Department of Mathematics

Guru Ghsidas Vishwavidyalaya, Bilaspur (CG)

Minutes of BOS Meeting held on March 12, 2021

The Following Members were Present:

1.	**Dr. P. P. Murthy,** Head	Chairman
2.	**Professor Ravi Prakash Dubey**	Subject Expert
3.	**Professor A. S. Ranadive**	Member
4.	**Dr. Sandeep Singh**	Member
5.	**Dr. J. P. Jaiswal**	Special invitee
6.	**Dr. Dhananjay Gopal**	Special invitee
7.	**Dr. M. K. Gupta**	Special invitee
8.	**Dr.K. N. V. V. Vara Prasad**	Special invitee
9.	**Dr. Uma Devi Patel**	Special invitee
10.	**Dr. Santosh Verma**	Special invitee
11.	**Dr. Brijendra Paswan**	Special invitee

Chairman of BOS welcome all the honourable members of **Board of Studies** and special invitees in this meeting. In the meeting, the following agenda approved unanimously. Most of the papers offered at Pre-Ph.D. Course level revised thoroughly and introduced new papers.

Pre-Ph.D. COURSE WORK in Mathematics

Examination Scheme

- There shall be a Course Work Examination for all provisionally admitted students after atleast six months from the commencement of classes of Pre-Ph.D. Course Work.
- For Pre-Ph.D. Course Work Examination, there shall be three papers of 100 marks each or such papers as mentioned in Ph.D. regulations/ Ordinances as amended from time to time.
- The duration of examination for each question paper shall be of three hours and there shall be two sections in each question paper in the following manner:

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a. There shall be 10 (3 marks each) objective type or short-answer questions in first section/ part of the question paper for 30 marks.

b. There shall be 05 (14 marks each) descriptive / essay / interpretable type answer questions in second section/ part of the question paper for 70 marks.

- Examinee of Pre-Ph.D. Course Work has to score minimum 40 marks in each paper and overall, 55% marks in aggregate in examination in order to be eligible to continue in the program leading to the completion of Ph.D. thesis.
- Examinee of Pre-Ph.D. Course Work has to present a Seminar in the department. No marks shall be awarded for this Seminar presented by examinee; it can be assessed as Successful / Unsuccessful only. This qualifying seminar shall be evaluated by the concerned department only.

COURSE STRUCTURE

There should be **one compulsory paper**, **two optional papers** and **Seminar evaluations**. Students are required to choose any two (02) optional papers from the given list of Eleven (11) papers approved by BOS.

COMPULSORY PAPER

MaPhD01: RESEARCH METHODOLOGY

OPTIONAL PAPERS (ANY TWO):

MaPhD02: INTRODUCTORY FUZZY GROUP THEORY

MaPhD03: APPLIED FUNCTIONAL ANALYSIS

MaPhD04: CRYPTOGRAPHY

MaPhD05: DYNAMICAL SYSTEM

MaPhD06: GEOMETRY OF FINSLER SPACE

MaPhD07: STRUCTURES ON MANIFOLDS

MaPhD08: FIXED POINT THEORY AND APPLICATIONS

MaPhD09: MECHANICS OF SOLIDS AND WAVE PROPAGATION

MaPhD10: ADVANCED NUMERICAL ANALYSIS

MaPhD11: ITERATIVE METHODS FOR SOLVING NONLINEAR EQUATIONS

MaPhD12: FRACTIONAL CALCULUS

MaPhD01: RESEARCH METHODOLOGY

Course Objectives:

This course is designed in such a manner which enables the students:

i. *to identify and discuss the role and importance of research in the Mathematical Sciences and its related areas.*

ii. *to identify and discuss the issues and concepts salient to the research process.*

iii. *to identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.*

iv. *to identify and discuss the concepts and procedures of sampling, data collection, analysis and reporting.*

v. *for Better presentation of the work in front of audience by using Latex.*

vi. *to understating MATLAB software for various implementation in the area of studies done by the candidate.*

Philosophy and Ethics: Introduction to philosophy, definition, nature and scope, concept, branches, Ethics, definitions, moral philosophy, nature of moral judgments and reactions.

