 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.

Reference Texts for Mathematical Methods:

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

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

Reference Texts for Analysis IV (Theory of ODEs):

1. C. Chicone: Ordinary differential Equations with applications.

2. L.D. Perko: Differential Equations and Dynamical Systems.

3. E. A. Coddington and N. Levinson: Theory of Ordinary Differential Equations.

Reference Texts for Numerical Analysis:

1. Kendall Atkinson: An Introduction to Numerical Analysis.

2. Brian Kernighan and Dennis Ritchie: The C Programming Language.

3. W.H. Press, S.A. Teukolsky, W.T. Vettering, B.P. Flannery: Numerical Recipes in C.

Reference Texts for Optimization Techniques:

1. C. H. Papadimitriou and K. Steiglitz: Combinational Optimization.

2. Robert J. Vanderbei: Linear Programming.

3. David Luenberger: Linear and nonlinear programming.

Reference Texts for Classical Mechanics:

1. Rana & Joag : Classical Mechanics.

2. Herbert Goldstein: Classical Mechanics.

3. A. K. Raychaudhuri: Classical Mechanics: A Course of Lectures.

Reference Texts for Theory of Computing:

1. J. E. Hopcroft and J. D. Ullman: Introduction to Automata Theory, Languages and Computation.

2. H. R. Lewis and C. H. Papadimitriou: Elements of The Theory of Computation.

3. M. Sipser: Introduction to The Theory of Computation.

Reference Texts for Game Theory:

1. M. Osborne and A. Rubinstein: A Course in Game Theory.

2. R. Myerson: Game Theory.

3. D. Fudenberg and J. Tirole: Game Theory.

4. S.R. Chakravarty, M. Mitra and P. Sarkar: A Course in Cooperative Game Theory.