



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				
MSMA401	DC	Functional Analysis II	60	20	20	00	00	4	0	0	4

Course Objective

To introduce the students to the fundamentals of Functional Analysis.

Course Outcomes

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

1. understand and apply the basics of Functional Analysis.
2. recognize the fundamental properties of Inner Product Space and Hilbert Space
3. represent functionals on a Hilbert space.
4. apply the spectral theorem to the resolution of integral equations.
5. correlate Functional Analysis to problems arising in Partial Differential Equations, Measure Theory, and other branches of mathematics
6. evaluate the Summability of sequences.

Course Content:

Unit I

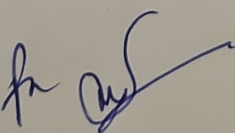
Inner Product Space, Hilbert Space, Further Properties of Inner Product Spaces, Orthogonal complements and Direct sum, Orthonormal Sets and Sequences. Schwarz, triangle, and Bessel Inequality. (1. Chapter 3 Sect 3.1 to 3.4 & Exercises)

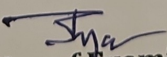
Unit II

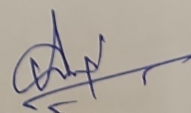
Series related to orthonormal sequences & sets, Total orthonormal sets & sequences, Representation of Functionals on Hilbert Spaces, Riesz's Theorem, Riesz Representation Theorem.

(1. Chapter 3 Sect 3.5, 3.6, 3.8 & Exercises)

Chairperson
Board of Studies
Physical Sciences


Chairperson
Faculty of Studies
Science


Controller of Examinations
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore


Registrar
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				
MSMA401	DC	Functional Analysis II	60	20	20	00	00	4	0	0	4

Unit III

Adjoint Operator, Hilbert Adjoint Operator, Self-Adjoint Operator, Unitary and Normal Operators

(1. Chapter 3 Sect 3.9, 3.10, Chapter 4: 4.5 & Exercises)

Unit IV

Adjoint Operator, Reflexive Spaces, Category Theorem. Uniform Boundedness Theorem, Strong and Weak Convergence.

(1. Chapter 4 Sect 4.6 to 4.8 & Exercises)

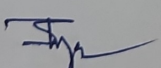
Unit V

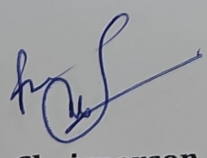
Convergence of Sequences of Operators and Functionals, Application of Summability of Sequences, Open Mapping Theorem, Closed Linear Operators, Closed Graph Theorem.

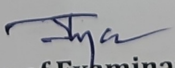
(1. Chapter 4 Sect 4.9, 4.10, 4.12, 4.13 & Exercises)

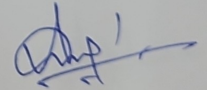
Reference Books:

1. E. Kreyszig 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.


Chairperson
Board of Studies
Physical Sciences


Chairperson
Faculty of Studies
Science


Controller of Examinations
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore


Registrar
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore



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				
MSMA402	DC	Numerical Analysis II	60	20	20	0	0	4	0	0	4

Course Objective

To introduce the students to the fundamentals of Numerical Analysis.

Course Outcomes

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

1. apply multistep Methods to find the solution to ODEs
2. analyse the convergence of Multistep Methods
3. solve Boundary Value Problems by using Shooting Method
4. construct the solutions of the Tridiagonal System
5. apply the Finite Element Method to find the solution of the variation problem

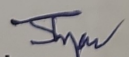
Course Content:

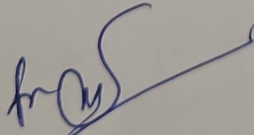
Unit-I

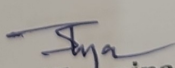
Extrapolation Methods (Richardson Extrapolation), Partial Differentiation and its estimations, Ordinary Differential Equations: Initial Value Problems, Reduction of Higher Order Equation, Existence and Uniqueness, Test equations, System Of Linear First Order Differential Equation With Constant Coefficients and its theorem, Multi-Step Methods, Various types of Explicit and Implicit Multistep Methods, General Multi Methods. Examples. (1. Chapter 5 Section 5.4, Section 5.5, Chapter 6 Section 6.1 and subsections, Section 6.6, definition 6.1, 6.2, 6.3, 6.4 and examples)

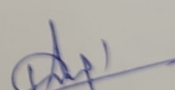
Unit- II

Maximum order of k -step methods and theorems, Convergence of Multi-Step Methods, Predictor and Corrector Method, Modified Predictor and Corrector Method, Stability Analysis of Multistep Methods and theorems: First Order and


Chairperson
Board of Studies
Physical Sciences


Chairperson
Faculty of Studies
Science


Controller of Examinations
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore


Registrar
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore



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				
MSMA402	DC	Numerical Analysis II	60	20	20	0	0	4	0	0	4

Second-order differential equations. (1. Chapter 6 Section 6.6 and subsections, Definition, 6.5, 6.6.7 and examples, Section 6.7 and subsections, Section 6.8 and subsections.)

