Quick Links

- Time Table (August 2022- November 2022) (uploaded_files/TimetableMathematics August-November,2022.pdf)
- Departmental Directory (Mathematics-Directory.html)
- Contact Us (Mathematics_contact_us.html)
- M.Sc. Curriculum (MSc-curriculum.html)
- Brochure for Ph.D. Admission (uploaded_files/DEPARTMENT-OF-MATHEMATICS-PH.D.jpg)
- Poster for M.Sc. Admission (uploaded_files/Poster_for_M.Sc_Admission.jpg)
- Newsletters (Mathematics_News.html)

M.Sc. Curriculum

Entire two year M.Sc. Programme in Mathematics has been divided into four semesters.

Stages of Progression:

First Year: In the 1st year (Two semesters), basic core courses are the main contents.

Second Year: 2nd year courses have been designed to accommodate more applicable elective courses and a project. Over all 5 elective courses is an attraction since this choice accommodates a series of 4 structured courses (if offered).

Semester-wise Structure of the Programme

First Semester

S. No.	Course Code	Course Description	Type	L	T	P	Credit
1.	MTH6011	Analysis – I	PC	3	1	0	4
2.	MTH6041	Linear Algebra	PC	3	1	0	4
3.	CSE104	Computer programming	PC	3	0	0	3
4.	CSE104(L)	Computer programming Lab	PC	0	0	3	2
5.	MTH6021	Optimization	PC	3	1	0	4

6.	MTH6012	Algebra	PC	3	1	0	4
Total Credits = 21							

Second Semester

S. No.	Course Code	Course Description	Type	L	T	P	Credit
1.	MTH6031	Probability & Statistics	PC	3	1	0	4
2.	MTH6022	Analysis-II	PC	3	1	0	4
3.	MTH6032	Complex Analysis	PC	3	1	0	4
4.	MTHXXXX	Numerical Analysis and Scientific Computing	PC	3	0	2	4
5.	MTH6042	Ordinary Differential Equations	PC	3	1	0	4
Total Credits = 20							

Third Semester

S. No.	Course Code	Course Description	Type	L	T	P	Credit
1.	MTH7011	Topology	PC	3	1	0	4
2.	MTH7021	Functional Analysis	PC	3	1	0	4
3.	MTH7031	Partial Differential Equations	PC	3	1	0	4
4.	MTHXXXX	Program Elective-I	OE	3	1	0	4
5.	MTHXXXX	Open Elective-I	OE	3	0	0	3
6.	--	Project	PC	--	--	--	3
Total Credits = 22							

Fourth Semester

S. No.	Course Code	Course Description	Type	L	T	P	Credit
1.	MTH7041	Mathematical Methods	PC	3	1	0	4
2.	MTHXXXX	Program Elective-II	OE	3	1	0	4
3.	MTHXXXX	Open Elective-II	OE	3	0	0	3

4.	MTHXXXX	Open Elective-III	OE	3	0	0	3
5.	--	Project	--	--	--		5
Total Credits = 19							

Total Credits:

Minimum number of credits required to complete the Programme is 82.

Possible Elective Courses*:

S. No.	Course No.	Course Name	L	T	P	Credit
1.	MTH5041	Numerical Methods for Partial Differential Equations	3	1	1	4
2.	MTH5022	Finite Element Methods	3	1	1	4
3.	MTH5051	Computational Topology	3	1	1	4
4.	MTH5061	Number Theory	3	1	0	4
5.	MTH5071	Differential Geometry	3	1	0	4
6.	MTH5032	Spectral Element Methods	3	1	1	4
7.	MTH5042	Computational Fluid Dynamics	3	1	0	4
8.	MTH5081	Fractal Geometry and Applications	3	1	0	4
9.	MTH5091	Elements of Sobolev Spaces and Applications	3	1	0	4
10.	MTH5052	Applied Harmonic Analysis	3	1	0	4
11.	MTH5062	Wavelets and Applications	3	1	0	4
12.	MTH5072	Parallel Numerical Algorithms	3	0	1	4
13.	MTH5082	Image Processing and Computer Graphics	3	0	1	4
14.	MTH5092	Mathematics in Multi-media	3	1	0	4
15.	MTH5102	Data Mining: A Mathematical Perspective	3	1	0	4