Scientific conduct: Ethics with respect to science and research, Intellectual honesty and research integrity, scientific misconducts Falsification, Fabrication and Plagiarism (FFP), redundant publications, duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data.

Publication Ethics: definition, introduction and importance, Best Practices/standards setting initiative and guideline, COPE, WAME, etc. Conflicts of interest, Publication misconduct, definition, concept, problems that lead to unethical behavior and vice versa, types, Violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals.

MATLAB: Basics of Mathematical calculations such as Integration, Solving Matrices, Drawing Graphs, Citation, etc.

Latex: Basics of Latex such as typing a research paper, Insertion of Table, Graphs, Pictures, etc.

Wring a review of at least 01 research paper suggested by supervisor (to his student who is allotted as a Pre-PhD Course Work student by the DRC as per university guidelines).

Learning Outcomes:

Students who successfully complete this course will be able:

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i. *to explain key research concepts and issues*

ii. *to read, comprehend, and explain research articles in their academic discipline.*

MaPhD02: INTRODUCTORY FUZZY GROUP THEORY

Fuzzy Subsets, Fuzzy Subgroups, Normal Fuzzy Subgroups, Conjugate Fuzzy Subgroups Normalizer of a Fuzzy Subgroup, Left and Right Cosets of a Fuzzy Subgroup, Quotient Group of a Crisp Group relative to a Normal Fuzzy Subgroups Quotient Fuzzy Subgroup, Normal Fuzzy Subgroup of a Fuzzy Subgroup Homomorphism and Isomorphism of Fuzzy Subgroups, Fuzzy Order relative to Fuzzy Subgroup, Fuzzy order of an element of a Group, Fuzzy Order in a Cyclic Group.

Index of Fuzzy Subgroup, Fuzzy Characteristic Subgroup, Conjugate Fuzzy Subgroups, Fuzzy Cayley's Theorem and Fuzzy Lagrange's Theorem, Solvable Fuzzy Subgroup, Fuzzy Order of a Fuzzy Subgroup.

Normalizer of a Fuzzy Subset, Commutative Fuzzy Subgroup, Ascending Central Series of a Fuzzy Subgroup, Nilpotent Fuzzy Subgroups, Commutator of fuzzy Subsets, Descending Central Chain of a Fuzzy Subgroup, Central Chain of a fuzzy Subgroup, Descending Central Series of a fuzzy Subgroup, Derived Chain of a Fuzzy Subgroup, Solvable Fuzzy Subgroups, Solvable series for a Fuzzy Subgroup.

Reference Books:

1. Fuzzy Group Theory by J. N. Mordeson, K. R. Bhutani, A Rosenfield, Springer Publications.

MaPhD03: APPLIED FUNCTIONAL ANALYSIS

Open Mapping Theorem, Factor Spaces, Duality, Orthogonality, Applications of Open Mapping Theorem.

The Spectrum: The Gelfand-Mazur Theorem, The Gelfand Transform, C*-Algebras.

Compact and Fredholm Operators: Compact Operatos, Fredholm Operators and the Index, Spectral Theorem for Compact Operators, Applications to Integral Equations.

Reference Books:

1. Serg Lang: Real and Functional Analysis, Third Edition , Springer.

MaPhD04: CRYPTOGRAPHY

Course Objectives:

The ciphers remain a mystery while hiding a very rewarding treasure. The motivation to break these ciphers may simply lie in the wealth one could acquire if they cracked the ciphers. However, the human mind is very curious, and with each uncovered step, our curiosity increases. That the motivation behind the study of Cryptography and its applications in day-to-day life.

Foundations of Cryptography: History of Cryptography.

