CHAPTER 30

MATHEMATICAL SCIENCES
MATHEMATICS

Doctoral Theses

346. AGGARWAL (Ritu)
Generalizations of Toeplitz and Hankel Operators.
Supervisor : Gopal Datt
Th 22574

Contents

1. Introduction. 2. Operator equations generalizing the notion of Hankel operators. 3. A generalization of slant Toeplitz operator. 4. Generalization of slant Hankel operators. 5. Extensions of Toeplitz and Hankel operators in reference of Calkin algebra. 6. Unanswered problems. References.

347. BHATIA (Neha)
Composition Operators on Generalized Lorentz-Zygmund Spaces, Lorentz-Karamata-Bochner Spaces and $L^2(\mu)$.
Supervisor : Dr. Anuradha Gupta
Th 22300

Abstract

Thesis presents a study of composition and weighted composition operators on function spaces like generalized Lorentz-Zygmund spaces, Lorentz-Karamata-Bochner spaces, Orlicz-Lorentz sequence spaces and $L^2(\mu)$. Studies various properties of composition and weighted operators like boundedness, compactness, closed range denseness, surjectiveness and invertibility on these spaces. Gives characterizations of these properties of operators in terms of measure and Radon-Nikodym derivative. Introduces n-normal and n-quasinormal composition and weighted composition operators on the Hilbert space $L^2(\mu)$. Discusses the conditions under which non-hyponormal operators like p-quasiposinormal, (n, k)- quasi- paranormal, (n, k)-*-quasiparanormal become composition and weighted composition operators on $L^2(\mu)$.

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1. Introduction 2. Composition operators on generalized lorentz-Zygmund spaces and Lorentz-Karamata-Bochner spaces 3. Multiplication operators on orlicz-Lorentz sequence 4. Non-normal composition operators 5. Non-normal weighted composition operators. Scope for further research. Bibliography.

348. CHAUHAN (Vinod)
Efficient Numerical Algorithms for Higher Even Order Nonlinear two point Boundary Value Problems on a Variable Mesh.

Supervisors : Dr. Arvind Patel and Prof. R. K. Mohanty
Th 22567

Contents

1. Background and preliminaries. 2. High accuracy numerov type dissertation for the system nonlinear two point boundary value problems on a variable mesh. 3. HIgh accuracy off-step dissertation for the system of non-linear two point boundary value problem on a non-uniform mesh. 4. High accuracy non uniform mesh three-point discretization based on polynomial spline approximations for the solution of system of nonlinear two point boundary value problems. 5. High accuracy variable mesh discretization based on non-polynomial spline approximations for the solution of system of nonlinear two point boundary value problems. Bibliography.

349. DAS (Pankaj Kumar)
Codes Detecting / Correcting Periodic and Solid Burst Errors.
Supervisor : Dr. V. K. Tyagi
Th 22296

Contents

1. Introduction 2. Codes detecting/correcting periodic errors 3. Codes detecting and locating periodic errors 4. Codes correcting blockwise periodic errors 5. b-SBEC cyclic codes 6. (1,3) Optimal codes on solid bursts. Scope for further research and references.

350. DINESH KUMAR
Semigroups of Transcendental Entire Functions and their Dynamical Properties.
Supervisor : Dr. Sanjay Kumar
Th 22568

Abstract

The present thesis considers the dynamical properties of transcendental entire functions, their compositions and the dynamics of semiconjugated entire functions. We have investigated the dynamics of semigroups of transcendental entire functions. The principal aim is to see, to what extent, the classical Fatou-Julia theory can be applied in this more general setting. In addition, we have initiated the study of escaping sets of semigroups of transcendental entire functions using Fatou-Julia theory. Chapter 1 is a brief survey of the basic concepts and results from the classical complex analysis and Fatou-Julia theory. In Chapter 2 entitled ``Composite Entire Functions and Semiconjugation," we consider the dynamical properties of transcendental entire functions, their compositions and discuss relationship between their singular values. In Chapter 3 entitled ``Dynamics of Composite Entire Functions," we continue our study of dynamics of composite entire functions. Using Approximation theory of entire functions, we have shown the existence of entire functions having infinite number of domains satisfying various properties and relating it to their compositions.The Chapter 4 entitled ``The Dynamics of Semigroups of Transcendental Entire Functions" deals with semigroups of transcendental entire functions and their dynamics. We have generalized the dynamics of a transcendental entire function on its Fatou set to the dynamics of semigroups of transcendental entire

functions. In Chapter 5 entitled ``The Escaping Set of a Transcendental Semigroup," we continue the study of semigroups of transcendental entire functions and their dynamics. For a transcendental semigroup, we have initiated the study of escaping sets of semigroups of transcendental entire functions. We have generalized the dynamics of a transcendental entire function on its escaping set to the dynamics of semigroups of transcendental entire functions on their escaping set.