16.	MTH5112	Introduction to Stochastic Differential Equations	3	1	0	4
17.	MTH5122	Mechanics	3	1	0	4
18.	MTH5132	Continuum Mechanics	3	1	0	4
19.	MTH5142	Cryptography	3	1	0	4
20.	MTH5152	Graph Theory	3	1	0	4
21.	MTH7032	Algebraic Topology	3	1	0	4
22.	MTH4011	Introduction to Stochastic Processes	3	1	0	4
23.	MTH5011	Commutative Algebra	3	1	0	4
24.	MTHXXXX	An introduction to Mathematical Finance	3	1	0	4
25.	MTH4031	An introduction to fractional calculus	3	1	0	4

*Some additional courses will be added to this list.

Core Courses

First Semester

Title of the course: Analysis-I

Course Code: MTH6011

Prerequisite: None

Topics:

Finite, Countable, and Uncountable sets. Metric spaces, neighborhoods, open set, limit point, closed set, perfect set, dense set, relatively open, Compact sets, Heine - Borel theorem, Weierstrass Theorem, Perfect sets, Connected sets. Sequences in Metric spaces, subsequences, Convergence, Cauchy Sequences, complete metric space, monotonic sequence, limsup, liminf. Series, Convergence of series, test of convergence, Power Series, Absolute convergence. Limit and continuity of functions defined on a metric space, continuity and compactness, continuity and connectedness, discontinuities, uniformly continuous. Differentiability, Mean value theorem, Continuity of Derivatives. Riemann -Stieltjes integrals: Definition and existence of integral, properties of integral, Integration and differentiations, the fundamental theorem of calculus. Functions of bounded variation and integration w.r.t. functions of bounded variation Sequence of functions, pointwise convergence, uniform convergence, uniformly convergence and continuity,

uniformly convergence and integration, uniformly convergence and differentiation. Weierstrass Approximation of continuous functions, Banach Contraction Principle. Arzela-Ascoli Theorem, Implicit & Inverse function Theorem.

Text Book:

- Rudin, Walter. Principles of Mathematical Analysis (International Series in Pure and Applied Mathematics). 3rd ed. McGraw-Hill, 1976. ISBN: 9780070542358.

Reference Books:

- Apostol, Tom M.: Mathematical Analysis, 2nd ed., Narosa, 2002.
- Ghorpade and Limaye: A Course in Multivariable Calculus and Analysis, 1st ed., Springer, 2009.

Title of the course: Linear Algebra

Course Code: MTH6041

Prerequisite: None

Topics:

Systems of linear equations, Row reduction and echelon forms, Matrix operations including inverses, Block Matrices. Vector Spaces, Subspaces, Span, Linear Dependence and Independence, Basis, Coordinates, Dimension, Ordered basis. Linear transformations, Algebra of linear transformations, Matrix representation of linear transformations, Null Space and the Range Space of a Linear Transformation, Rank-nullity theorem, isomorphism, Change of basis. Linear Functional, the Dual Space. Dual Basis, Subspace, Annihilators, Subspace Annihilators, the Double Dual, the Double Annihilator. Inner product space: Definition, basic properties and examples, Orthogonality, Orthonormal basis, Gram-Schmidt Process, Cauchy-Schwarz Inequality. Eigenvalues and eigenvectors, Diagonalizability, Cayley-Hamilton theorem. Quadratic Forms, Minimal Polynomial, Canonical Forms, Triangular Form, Invariance, Invariant Direct-Sum Decompositions, Primary Decomposition, Nilpotent Operators, Jordan Canonical Form, Rational Canonical Form. Bilinear Forms, Bilinear Forms and Matrices, Symmetric Bilinear Forms, Quadratic Forms, Hermitian Forms.