Encryption: Encryption system, Symmetric and Asymmetric Cryptosystems, Cryptanalysis, Alphabets and Words, Permutations, Block Ciphers, Multiple Encryption, The use of Block Ciphers, Stream Ciphers, The Affine Ciphers, Matrices and Linear Maps, Affine Linear Block Ciphers, Vigenere, Hill and Permutation Ciphers, Cryptanalysis of Affine Linear Block ciphers, Secre Cryptosystems.

Probability and Perfect Secrecy: Probability, Conditional Probability, Birthday Paradox, Perfect Secrecy, Vernam One-Time Pad, Random Numbers, Pseudorandom Numbers.

DES: Feistel Ciphers, DES Algorithm, Security of DES.

AES: Notation, Cipher, Key Expansion, InvCipher.

Prime Number Generation: Trial Division, Fermat Test, Carmichael Numbers, Miller-Rabin Test, Random Primes.

Public-Key Encryption: Idea, Security, RSA Cryptosystem, Rabin Encryption, Diffie-Hellman Key Exchange, ElGamal Encryption.

Reference Books:

1. Johannes A Buchmann, ***Introduction to Cryptography***, Springer International 2nd Edition (ISBN: 81-8128-232-9).

Learning Outcomes:

Students undergoing this course are expected:

i. *to learn fundamentals of cryptography and its application to network security. Understand vulnerability analysis of network security.*
ii. *to acquire background on hash functions; authentication; firewalls; intrusion detection techniques.*

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MaPhD05: DYNAMICAL SYSTEM

Course Objectives:

The course aims to introduce the main features of dynamical systems, particularly as they arise from systems of ordinary differential equations as models in applied mathematics. The topics presented will include phase space, fixed points and stability analysis, bifurcations, Hamiltonian systems and dissipative systems. Discrete dynamical systems will also be discussed briefly, leading to the idea of a 'chaotic' dynamical system.

One Dimensional Maps: One-Dimensional Maps, Cobweb Plot: Graphical Representation of an Orbit, Stability of Fixed Points, Periodic Points, The Family of Logistic Maps, The Logistic Map $G(x) = 4x(1 - x)$, sensitive Dependence on Initial Conditions.

Two Dimensional Maps: Mathematical Models, Sinks-Sources and Saddles, Linear Maps, Coordinate Changes, Nonlinear Maps and the Jacobian Matrix, Stable and Unstable Manifolds, Matrix Times Circle Equal Ellipse.

Chaos: Lyapunov Exponents, Chaotic Orbits, Congjugacy and the Logistic Map, Transition Graphs and Fixed Points, Basins of Attaction.

Fractals: Cantor Sets, Probabilistic Constructions of Fractals, Fractals from Deterministic Systems, Fractal Basin Boundaries, Fractal Dimension, Computing the Box-Counting Dimension, Correlation Dimension.

Chaos in Two Dimensional Maps: Lyapunov Exponents, Numerical Calculation of Lyapunov Exponents, Lyapunov Dimension, A two-Dimensional Fixed Point Theorem, Markov Partitions, The Horseshoe Map.

Chaotic Attactors: Forward limit sets, Chaotic Attactors, Chaotic Attactors of Expanding Inerval Maps, Measure, Natural Measure, Invariant Measure for One-Dimensional Maps.

Reference Books:

1. Kathleen T. Alligood, Tim D. Sauer and James A. Yorke, ***Chaos: An introduction to dynamical systems***, Springer International Edition (ISBN: 978-81-8128-408-2).