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351. KALUCHA (Geeta) nee GEETA NAGRATH
Mean Estimation with Optional RRT Models Using Auxiliary Information.
Supervisors : Prof. B. K. Dass and Prof. Sat Gupta
Th 22295

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352. KHATTAR (Geetika)
On the Reconstruction Property and Frames in Banach Spaces.
Supervisor : Dr. Lalit Kumar
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353. PANWAR (Suman)
Interplay Between Gabor and Wilson Systems in $L^2(\mathbb{R})$
Supervisor : Dr. Shiv Kumar Kaushik
Th 22299

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354. PRANJALI
Graphs Associated with Commutative Rings.

Supervisors : Dr. Atul Gaur and Prof. Mukti Acharya
Th 22570

Abstract

"Graphs Associated with Commutative Rings" The aim of this thesis is to expound three very interesting and widely studied variants of graphs, namely, the problem based on embedding of graphs through the concept of labeling, domination in algebraic graphs, and the problems related to the study of balanced and consistent signed graph derived from algebraic structure. The contents of the thesis are as follows: CONTENTS: General Introduction Zero-Divisor Labeling of Graphs Zero Ring and Zero Ring Graphs Zero Ring Labeling of Graphs Abelian Group Labeling of Graphs Unit Graphs Signed Total Graphs New Directions for Further Research A brief organization of the thesis is as follows: Chapter 1, is devoted to the survey of the literature on the above mentioned concepts. Chapter 2, depicts the notion of zero-divisor labeling of graphs. Chapter 3, delineates with the structure of zero ring and zero ring graph. Chapter 4, is based on the study of zero ring labeling of an arbitrary graph. Chapter 5, is devoted to the study on a new kind of labeling, called an abelian group labeling in which the operation between vertex labels vary according to the nature of a binary operation in the group. Chapter 6, is two folds. In the first half, we establish a MATLAB program to obtain unit graphs, their energy and Wiener index. The second half of this chapter, deals with the problems on domination in unit graph. Chapter 7, is based on a natural extension of the notion of total graph in the realm of signed graph for a finite commutative ring R. Chapter 8, merely lists several research problems which were encountered during our investigation reported in the foregoing chapters.

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355. PRASAD (Ram Pravesh)
Studies on Chao synchronization in Different Nonlinear Chaotic and Hypercshaotic Systems.
Supervisors : Prof. Ayub Khan and Dr. V. Ambethkar
Th 22297

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356. RAVINDRA KUMAR

Efficient Numerical Algorithms for Quasi-Linear Elliptic and Hyperbolic Partial Differential Equations.

Supervisors : Prof. Ajay Kumar and Prof. R. K. Mohanty

Th 22569

Abstract

Whenever we consider numerical methods for the solution of partial differential equation or ordinary differential equation, a few important things has to be taken care of like solution obtained by numerical scheme should be of good approximation to the exact solution The thesis contains five chapters.In chapter1 we have given introduction of the topics related to further chapters. In chapter 2 a numerical algorithm of Numerov type for 2D quasi- linear elliptic boundary value problems has been developed by using three function evaluations we discuss a nine point compact scheme of order $O(\Delta y^2 + \Delta x^4)$ based on Numerov type discretization for $A(x,y,u)u_{xx} + B(x,y,u)\, u_{yy} = f(x,y,u,u_x,u_y)$ defined in the bounded domain with boundary , where$A(x,y,u)>0$ and $B(x,y,u)>0$ in the domain with Dirichlet boundary conditions. In chapter 3 cubic spline functions are used to generate the approximate solution by discretization of the partial differential equation with certain level of consistency of the cubic spline function based on off-step discretization for the solution of two dimensional quasi-linear elliptic partial differential equation of the form: $u_{xx} + B(x,y,u)\, u_{yy} = f(x,y,u,u_x,u_y)$ defined in the solution domain with boundary , where $B(x,y,u)>0$ in the boundary with appropriate Dirichlet boundary conditions. In chapter 4, we describe a new compact three level implicit method of order four in time and space based on half-step discretization for one dimensional quasi-linear hyperbolic equation $u_{tt} = A(x,t,u)\, u_{xx} + f(x,y,u,u_x,u_t)$,$0< x< 1$,$t>0$ subject to the appropriate initial conditions and the boundary conditions. In chapter 5, two numerical method based on non-polynomial spline for the numerical solution of one space dimensional quasi-linear second order hyperbolic partial differential equation on a variable mesh were discussed. The usefulness of the proposed methods are also illustrated graphically in comparison with the exact solution of the problem. Concluding Remarks and Future Work

