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				
BSMHMA601	DC	**Analysis IV (Theory of PDEs)**	60	20	20	-	-	4	1	-	5

Course Objective

To introduce the students with the Theory and Applications of the Partial Differential Equations

Course Outcomes

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

1. *To know the basics of partial differential equations*
2. *To construct and solve partial differential equations*
3. *To discuss the applications of wave and heat equations*
4. *To evaluate the fundamental problems of partial differential equations*

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:

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA601	DC	**Analysis IV (Theory of PDEs)**	60	20	20	-	-	4	1	-	5

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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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			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 and its Applications

Course Outcomes

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

1. *To know the fundamentals of numerical analysis*
2. *To discuss the Approximation techniques*
3. *To apply the interpolation techniques in Differentiation*
4. *To evaluate the fundamental problems of numerical analysis.*

Course Content:

Unit I:
Numerical solution of equations: Determination of real roots: Bisection method. Regula- Falsi method and modification, Newton-Raphson method, Secant method and their geometrical significance. Fixed point iteration method.

Unit II:
Complex roots: Muller's method. Errors in Numerical computation: Approximation and errors in numerical computation. Interpolation: Problems of interpolation, Weierstrass approximation theorem (only statement). Polynomial interpolation.

Unit III:
Equispaced arguments. Difference table. Deduction of Newton's forward and backward interpolation formulae. Statements of Stirling's and Bessel's interpolation formulae. Error terms. General interpolation formulae.

Unit IV:
Deduction of Lagrange's interpolation formula. Divided difference formula, Newton's General Interpolation formula (only statement). Inverse interpolation. Interpolation formulae using the values of both f(x) and its derivative.

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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

Unit V: Euler's Method for Numerical Solution of ODE; Modified Euler's Method; Runge-Kutta Method, Multistep Methods: Predictor-Corrector method, Numerical solutions of elliptic, parabolic, and hyperbolic partial differential equations.

Reference Books :

1. Kendall Atkinson: An Introduction to Numerical Analysis, Wiley.
2. Brian Kernighan and Dennis Ritchie: The C Programming Language, Prentice Hall.
3. W.H. Press, S.A. Teukolsky, W.T. Vettering, B.P. Flannery: Numerical Recipes in C, Cambridge University *Press*.

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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 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:

1. *To know the fundamentals of optimizations problem*
2. *To apply the fundamentals of linear programming*
3. *To create and apply the optimizations algorithms.*
4. *To evaluate the fundamental problems of queuing theory.*

Course Content:

Unit I:
Linear programming: basic formulation; geometric interpretation, lines and hyperplanes, convex hull, convex polyhedron, graphical solution of two variable problems, Fundamental theorem of linear programming.

Unit II:
Simplex method: computational procedure of simplex method, Artificial variable techniques, two phase method, big-M method. Degeneracy problem. Duality in linear programming: concept of duality, duality theorems, dual simplex method.

Unit III:
Transportation problem: mathematical formulation, Matrix form of transportation problem, Feasible solution, basic feasible solution and optimal solution, degeneracy in transportation problem. Assignment problems: Mathematical formulation, fundamental theorem, Hungarian method.

Unit IV:
Queueing theory: queueing system, elements of queueing system, customer's behavior in a queue, queueing problem, transient and steady states, traffic intensity, Poisson process and its properties. Classification of queueing models, solution of queueing model M/M/1 or $(\infty/FCFS)$.

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			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

Unit V:

Stochastic Process or Random Process: random variables, the Markov Process, Markov process with discrete state space, Markov chain, transition matrix, distribution vector, Markov chain as graphs , higher transition probabilities, regular Markov chain.

Reference Books :

1. C. H. Papadimitriou and K. Steiglitz: Combinational Optimization, Dover Publications.
2. Robert J. Vanderbei: Linear Programming, Springer.
3. David Luenberger: Linear and nonlinear programming, Springer.
4. S.D. Sharma, Operation Research: Theory Methods and Applications, Kedar Nath-Ram Nath, Meerut.