Learning Outcomes:

Students are able to understand after the course:

i. *to describe the main features of dynamical systems and their realisation as systems of ordinary differential equations*
ii. *to identify fixed points of simple dynamical systems, and study the local dynamics around these fixed points, in particular to discuss their stability and bifurcations*

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iii. *to use a range of specialised analytical techniques which are required in the study of dynamical systems*

iv. *to describe dynamical systems geometrically and represent them graphically via phase plane analysis*

v. *to understand and predict the occurrence and consequences of bifurcations*

vi. *to explain and prove special properties of finite-dimensional Hamiltonian systems, in particular conservation laws, Liouville's Theorem and Poincare's Recurrence Theorem prove simple theoretical results about abstract dynamical systems*

vii. *to understand the origin of dissipation and its effect on the orbits of dynamical systems*

viii. *to find fixed points and period orbits of discrete dynamical systems, and find their stability*

ix. *to do graphical analysis of 1D discrete dynamical systems*

x. *to understand the basic properties of a chaotic dynamical system*

MaPhD06: GEOMETRY OF FINSLER SPACE

Course Objectives:

The objective of this course is to enable the students, concepts of Finsler geometry so that they can pursue research in this area.

Basic concepts of Finsler space

Berwald and Cartan covariant differentiation

Lie differentiation of a tensor, Lie differentiation of Berwald connection coefficients, different commutation formulae, Motion, affine motion and projective motion, Conformal tansformation.

Riemannian curvature, isotropic point, Shur's theorem, Szabo's theorem.

Reference Books:

1. H. Rund, The Differential Geometry of Finsler Spaces, Springer-Verlag, Berlin, 1959.
2. M. Matsumoto, Foundations of Finsler Geometry and Special Finsler Spaces, Kaisheisha Press, Otsu, 1986.
3. P. L. Antonelli (ed.), Handbook of Finsler Geometry, Kluwer Academic Publishers, Dordrecht, the Netherlands, 2003.
4. D. Bao, S.S. Chern and Z. Shen, An Introduction to Riemannian-Finsler Geometry, GTM, Springer, 2000.
5. S.S. Chern and Z. Shen, Riemannian-Finsler Geometry, World Scientific, 2004.
6. Z. Shen, Lectures on Finsler Geometry, Lectures on Finsler Geometry, World Scientific, 2001.

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Learning Outcomes:

After the completion of the course, students will be able to learn basic concepts of Finsler geometry. They may understand better the topics covered in allied courses like Riemannian geometry, Mathematical Physics and their applications in allied areas. They will be adequately prepared for pursuing research in Finsler geometry.

MaPhD07: STRUCTURES ON MANIFOLDS

Course Objectives:

The course develops the basic concept of Differentiable manifold and also gives concepts of different complex structures on manifolds.

Manifolds and Connection: Concepts of manifolds, Tangent vectors, Vector fields, Lie Brackets, Affine connections, Torsion tensor of an affine connection, Curvature tensor of an affine connection.

Complex and almost Complex Manifolds: Definition and example, Nijenhuis tensor, Eigen Values of an almost complex structure, Existence theorem and inerrability condition, contravariant and covariant almost analytic vector fields.

Almost Hermite Manifold: Nijenhuis tensor, Almost analytic vector fields, Curvature in almost Hermite manifold, Holomorphic Sectional Curvature, Linear connection in an almost Hermite manifold.

Koehler Manifold: Definition, Holomorphic Sectional Curvature, Bochner Curvature tensor, affine connection in almost Kaehler manifold.

Nearly Kaehler Manifold: Definition, Projective correspondence between two Nearly Kaehler manifolds, Curvature identities.

ParaKaehle Manifold: Definition, Curvature Identities and conformal flatness of ParaKaehler manifold.

Reference Books:

1. K. Yano and M. Kon, Structures on Manifolds, World Scientific, 1984.

2. D. E. Blair, Riemannian Geometry of Contact and Symplectic Manifolds, Progress in Mathematics, Vol. 203, Birkhäuser Inc., Boston, MA, 2002.

3. R. S. Mishra, Structures on Differentiable Manifolds and their Applications, ChandramaPrakashan, Allahabad, 1984.

4. U. C. De and A. A. Shaikh, Complex Manifolds and Contact Manifolds, Narosa.

Learning Outcomes:

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On completion of the course the student should have the capability to define all the basic terms related to manifold and also student should have capability to know all the complex structures defined on different manifolds.