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357. RIMPI PAL

Control Designing and Chaos Synchronization in Certain Physical and Generalised Systems.

Supervisors : Prof. Ayub Khan and Dr. V. Ambethkar

Th 22662

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1. Introduction 2. Synchronization of identical parabolic restricted three body problem 3. Chaos control and synchronization of identical restricted planar isosceles three body problem.4. Adaptive synchronization of identical chaotic space-tether system 5. Synchronization using various control techniques of identical chaotic dumbell satellite and a modified version 6. Adaptive synchronization of non-identical multi time-delayed undertain chaotic systems. Bibliography.

358. SETIA (Nikita)
High Accuracy Off-Step Discretizations for the System of Multi-Dimensional Quasi-Linear Elliptic and Paraoblic Partial Differential Equations.
Supervisors : Prof. R. K. Mohanty and Dr. R. Panda
Th 22303

Contents

1. Background and preliminaries 2. fourth order accurate Off-step discretization for the system of 2D Quasi-linear elliptic boundary value problems 3. Highly accurate unequal mesh off-step discretization for the solution of the system of quasi-linear elliptic partial differential equations. 4. fourth order off-step discretization for the 3D quasi-linear elliptic partial differential equations 5. Two-level implicit high order method based on off-step discretization for the system of 2D quasi-linear parabolic initial -boundary value problems 6. High accuracy two-level implicit off-step discretization for the system of 3D quasi-linear parabolic initial-boundary value problems. Scope for future research work. Bibliography.

359. SHARMA (Kanika)
Differential Subordination Critetia for Starlike Functions.
Supervisor : Prof. V. Ravichandran
Th 22571

Abstract

The thesis consists of six chapters of which Chapter 1 gives an introduction to basic concepts and results needed later. In Chapter 2, we have introduced the subclass S^*_C of normalized analytic functions f defined in the unit disc $D = \{ z : |z| < 1 \}$ with $zf'(z)/f(z)$ lying in the region bounded by the cardioid Ω_C: $= \{ z = x + iy : (9x^2 + 9y^2 - 18x + 5)^2 - 16(9x^2 + 9y^2 - 6x + 1) = 0 \}$. We determine the structural formula, coefficient estimates, growth results and various radii constants such as the radius of starlikeness, radius of lemniscate of Bernoulli starlikeness, radius of M -starlikeness and radius of M(β) -starlikeness for functions in the class S^*_C . Chapter 3 and Chapter 4 focus on the subordination problems associated with the regions in the right half plane. In Chapter 5, we generalize few results of Miller and Mocanu [2] for analytic functions with fixed second coefficient by applying results of [1]. Chapter 6 deals with sufficient conditions for Janowski starlikeness using second order differential subordination. [1] R. M. Ali, S. Nagpal and V. Ravichandran, Second-order differential subordination for analytic functions with fixed initial coefficient, Bull. Malays. Math. Sci. Soc. (2) 34 (2011), no. 3, 611–629. [2] S. S. Miller and P. T. Mocanu, Differential Subordinations, Monographs and Textbooks in Pure and Applied Mathematics, 225, Dekker, New York, 2000.

Contents

1. Introduction. 2. Starlike functions associated with a cardioid. 3. Sufficient conditions for lemniscate and other starlikeness. 4. First order differential subordination for starlike functions. 5. Differential subordination for functions with fixed coefficient. 6. Second order differential subordination for janowski starlikeness. References and Index.