Text Book:

K. Hoffman & R. Kunze, Linear Algebra, Prentice Hall 2nd Ed

Reference Books:

- David C. Lay, Linear Algebra and its Applications, Pearson Education 3rd Ed, 2003
- G. Strang, Linear Algebra and Its Applications, Thomson Brooks/Cole, 2007.
- S. Kumaresan, Linear Algebra A Geometric Approach , Prentice Hall India
- Seymour Lipschutz and Marc Lipson: SCHAUM'S OUTLINE OF LINEAR ALGEBRA, McGraw Hill Education; 3 edition

---

Title of the course: Optimization

Course Code: MTH6021

Pre-requisites: Nil

Topics:

Introduction and definition of Linear Programming Problem. Formulation of L P Problem, Graphical solutions of LP Problem. Convex Sets. Solution of a LP Problem by Simplex Method, Two Phase Method and Big-M Method. Duality. Solution of a LP Problem by its Dual. Sensitivity Analysis Transportation, Assignment and Traveling Salesman Problem. Mathematical Formulation of Transportation Problem, Initial Feasible Solution Methods, Optimality Test, Degeneracy in TP. Mathematical formulation of assignment problem. Vogel's approximation Method, Hungarian Method. Unbalanced and Restricted assignment problem. Traveling Salesman Problem. Queuing Theory Pure Birth Process, Pure Death Process, (M/M/1):(Infinity/FCFS) , (M/M/1):(N/FCFS), (M/M/s):(Infinity/FCFS), (M/M/s):(N/FCFS), (M/Ek/1):(Infinity/FCFS) models Non-linear Programming Problem Formulation of NLPP, General and canonical form, graphical solution. Saddle Point problems Constrained Optimization with equality and Inequality constraints, Steepest Descent method, Lagrangian Multipliers Method, Kuhn- Tucker Conditions (Necessary and Sufficient), and theorems. Unconstrained optimization via iterative methods (Newton's method, Gradient/ conjugate gradient based methods, Quasi- Newton methods).

Text Book:

- A. H. Taha, "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
- J. C. Pant, "Introduction to Optimization Operation Research", Jain Brothers, 2008.
- W. L. Winston, ``Operations Research Applications and Algorithms'', Brooks/Cole, 4th Edition, 2003.
- M. C. Joshi and Kannan M. Moudgalya, "Optimization: Theory and Practice" Narosa Publication.

Reference books:

- E. M. L. Beale, Introduction to optimization, John Wiley, 1998.
- M. Bazarra and C. Shetty, Nonlinear Programming, Theory and Algorithms, Wiley, 1979.
- F. S. Hillier and G. J. Lieberman, ``Introduction to operations research'', McGraw-Hill, 7th Edition, 2001

Title of the course: Algebra

Course Code: MTH6012

Pre-requisites: Elementary set theory

Topics:

Definition of a group, Examples and basic properties. Subgroups, Cyclic groups, Group action on a set, Dihedral Groups, Permutation, Cayley's theorems, Lagrange's theorem, Cauchy's Theorems, (in the language of group actions.) Normal subgroups, Quotient group, Center of Group, Normalizer. Solvable group. Homomorphism and Sylow's Theorems: Homomorphism's, Isomorphism theorems, direct product of groups, Sylow's theorems and applications. Rings:

Definition, Examples and basic properties. Zero divisors, Integral domains. Characteristics of a ring, Subrings, Ideals, Prime ideal, Maximal ideals. Quotient rings, Quotient field of an integral domain. Euclidean Domain, PID, UFD, Ring of polynomials. Irreducibility of Polynomials, Gauss Lemma, Eisenstein Criterion Field: Field Extension, Algebraic Extension, Splitting Field, Separable Extension, Fundamental Theorem of Galois Theory (statement only), Finite Fields.

Textbooks (IEEE format):

- J. Gallian, Contemporary Abstract Algebra, 4th edition, Narosa, 2009.
- I.N. Herstein, Topics in Algebra, Wiley, 2008.

References Books

- E. Artin, Algebra, Prentice-Hall of India.
- David S. Dummit and Richard M. Foote, Abstract Algebra, Wiley, 3rd Edition. J. B. Fraleigh, A First Course in Abstract Algebra, Pearson, 2003.