MaPhD08: FIXED POINT THEORY AND APPLICATIONS

Course Objectives:

The objective of this paper aims to prepare students with a deep understanding of development of fixed-point theory and the research-oriented attitude and skill of application of mathematical iterative technique and computational tools.

Introduction to metric fixed-point theory. Contraction Mapping in a Metric Space, Linear Operators, Some generalizations of the Contraction Mappings, Approximate Iteration; A Converse of the Contraction Principle; Some Applications of the Contraction Principle. Examples and applications.

Brouwer's Fixed Point Theorem, equivalent Formulations; The Elementary Proof of Brouwer's Fixed Point Theorem; Examples and Applications.

The Schauder Fixed Point Theorem; Darbo's Generalization of Schauder's Fixed Point Theorem; Browder's and Fan's Generalizations of Schauder's and Tychonoff's Fixed Point Theorem.

Nonlinear Operators, Lipschitzian Mappings, Picard Iterative Method, Mann Iterative Method, Ishikawa Iterative Method, a few convergence theorems.

Reference Books:

1. Vasile I. Istratescu, Fixed Point Theory; D. Reidel Publishing Company; 90-277-1224-7.
2. VasileBerinde "Iterative Approximation of Fixed Points" Springer.
3. Saleh Almezel, Qamrul Hasan Ansari, Mohamed Amine Khamsi, Topics in Fixed Point Theory, Springer.

Learning Outcomes:

By the end of course work, students will be get knowledge of the contraction, Brower's and Schauders' fixed point theorem and their development. Also student get the knowledge about the convergence theorem by using Picard, Mann and Ishikawa iteration process.

MaPhD09: MECHANICS OF SOLIDS AND WAVE PROPAGATION

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Course Objectives:

The prime objective of this paper is to develop the mathematical concept of solid mechanics with its applications to seismic wave propagation.

Introduction to Continuum Mechanics, Basic definitions of Solid Mechanics, Principles of Elasticity, Fundamentals of Tensor Calculus, Body and Surface forces, Effects of force: tension, compression and shear, Analysis of stress, principal stresses, principal planes, maximum shearing stresses, Computation of Traction Vector and Principal Axes.

Introduction to Strain, Affine Transformation, Infinitesimal Affine Deformation, Geometrical Interpretation of components of Strain, Principal Strains, Invariants, General Infinitesimal Deformation, Examples of Strain, Notations, Equations of Mohr's circle diagram, equations of deformation and strain, strain in form of displacement, compatibility concepts, need and physical significance.

Stress-strain relations, Generalized Hook's Law, different types of symmetry, density function, Airy's stress function, Poisson's ratio. Complementary Shear Stress, Shear Strain, Shear Modulus. Unit for elastic moduli, Relation between modulus of elasticity, modulus of rigidity and bulk modulus. Saint-Venant's Principle.

Wave equation, Solution of Wave equations, Seismic wave equation, Plane waves, Harmonic plane wave equation, Polarization of P and S waves, Wave propagation in unbounded elastic medium.

Study of propagation of waves in elastic, viscoelastic and poroelastic media, Waves in anisotropic medium, thermoelastic medium, study of surface waves (Rayleigh & Love waves) in elastic and viscoelastic medium including layered medium, Reflection and refraction of waves in elastic media.

Reference Books:

1. Love, A.E.H. *A Treatise on Mathematical Theory of Elasticity*, Cambridge University Press, New York.
2. Sokolnikoff, I.S., (1956) *Mathematical Theory of Elasticity*, McGraw Hill Book Co., NewYork.
3. Biot, M .A. (1965) *Mechanics of* Incremental Deformations, John Wiley & Sons , NewYork.
4. Ewing, W.M., (2018) *Elastic Waves in Layered Media*, Creative Media Partners,LLC.
5. Achenbach, J.D., (2012) *Wave Propagation in Elastic Solids*, North Holland,Elsevier.
6. Kazimi, SMA., (2013) Solid Mechanics, McGraw Hill Education (India) Pvt Ltd.

