Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Name of the Program: M. Sc. in Mathematics

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA301	DC	Functional Analysis I	60	20	20	00	00	4	0	0	4

Course Objective

To introduce the students to Functional Analysis.

Course Outcomes

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

1. *understand and apply the basics of Banach Spaces.*
2. *recognize the fundamental properties of normed linear spaces and the transformations between them.*
3. *analyse the finite-dimensional normed space and equivalent norms.*
4. *illustrate the linear functions and the Hahn-Banach Theorem*
5. *create and apply the Bounded Linear Functionals on $C[a, b]$.*

Course Content:

Unit I

Normed linear spaces, Banach Spaces, and examples. Properties of Normed linear Spaces, Completeness proof of Banach Spaces. Quotient spaces,
1. Chapter 2 Section 2, 2, 2.3 & Exercises)

Unit II

Finite dimensional Normed spaces & subspaces, Equivalent norms, Compactness and Finite Dimension, Riesz Lemma, Linear Operators,
(1. Chapter 2 Sect *2A,* 2, 5, 2.6 & Exercises)

Unit III

Bounded and Continuous Linear Operators, Linear Functionals.

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(1. Chapter 2 Sect 2.7, 2.8 & Exercises)

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			END SEM	MST	Q/A	END SEM	Q/A				
MSMA301	DC	Functional Analysis I	60	20	20	00	00	4	0	0	4

Unit IV

Linear Operators and Functionals on and Finite Dimensional Spaces, Normed Spaces of Operators, Dual Space.

(1. Chapter 2 Sect 2.9, 2.10 & Exercises)

Unit V

Zorn's Lemma, Hahn-Banach Theorem, Hahn-Banach Theorem for Complex Vector Spaces and Normed Space, Application to Bounded Linear Functionals on C[a, b].

(1. Chapter 4 Sect 4.1 to 4.4 & Exercises)

Reference Books

1. E. Kreyszig, Chapter 2 (2.1 to 2.10 & 4.1 to 4.4), Introductory Functional Analysis with applications, John Wiley & Sons New York.
2. G.F. Simmons, Introduction to Topology & Modern Analysis Mc Graw Hill New York 1963
3. B. Choudhary and Sudarsan Nanda. Functional Analysis with applications, wiley Eastern Ltd.

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA302	DC	Numerical Analysis I	60	20	20	-	-	4	0	-	4

Course Objective

To introduce the students to the Numerical Analysis.

Course Outcomes

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

1. *understand and apply the basics of Numerical Analysis*
2. *evaluate interpolating and extrapolating values*
3. *find missing discrete and continuous data by applying the concept of interpolation and bivariate interpolation*
4. *create orthogonal basis by applying the concept of Gram-Schmidt Orthogonalization Process*
5. *illustrate numerical differentiation by using methods based on Interpolation and Finite Difference Operators.*

Course Content:

Unit – I

Introduction: Interpolation, Linear Interpolation and higher-order interpolation. Hermite Interpolation Piecewise and Spline Interpolation, Piecewise quadratic Interpolation, Piecewise cubic interpolation Piecewise cubic interpolation using Hermite Type Data, Quadratic Spline Interpolation, Cubic Spline Interpolation and its derivation, Problems. (Chapter 4 section 4.1, 4.5 and examples, section 4 and examples)

Unit - II

Bivariate Interpolation: Lagranges and Newtons Bivariate Interpolation polynomials

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA302	DC	Numerical Analysis I	60	20	20	-	-	4	0	-	4

and their derivation, Approximation: Discrete and continuous data, Least Square Approximation. (1. Chapter 4 section 4.7 and examples, section 4.8 and examples, section 4.9 and examples.)

Unit - III

Orthogonal, Gram-Schmidt Orthogonalizing Process, Legendre and Chebyshev Polynomials. (1. Chapter 4 section 4.9 definition 4.3 and 4.4 and subsections, examples.)

Unit- IV

Uniform Approximation, Uniform Polynomials Approximation (Chebyshev), Chebyshev Polynomials Approximation and Lanczos Economization, Rational Approximation, Choice of Methods. (1. Chapter 4 section 4.10 and subsection, Examples, Section 4.11, Section 4.12, examples.)

Unit- V

Numerical Differentiation: Method Based On Interpolation, Non uniform and uniform nodal points, Quadratic Interpolation, Method based on Finite Difference Operators, Method based on Undetermined Coefficient, Optimum Choice Of Step Length. (1. Chapter 5 section 5.2 and subsection, Examples, Section 5.3)

Reference Books

1. Numerical Methods, Jain, Iyanger and Jain, New Age International Edition 2012.
2. Richard L. Burden and J. Douglas Faires, Numerical Analysis, 8th Edition. Student Edition ISBN-10: 0-534-39200-8
3. J. Stoer and R. Bulirsch, Introduction to Numerical Analysis, Springer-Verlag, ISBN 0 387- 90420-4

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA303(1)	DC	Advanced Special Function I	60	20	20	-	-	4	0	-	4

Course Objective

To introduce the students to the Advanced Special Function.