Title of the course: Computer Programming and Lab

Course Code: CSE104 and CSE104(L)

Prerequisites: None

Topics:

Basic syntax and semantics of a higher-level language, Variables, and Primitive data types (e.g., numbers, characters, Booleans).Expressions and assignments, Basic input and output handling. Branching Control constructs (if-else, Nested If-else). Iterative constructs (looping) (Core Concepts for Computational Platforms) Computer organization and its hardware components. Integer and floating-point representations Operating Systems (OS) and their purpose. UNIX OS commands and text-editors for constructing, compiling and running programs. Single function C programs Writing simple C programs within function main () using basic types and flow-control constructs. Topics include: variable declarations for basic types, assignment statements, arithmetic expressions, if-statements, switch-statements, for-loops, and while-loops. Also introduce: Overview of C standard libraries, input-output using print () and scanf(), short-circuit evaluation of Boolean expressions, single-dimension arrays. Modular Programming Approach Functions: prototype, definition, parameter passing – by value and by Reference. Variables: Scope, Lifetime, storage class for variables. Recursion. Sorting and searching (Basic Data Structures) Records/structure (heterogeneous aggregates) Strings and string processing. Arrays (Multi-dimensional) 3The concept and properties of algorithms, Informal comparison of Algorithm efficiency, comparing multiple algorithms for a problem (Memory Management and C Pointers) Static & Dynamic memory allocation Memory referencing and Dereferencing, Single-linked data-structures: lists – stack, queue disciplines. File Management Formatted I/O including file I/O Declaration, definition and accessing.

Text Book:

- Computer Science: A Structured Programming Approach Using C, Forouzan, B.Aand Gilberg R. F., 3rd, Cengage Learning.
- Intro to Python for Computer Science and Data Science, Dietel P. & Dietel H., 1st ed, Pearson.
- Class Notes if available.

Reference books:

- C How to Program, Dietel P. & Dietel H., 7th ed, Pearson.
- The C Programming Language: ANSI C, Brian W. Kernighan, Dennis M. Ritchie, 2nd ed., Prentice Hall.
- Let Us C, Yashavant P. Kanetkar, 12th ed., Infinity Science Press, LLC.
- Programming in ANSI C, E. Balagurusamy, 4th ed., Tata McGraw-Hill Education.
- Mastering C, Venugopal K R, Prasad S R, McGraw-Hill Education.

Second Semester

Title of the course: Probability & Statistics

Course Code: MTH6031

Pre-requisites: Elementary Calculus

Topics:

Introduction, Review of set theory, countable and uncountable sets, Sample Space; Events; Definition of Probability function, Properties of Probability function, continuity of probability function. Conditional Probability; Total Probability Theorem; Bayes' Theorem, Independent Events; Random Variable; Events generated by random variables, Distribution function, probability density function (pdf), probability mass functions (pmf). Discrete uniform, Binomial, Poisson, Geometric, Normal, Exponential, Continuous uniform random variables. Function of a random variable, distributions, pdf and pmf of function of random variable. Expectation, Variance; Moments, Joint distribution and joint density function, Function of two random variables. Expected value and variance of function of random variables, Covariance, Correlation coefficient, Covariance matrix and its properties, Conditional distributions, Conditional expectation, Probabilistic Inequalities, Characteristic Function, Limit Theorems Jensen's Inequality, Markov's Inequality, and Chebyshev's Inequality; Characteristic Function and its properties. Weak and strong law of large numbers, central limit theorem; Unbiased Estimates, minimum-variance unbiased estimators, Maximum likelihood estimation, confidence intervals, Testing Hypotheses, Nyman-Pearson Lemma, Likelihood Ratio Tests, Students' t-distribution. Parametric test based on Chi-square, normal, t, F distributions. Simple Linear regression.

Text Book:

- Dimitri P. Bertsekas and John N. Tsitsiklis, Introduction to Probability, 2nd Edition, Athena Scientific, Belmont, Massachusetts.
- Papoulis & S.U. Pillai, Probability, Random Variables and Stochastic Processes, Mc Graw Hill, 4th Edition, 2002.

- Introduction to Probability, Statistics, and Random Processes by Hossein Pishro-Nik.(available free on net: https://www.probabilitycourse.com/)

Reference books:

- P.G. Hoel, S.C. Port and C.J. Stone, Introduction to Probability theory, Boston : Houghton Mifflin, 1971.
- Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh: An Introduction to Probability and Statistics, Wiley; Second edition (2008).

Title of the course: Analysis-II

Course Code: MTH6022

Pre-requisite: Analysis-I

Topics:

Introduction, Lebesgue outer measure, measurable sets, Countable additivity, non-measurable set, cantor sets, Measurable functions, Littlewood's Three Principles, The Riemann Integrals, The Lebesgue Integrals Countable additivity and continuity of integration Product measure, Fubini's theorem, Differentiation and integration The Lp spaces, completeness and separability The Riesz Representation of dual Fourier series: Definition of Fourier series, formulation of convergence problems, The L2 theory of Fourier series, convergence of Fourier series.