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Learning Outcomes:

After the completion of this course, students will be able to examine the characteristics of seismic wave propagation in a mathematical sense. This course will be helpful in dealing the problems on reflection/transmission phenomena, crack propagation and moving load in anisotropic elastic materials.

MaPhD10: ADVANCED NUMERICAL ANALYSIS

Course Objectives:

To know about various types of Errors. Calculate the error correction and get actual root of the equation. Understand different methods of solution of the equations and compare them. To get the detailed knowledge about different numerical methods which are used in real world problems, with emphasis on how to prepare program for different methods.

Errors and Approximations: Rate of convergence of an Iterative method, Efficiency index of an Iterative method

Extension of Newton-Raphson method for finding multiple roots and to solve system of non-linear equations. Mullers method, Chebyshev's methods.

System of linear equations: LD decomposition techniques and its complexity analysis.

Interpolation: Newton's Divided difference method. Hermite's interpolation. Cubic spline interpolation. Errors in interpolation.

Numerical Integration: Method of undetermined coefficients. Errors in integration formulae. Iterative solution of linear equations.

Eigen values & Eigen Vectors: Bounds on eigen values, method for finding eigen values of symmetric matrices, method for finding eigen values of arbitrary matrices, method for finding largest eigen values of matrices.

Reference Books:

1. Jain M K, Iyengar S R K and *Jain* R K, Numerical Methods for Scientific and Engineering Computation, 4th Edn, New Age International Pvt Ltd (2005)
2. Jain M K, Numerical Solutions of Differential Equations, 2nd Edn, John Wiley and Sons Ltd (1984)
3. S S Sastry, Introductory Methods of Numerical Analysis, 5th Edn. Prentice Hall of India.

Learning Outcomes:

After completion of this course, student will be able to be aware of the use of numerical methods in modern scientific computing. Be familiar with finite precision Computing. Be familiar with numerical solutions of nonlinear equations in a single variable. Be familiar with numerical

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interpolation and approximation of functions. Be familiar with numerical integration. Be familiar with calculation and interpretation of errors in numerical methods

MaPhD11: ITERATIVE METHODS FOR SOLVING NONLINEAR EQUATIONS

Course Objectives:

To know about various types of iterative methods, theoretical and computational order of convergence. Two-step without memory iterative methods for solving nonlinear equations. Two-step with memory iterative methods. To get the detailed knowledge about optimal & non-optimal iterative methods with improve them.

Errors and Approximations: Rate of convergence of an Iterative method, Efficiency index of an Iterative method

Classification of iterative methods, computational order of convergence (COC), R-order of convergence, computational efficiency of iterative methods, initial approximations, stopping criteria, one-point iterative methods for simple roots.

Two-point without memory IM: Traub's two-point IM, Owtrowski's fourth order IM & its generalization, Kung-Traub's multipoint IM, Jarratt's type IM, Non-optimal two-point IM for multiple zeros, optimal two-point IM for multiple zeros,

Two-point with memory IM: Secant like method, Steffensen like method, two-step method with memory of Neta's type.

Higher order IM: Non-optimal IM, optimal IM, with derivative IM, derivative free IM, Higher order without memory IM, higher order with memory IM.

Reference Books:

1. M. S. Petkovic, B. Neta, L.D. Petkovic, J. Dzunic (2013): Multipoint iterative methods for solving nonlinear equations, Elsevier, MA, USA.
2. J. F. Traub (1982): Multipoint iterative methods for solution of equations, Chelsea Publishing Company, NY, USA.