Unit-III

Ordinary Differential Equation, Boundary Value Problems: Shooting Method, Alternate Method, Nonlinear Second Order Differential Equation.
(1. Chapter 7 section 7.1, Section 7.2 and subsections)

Unit-IV

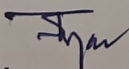
Finite Difference Methods Linear Second Order Differential Equations, Local Truncation Error, Derivative Boundary Conditions, Solutions of Tridiagonal System, Nonlinear Second Order Differential Equation, Convergence of Difference Schemes and theorems, Stability of Finite Difference Schemes
(1. Chapter 7 section 7.3 and subsections)

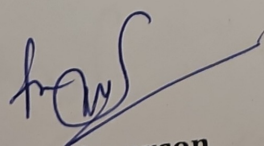
Unit-V

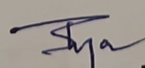
Finite Element Method, Solution of the Variation Problem, Ritz Method (Galerkin equations), Finite Elements, Linear Lagrange Polynomial, Ritz Finite Element Method, Finite element solution of Linear Boundary Value Problems, Assembly of Element Equations, Mixed Boundary Conditions
(1. Chapter 7 section 7.4 and subsections)

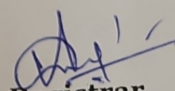
Reference Book:

1. Numerical Methods, Jain, Iyengar 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


Chairperson
Board of Studies
Physical Sciences


Chairperson
Faculty of Studies
Science


Controller of Examinations
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore


Registrar
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore



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				
MSMA403(1)	DC	Advanced Special Function II	60	20	20	0	0	4	0	0	4
Objective											

Course Objective

To introduce the students to the fundamentals of the Advanced Special Function

Course Outcomes

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

1. create recurrence relations and generating functions
2. construct solutions of the Laguerre's Differential Equation
3. form the Generalized Laguerre Polynomials and Jacobi polynomials
4. create $T_n(x)$ and $U_n(x)$ for a given value of n .

Course Content:

Unit- I

Hermite Polynomials: Definition of Hermite Polynomials $H_n(x)$, pure recurrence relations, Differential recurrence relations, Rodrigue's formula, other generating functions, Orthogonality, Expansion of Polynomials, more generating functions.
(3. Chapter 7 Pages 209-238)

Unit -II

Simple Laguerre Polynomials: Solution of Laguerre's Differential Equation, Generating Function, Rodrigue's Formula, Recurrence Relations, Laguerre Polynomials for particular values of n and x , Differential Equation of $L_n(x)$, Orthogonal Property of $L_n(x)$, Other Integral Relation.
(3. Chapter 8-1 Page 239 - 257)

Chairperson
Board of Studies
Physical Sciences

Chairperson
Faculty of Studies
Science

Controller of Examinations
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore

Registrar
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore



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				
MSMA403(1)	DC	Advanced Special Function II	60	20	20	0	0	4	0	0	4

Unit -III

Generalized Laguerre Polynomials: Definition, Recurrence Relations, Rodrigue's Formula and Orthogonality, Expansion, Some Special Result, More Generating Relations.
 (3. Chapter 8-II Page 257 - 279)

Unit-IV

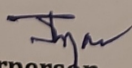
Chebyshev Polynomials: Independent Solution of Chebyshev's Equation, Expansion of $T_n(x)$ and $U_n(x)$, Generating Functions, Recurrence Relations, To determine $T_n(x)$ and $U_n(x)$ for given value of n , Orthogonal Properties of $T_n(x)$, and $U_n(x)$.
 (3. Chapter 9 Pages 280 -293)

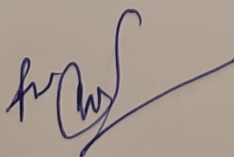
Unit -V

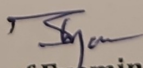
The Jacobi Polynomials: The Jacobi polynomials, Bateman's generating function, The Rodrigues formula, Orthogonality, Differential recurrence relations, pure recurrence relation
 (3. Chapter 10 Page 294 - 325)