360. SHARMA (Shalu)
Certain types of Frames in Banach Spaces.
Supervisor : Dr. Shiv Kumar Kaushik
Th 22572

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361. SRIVASTAVA (Mohit Kumar)
Numerical Study of Viscous Fluid Flow WithHeat Transfer Using Marker-And - Cell (MAC) and Finite Volume Methods.
Supervisor : Dr. Vusala Ambethkar
Th 22298

Contents

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362. THAKRAN (Seema) nee SEEMA RANI
Generalized Reed-Muller Codes.
Supervisors : Prof. B K Dass and Dr. Vinod Tyagi
Th 22294

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1. Introduction 2. New construction of GRM Codes 3. Recursive matrix method for GRM and DGRM Codes 4. New class of double inductive error correcting codes based on the class of GRM and DGRM Codes over GF(2) 5. Z_4 - Linear GRM Codes. Scope for further research. Bibliography.

363. THUKRAL (Rashmi Sehgal)
Decomposability of Nonnegative γ-Potent Operators.
Supervisor : Dr. Alka Marwaha

Th 22573

Abstract

The invariant subspace problem has intrigued mathematicians for more than six decades and is still open. The problem is closely related to the concept of decomposability of operators. This relationship has motivated mathematicians to study decomposability of several interesting classes of operators. The primary contribution of this thesis is to investigate the decomposability of r-potent operators in both finite and infinite dimensions. In the finite dimension case, this thesis establishes using multiple facets of Peron Frobenius theorem that r-potent matrices are decomposable and outlines the precise set of conditions for decomposability. The thesis further develops unique insights into the structure of decomposable r-potent matrices including precise upper and lower bounds on the total number of zero and nonzero diagonal blocks in the block triangular manifestation of the matrix. The thesis further extends the results on decomposability to semigroups of r-potent matrices. In the infinite dimension case, the thesis establishes the decomposability of nonnegative compact r-potent operators on a separable Hilbert space. The thesis specifically develops an elegant three stage proof for this decomposability. In the first and second stages, the problem is reduced using a constructive iterative algorithm to decomposability in a case where all the functions in the basis of the range space of the r-potent operator are nonnegative as well as mutually orthogonal. In the third stage, it is shown that existence of such basis implies a special kind of cyclicality between the basis functions. This cyclicality along with a nontrivial dimension counting argument establishes that r-potent operators in infinite dimensions are indeed decomposable provided the dimensions of their respective range spaces are greater than r-1. The thesis further obtains certain concrete inferences on the structure of r-potent operators in infinite dimensions. Finally, the thesis establishes decomposability of semigroups of r-potent operators in infinite dimensions.

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364. YADAV (Sushil)
Resonance Problems in a GEO-Synchronous Satellite Including Earth's Equatorial Ellipticity.
Supervisor : Dr. Rajiv Aggarwal
Th 22301

Abstract

In the present thesis, we have investigated resonance in a geo-centric satellite due to earth's equatorial ellipticity. It is assumed that the satellite is moving around the earth in the ecliptic plane. It is observed that there are five resonance points between the angular velocity of the satellite around the earth and rate of change of the parameter

due to the earth's equatorial ellipticity. Amplitude and time-period of oscillation at the resonance points have been determined. Resonance points have been shown on the torus when satellite completes one circuit of the orbit. Resonances in the earth-moon system around the Sun including Earth's equatorial ellipticity are investigated. It is assumed that the reference plane is the ecliptic plane and the moon's orbital plane is fixed. It is observed that resonance occurs at seven points in the motion of the moon orbiting around the earth. Resonance in a geo-centric synchronous satellite under the gravitational forces of the Sun, the Moon and the Earth including it's equatorial ellipticity is also studied. Expression for drift due to the oscillatory terms under the summation sign involved in the equations of motion of the satellite is derived by using statistical method. In the determination of the drift , it is found that the maximum value of the drift is 0.44 degree, which confirms the result of Frick (1967), i.e. residual terms in in the equations of motion of the satellite is less than half a degree. Finally, we have studied the resonances due to the perturbations of a geo-centric synchronous satellite under the gravitational forces of the Sun, the Moon and the Earth including it's equatorial ellipticity. A perturbation technique is adopted to convert the non-linear in-plane equations of motion of synchronous satellite to linear form. The expressions for the radial deviation and the tangential deviation have also been determined.

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Regular Digraph of Ideal, Cayley Graph and Regular Graph of a Commutative Ring.
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368. BAIDAR (Abdul Wakil)
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