   C. T. Kalley (1995): Iterative methods for linear and nonlinear equations, SIAM, Philadelphia.

Learning Outcomes:

After completion of this course, student will be able to be aware of the use of iterative methods in modern real-world problems. Be familiar with fundamental iterative methods such as Newton-Raphson method, Secant method, Kung-Traub's method, Steffensen method etc. Be familiar with multipoint without and with memory iterative methods. Be aware about the importance optimal iterative methods and how to improve non-optimal to optimal.

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MaPhD11: FRACTIONAL CALCULUS

Course Objectives:

The objective of the paper is to develop the advanced concept of Fractional Calculus with the special interest recurrence relations and the time space fractional diffusion equations.

Advance concept of Gamma and Beta function, Bessel functions.

Hypergeometric and Generalized hypergeometric functions: Definition and some identities, Recurrence formulae and Expansion formulae.

Mittag-Leffler and Generalized Mittag-Leffler functions and its applications.

Introductions and definitions of Riemann-Liouville fractional differential and Riemann-Liouville fractional integral of order α. Basic properties of fractional integrals, The Weyl fractional: Basic properties of Weyl integral with its applications. Kober operators and generalized Kober operators.

Reference Books:

1. Special functions: Earl D. Rainville, Chelsea publishing Company, Bronx, New York.
2. The H-functions of one and two variables with applications: H. M. Shrivastava, K. C. Gupta and S. P. Goyal, South Asian Publishers Pvt. Ltd.
3. An introduction to the fractional calculus and fractional differential equation: Kenneth S. Miller and Bertram Ross, John Wiley & Sons, Inc. New York.
4. Special function for applied scientists: A. M. Mathai and Hans J. Haubold, Springer publishers.
5. The H-function with application in statistics and other disciplines; A. M. Mathai and R. K. Saxena, Publishing John Wiley & Sons, New York.
6. The H-function Theory and application, A. M. Mathai, Ram Kishore Saxena and Hans J. Haubold, Springer publishers.

Learning Outcomes:

Students will be able to solve differential equation of arbitrary order. This course will help to develop the extended mathematical modelling of fractional order in Science and Engineering.

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Note: The following papers at M.Sc. level modified slightly at M.Sc. III and M.Sc. IV semester. Implementation of the course will be from the session 2021-22 onwards.

M.Sc. III Semester

INFORMATION THEORY AND ITS APPLICATIONS

Course Objectives:

The main concern of information theory is to discover mathematical laws governing the system, design to communicate or manipulate information. It sets up quantitative measure of information and capacity of various systems to transmit, store and process the information. Coding is the application of the information theory which will be taught to the students in this paper

Introduction, communications, processes, a model for a communications system, a quantitative measure of information, a binary unit of information, discrete scheme without memory, Basic concepts of probability related to information theory, Basic concept of information theory, memory less finite scheme, elements of encoding, continuum without memory.

Books Recommended.

1. F. M. Reza, An introduction to information theory, Dover Publications Inc. New York.
2. Robert B Ash, Information theory, Inter Science Publishers New York.
3. John R. Pierce, An Introduction to information theory, Dover Publications Inc. New York.
4. John Avery, Information theory and evolution, World Scientific, New Jersey.

Learning Outcomes:

After successful completion of this paper the students will be able to explain the concepts of entropy and mutual information. The students will also be able to understand the concept of information theory and its usefulness in various fields such as in defence, in portfolio selection, in general election, in computer science, in pattern recognition and in image processing.

M.Sc. III Semester

SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

Course Objectives:

The main objectives of this paper is to study about the securities analysis and portfolio optimization which can be used in the analysis of stock market related entities.

Introduction, investment, securities market, stock exchanges, risks, share valuation, band valuation, portfolio analysis, portfolio selection, capital asset pricing model (CAPM).

Books Recommended

1. John C Hall, Options, features and other derivatives, Prentice- Hall of India Private Limited.
2. Sheldon M Ross, An introduction to Mathematical Finance, Cambridge University Press.
3. S. Kevin, Security analysis and portfolio management, PHI learning Private limited.