Course Outcomes

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

1. *understand and apply the basics of the Advanced Special Function*
2. *evaluate and illustrate the various forms of gamma function*
3. *examine the transformations and hypergeometric functions*
4. *to illustrate several forms of Legendre Polynomials.*

Course Content:

Unit-I

The Gamma and Beta Functions: The Euler or Mascheroni constant γ, The Gamma function, A Series of $\Gamma'(z)/\Gamma(z)$, Evaluation of $\Gamma(1)$ and $\Gamma'(1)$, The Euler Product for $\Gamma(z)$, The Difference equation $\Gamma(z+1) = z\Gamma(z)$, The Beta function, the value of $\Gamma(z)$ and $\Gamma(1-z)$, the factorial function, Legendre's duplication formula, Gauss Multiplication theorem. (3. Chapter 2 Pages 19 - 41)

Unit-II

Hypergeometric functions: Hypergeometric functions, Integral representation of $f(a,b,c,z)$, hypergeometric differential equations, simple transformation, quadratic transformation. (3. Chapter 3 pages 42-72.)

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA303(1)	DC	Advanced Special Function I	60	20	20	-	-	4	0	-	4

Unit –III

Generalized Hypergeometric functions: The function ${}_pF_q$, A differential equation, Contiguous function relations, a simple integral, Saalschutz theorem, Whipple's theorem, Dixon's theorem, Kummer's theorem, Ramanujan's theorem.
(3.Chapter 4 Pages 73-106)

Unit -IV

Bessel Functions: Definition of $J_n(z)$, Bessel differential equation, Differential recurrence relations, pure recurrence relation, Generating function, Bassel's integral, Index half and n odd integer. (3. Chapter 5 Pages 107-156)

Unit-V

Legendre Polynomials: A generating function, Differential recurrence relations, pure recurrence relation, Legendre's differential equation, the Rodrigues formula, Bateman's generating function Additional generating functions, Hypergeometric forms of $P_n(x)$, Special properties of $P_n(x)$ More generating functions, Laplace's first integral form, Orthogonality. (3. Chapter 6 Page 157 208)

Reference Books

1. Rainville, E.D, Special functions, The Macmillan co., New York 1971.
2. Srivastava, H.M. Gupta, K.C. and Goyal, S.P., the ff-functions of one and Two Variables wi applications, South Asian Publication, New Delhi.
3. Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati Prakashan, 198

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA303(2)	DC	Operations Research I	60	20	20	-	-	4	0	0	4

Course Objective

To introduce the students to the Operations Research.

Course Outcomes

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

1. *understand the need for Operations Research*
2. *construct Operation Research models and interpret the solution of the LP model*
3. *analyse the situations in which linear programming techniques can be applied*
4. *formulate the dual LP problem and understand the relationship between primal and dual*
5. *apply cutting plane methods to obtain the optimal integer solution value of variables in an LP Problem*

Course Content:

Unit I

Operations Research - Introduction. Origin and Development of Operations Research, Nature and Features of Operations Research, Models in Operations Research, General Solution Methods for Operations Research, Phases of Operations Research, Uses and Limitations of Operations, Linear Programming Problems: Introduction Mathematical Formulation, Graphical Solution Method.

(1. Chapter 1 section 1.1 to 1.8, 1.10, Examples & Exercises, 1. Chapter 2 section, 2.2, 2.3, 2.4, Examples & Exercises, 1. Chapter 3 sect 3.1, 3.2, Examples & Exercises)

(2. Chapter 1 sect 1.1, 1.2, 1.6, Chapter 2 section 2.1, 2.2)

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MSMA303(2)	DC	Operations Research I	60	20	20	-	-	4	0	0	4

Unit II

General Linear Programming Problems, Theory of the Simplex method, Computational Procedure, Numerical problems, Solutions of simultaneous linear equations, the inverse of a matrix using the simplex method.

Unit III

Use of artificial variables, Big-M method, Two-phase method, Problem of degeneracy and resolution of degeneracy; Applications of the simplex method. (1 Chapter 4 sect 4.4, 4.5, 4.8, Examples & Exercises)

Unit IV

Concept of duality: Introduction, General Primal-Dual pair, formulating a dual problem, primal-dual pair in matrix form, economic interpretation of duality, duality and simplex method, Fundamental Properties and Theorems of duality, complementary slackness, dual simplex method.
(1. Chapter 5 sections 5.1, to 5.9, Examples and Exercises)

Unit V

Post optimality analysis, integer programming, revised simplex method.
(1. Chapter 6, Chapter 7: 7.1 to 7.4, Chapter 9: 9.1 to 9.2, Examples and Exercises)

Recommended Books

1. Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi, fifteenth revised edition.
2. H.A. Taha, Operations Research - An Introduction, Macmillan Publishing Co. Inc. New York
3. S.D, Sharma, Operation Research,
4. F.S, Hiller and G. J. Lieberman, Industrial Engineering Series, 1995.

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