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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				
BSMHMA604	DC	**Classical Mechanics**	60	20	20	-	-	4	0	-	4

Course Objective

To introduce the students with the Classical Mechanics

Course Outcomes

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

1. *To know the fundamentals of statics.*
2. *To apply the fundamental of dynamics.*
3. *To determine the center of gravity of some mechanical systems.*
4. *To discuss the Applications of statics and dynamics.*

Course Content:

Unit I:

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

Unit II:

Forces in three dimensions, Poinsot's central axis. Null lines and planes.

Unit III:

Velocities and accelerations along radial and transverse directions and along tangential and normal directions. .

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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				
BSMHMA604	DC	**Classical Mechanics**	60	20	20	-	-	4	0	-	4

Unit IV:

Simple harmonic motion, elastic string projectile **,** Motion on smooth and rough plane curves motion in a resisting medium.

Unit V:

Central orbits, Keplar's law of motion and Motion of a particle in three dimensions.

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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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 605(1)	DC	**Elective II** **Theory of Computing**	60	20	20	-	-	3	0	-	3

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:

1. *know the basics of Computing Techniques*
2. *know the basics of languages*
3. *discuss and apply languages and machines*
4. *analyse the complexity of machines.*

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.

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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 605(1)	DC	**Elective II** **Theory of Computing**	60	20	20	-	-	3	0	-	3

Unit V:

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

Reference Books :

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.

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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 605(2)	DC	**Fourier and Laplace Transforms**	60	20	20	-	-	3	0	-	3

Course Objective

To introduce the students with the Fourier and Laplace Transforms

Course Outcomes

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

1. *know the fundamentals of Fourier series and Fourier transform.*
2. *know the fundamental of Laplace transform.*
3. *apply the basics of Fourier and Laplace transforms.*
4. *evaluate and justify the problems of Fourier and Laplace transforms.*

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.

Reference Books:

1. P.P.G. Dyke, An Introduction to Laplace Transforms and Fourier Series, Springer.
2. Murray R. Spiegel, Laplace Transforms - Schaum's Series, McGraw-Hill Education.
3. R. J. Beerends, H. G. ter Morsche, J. C. van den Berg and E. M. van de Vrie, Fourier and Laplace Transforms, Cambridge.
4. Murray R. Spiegel, Schaum's Outline of Fourier Analysis, McGraw-Hill Education.

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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 606(1)	DC	**Elective III** **Game Theory**	60	20	20	-	-	3	0	-	3

Course Objective

To introduce the students with the Game Theory

Course Outcomes

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

1. *know the fundamentals of Game theory.*
2. *apply the fundamental of Game theory.*
3. *discuss the applications of Game theory.*
4. *evaluate the problems based on 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:

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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 606(1)	DC	**Elective III** **Game Theory**	60	20	20	-	-	3	0	-	3

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.

Reference Books :

1. M. Osborne and A. Rubinstein: A Course in Game Theory, MIT Press.
2. R. Myerson: Game Theory, Harvard University Press .
3. D. Fudenberg and J. Tirole: Game Theory, MIT Press .
4. S.R. Chakravarty, M. Mitra and P. Sarkar: A Course in Cooperative Game Theory, Cambridge University Press.

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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 606(2)	DC	**Elective III** **Statistics**	60	20	20	-	-	3	0	-	3

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:

1. *know the fundamentals of descriptive statistics.*
2. *apply the fundamental of measure of dispersion.*
3. *know and apply the sampling and testing of hypothesis.*
4. *discuss and evaluate the fundamental problems of 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:

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSMHMA 606(2)	DC	**Elective III** **Statistics**	60	20	20	-	-	3	0	-	3

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

Reference Books:

1. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons.
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata
3. E.N. Nadar, Statistics, PHI Learning.
4. P. Mukhopadhya, Mathematical Statistics, New Central Book Agency, Calcutta.
5. Goon A.M., Gupta M.K.and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata
6. Miller, lrwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7thEdn.), Pearson Education, Asia.