Learning Outcomes:

After successful completion of this paper the students will be able to analyze the various kinds of securities and they can decide to take the decision about to purchase the securities for the benefit of their own in future.

M.Sc. IV Semester

FINSLER GEOMETRY

Course Objectives:

The objective of this course is to enable the students, the basic concepts of Finsler geometry which are useful for further study.

Line element, degree of homogeneity, Finsler space, Euler's theorem, metric tensor, generalized Christoffel symbols, Cartan tensor, Minkowskian space, Tangent space, dual tangent space, length of a vector, Geodesic.

δ-differentiation, partial δ-differentiation, Berwald differentiation, commutation formulae, metrical connection, Landsberg space, Affinely connected space, Ricci commutation formula, Berwald curvature and torsion tensors, Berwald deviation tensor, Bianchi identities, Recurrent Finsler space, Symmetric Finsler space.

Projective change, projective deviation tensor, projective curvature and torsion tensors.

Cartan two processes of covariant differentiation, Cartan curvature and torsion tensors.

Books Recommended:

1. H. Rund, The Differential Geometry of Finsler Spaces, Springer-Verlag, Berlin, 1959.
2. M. Matsumoto, Foundations of Finsler Geometry and Special Finsler Spaces, Kaisheisha Press, Otsu, 1986.
3. P. L. Antonelli (ed.), Handbook of Finsler Geometry, Kluwer Academic Publishers, Dordrecht, the Netherlands, 2003.

Learning Outcomes:

After the completion of the course, students will be able to learn some basic concepts of Finsler geometry. They may understand covariant differentiation better.

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M.Sc. IV Semester

MATHEMATICAL MEASURE OF INFORMATION AND THEIR CHARACTERIZATIONS

Course Objectives:

The main objective of this paper is to study how to measure the information mathematically.

Introduction, entropy of a single event, functional equations, Shannon's measure of information, some desirable properties of entropy and their correlations, the HincinFaddeev characterization of Shannon Entropy, The fundamental equation of information.

Books Recommended.

1. J. Aczel and Z. Doroczy, On measure of information and their characterizations, Academic Press, New York.
2. F. M. Reza, An introduction to information theory, Dover Publications Inc. New York.

Learning Outcomes:

After successful completion of this paper the students will be able to measure the decay of information in communication channel during the transmission of information.

M.Sc. IV Semester

FINANCIAL MATHEMATICS AND ITS APPLICATIONS

Course Objectives:

The objectives of this paper is to study various types of financial instruments and their applications in various fields.

Financial Derivatives - Introduction, types of financial derivatives, forwards and futures. Options and its types and SWATS. Technical analysis and fundamental analysis.

Pricing contracts via arbitrage. The arbitrage theorem. The block scholes formula Cox-Ross Rubinstein model.

Books Recommended

1. John C Hall, Options, features and other derivatives, Prentice- Hall of India Private Limited.
2. Sheldon M Ross, An introduction to Mathematical Finance, Cambridge University Press.

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3. Sahil N. Nettci and Hirsa, An introduction to Mathematics of financial derivatives, Academic Press Inc.
4. Robert J Elliot and P. Ekkehard Kopp, Mathematics of financial markets, Springer-Verlag New York Inc
5. S. Kevin, Security analysis and portfolio management, PHI learning Private limited.
6. Steven Roman, Introduction to the mathematics of finance, Springer.

Learning Outcomes:

After successful completion of this paper the students will be able to explain various types of financial derivatives and they will be able to apply this concept in stock market analysis.

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Dr. P. P. Murthy | Prof. Ravi Prakash Dubey | Prof. A. S. Ranadive

Dr. Sandeep Singh | Dr. J. P. Jaiswal | Dr. Dhananjay Gopal

Dr. M. K. Gupta | Dr.K. N. V. V. Vara Prasad

Dr. Uma Devi Patel | Dr. Santosh Verma (12/03/2021) | Dr. Brijendra Paswan