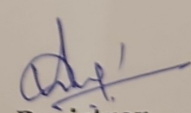
Reference Books

1. Rainville. E.D, Special functions, The Macmillan Co., New York 1971.
2. Srivastava, H.M. Gupta, K.C. and Goyal, S.P., The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
3. Saran, N., Sharma, S.D. and Trivedi, Special Functions with application, Pragati Prakashan, 1986


Chairperson
 Board of Studies
 Physical Sciences


Chairperson
 Faculty of Studies
 Science


Controller of Examinations
 Shri Vaishnav Vidyapeeth
 Vishwavidyalaya, Indore


Registrar
 Shri Vaishnav Vidyapeeth
 Vishwavidyalaya, Indore

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				
MSMA403(2)	DC	Operations Research II	60	20	20	0	0	4	0	0	4

Course Objective

To introduce the students to the fundamentals of Operations Research.

Course Outcomes

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

1. construct an optimal solution to Transportation problems
2. construct an optimal solution to Assignment problems
3. differentiate between CPM and PERT
4. analyse and solve $m \times n$ games by Linear Programming
5. apply minimax and maximin principles to compute the value of the game when there is a saddle point

Course Content:

Unit-I

Transportation problems: Introduction, General transportation problem, duality in TP, Transportation Table, LP formulation of T.P., Initial solution of transportation problem: North-West Corner Method, Least Cost Method, Vogel's Approximation Method, test for optimality by MODI (u - v method) method, economic interpretation, degeneracy in transportation problems, steppingstone algorithm. (1. Chapter 10 sect 10.1 to 10.14, Examples and Exercises)

Unit-II

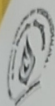
Assignment problem: Introduction, Mathematical formulation of assignment problem, Solution of assignment problem: Hungarian Method, Special Cases: Unbalanced Assignment Problem, Maximization Assignment Problems., Prohibited A.P., Dual of the assignment problem,

Chairperson
Board of Studies
Physical Sciences

Chairperson
Faculty of Studies
Science

Controller of Examinations
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore

Registrar
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore



Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Name of the Program: M. Sc. in Mathematics

Travelling Salesman problem. Dynamic Programming: Introduction, Characteristics, Dynamic

Examining: Introduction, Characteristics, Dynamic												
SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME									
			THEORY			PRACTICAL		Th	T	P	CREDITS	
			END SEM	MST	Q/A	END SEM	Q/A					
MSMA403(2)	DC	Operations Research II	60	20	20	0	0	3	0	0	3	

Algorithms. (1. Exercises)

Unit-III

Network analysis: Introduction, Basic Terminology/ Components, Rules of network construction, Critical Path Method (CPM), PERT Calculation, Difference between CPM /PERT. (1. Chapter 25, sections 25.1 to 25.11, Examples and Exercises)

Unit IV

Game Theory: Introduction, Two- person Zero-Sum Games, Basic Terms, The Maximin-Minimax principle, games without saddle points - Mixed strategies, dominance property, Graphical solution of $2 \times m$ and $m \times 2$ games, Arithmetic method for $n \times n$ games, Solution of $m \times n$ games by Linear Programming, General solution of $m \times n$ rectangular games, Limitations. (1. Chapter 17, sections 17.1 to 17.11, Examples and Exercises)

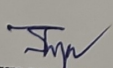
Unit V

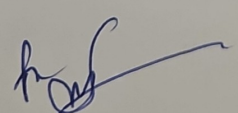
Non-Linear programming Techniques Kuhn-Tucker Conditions with Non-negative Constraints, Quadratic Programming, Wolfe's simplex method, Beals method, Separable Convex Programming, and Separable programming algorithm.

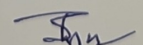
(1. Chapter 27, sections 27.1 to 27.7, Chapter 28, 28.3 to 25.8, Examples and Exercises)

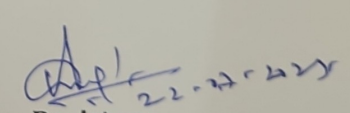
Reference Books

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


Chairperson
Board of Studies
Physical Sciences


Chairperson
Faculty of Studies
Science


Controller of Examinations
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore


Registrar
Shri Vaishnav Vidyapeeth
Vishwavidyalaya, Indore