Text Book

- H.L. Royden, Real Analysis, 3rd ed., Macmillan, 1988.

Reference Book

- Walter Rudin, Real and complex analysis, McGraw-Hill, New York, 1966
- P.R. Halmos, Measure Theory, Graduate Text in Mathematics, Springer-Verlag, 1979.
- de Barra, G., Measure theory and integration, revised edition of the 1981 original, Horwood Publishing Series, Mathematics and Its Applications, Horwood Publishing Limited, Chichester, 2003.

Title of the course: Complex Analysis

Course Code: MTH6032

Pre-requisites: Analysis-I

Topics:

The Algebra of Complex Numbers, Point Representation of Complex Numbers, Vectors and Polar Forms, The Complex Exponential, Powers and Roots, Inequalities involving complex numbers, Planar Sets, The Riemann Sphere and Stereographic Projection, Functions of a Complex Variable, Limits and Continuity, Differentiability, Necessary and sufficient conditions for differentiability (Cauchy-Riemann equations), Polar form of CR equations, Analyticity, Polynomials, Rational

functions ,Harmonic Functions, The Exponential, Trigonometric, and Hyperbolic Functions, The Logarithmic Function, Multivalued Functions, Branch cut and branch point, Complex exponent, Inverse Trigonometric and hyperbolic functions, Contours, Contour Integrals, Line integrals, Rectifiable arcs, Line integrals as functions of arcs, Independence of path, ML Inequality, Antiderivatives, Cauchy-Goursat theorem -Deformation of contours approach, Vector analysis approach, Simply and Multiply connected domains, Cauchy's Integral Formula and its consequences, Higher derivatives, Morera's Theorem, Cauchy inequality, Lowville's theorem and the Fundamental Theorem of Algebra, Maximum Modulus principle, Sequences and Series, Taylor Series, Power Series, Mathematical Theory of Convergence, Laurent Series, Isolated singular point, Residues, Residue Theorem, Isolated singular points, The Point at Infinity, Residue at poles, Residue at infinity, Zeros of analytic functions, Behavior of a function in the neighborhood of an isolated singularity. Trigonometric Integrals over [0, 2π], Improper Integrals of Certain Functions over (-∞,∞), Jordan's Lemma, Improper Integrals Involving Trigonometric Functions, Indented Contours, Integrals Involving Multiple-Valued Functions, The Argument Principle and Rouché's Theorem Invariance of Laplace's Equation, Geometric Considerations, Linear transformation, The linear group, The cross ratio, Möbius Transformations, The Schwarz-Christoffel Transformation.

Text Book:

- J.B. Conway, Functions of one complex variable, Narosa, New Delhi.
- R.V. Churchill and J.W. Brown, Complex Variables and Applications. Wiley

Reference books:

- Lars V. Ahlfors, Complex Analysis, McGraw-Hill International Edition.
- T.W. Gamelin, Complex Analysis, Springer International Edition, 2001.

Title of the course: Numerical Analysis and Scientific Computing

Course Code:

Prerequisites: Basic linear algebra

Topics:

Approximations in Scientific computing, Error propagation and amplification, conditioning, stability and accuracy, computer arithmetic. Bisection, Secant, False–position, Newton's methods, Muller's methods, Fixed point iteration method, Order of convergence, Newton's method for multiple roots, Error Analysis, Linear Algebra review, Gaussian elimination, Pivoting, Gauss Elimination as LU Factorization, Cholesky Factorization, Pathology in linear systems-singular matrices, Determinants and matrix inversions, Norms, Condition numbers and error analysis; Stability, Iterative methods: Jacobi and Gauss-Seidel method and Newton's and fixed-point method of non-linear systems Eigen Values, Power method, Inverse power method, QR methods of finding eigenvalues and eigenvectors of matrices, Existence and uniqueness of interpolating polynomial, Lagrange polynomials, Divided differences, Evenly spaced points, Error of interpolation, Piecewise interpolation, Extrapolation, Cubic spline, Least-Square approximations Numerical differentiation, Richardson Extrapolation, Newton-Cotes integration formulas,

Composite rules, Error terms for Newton-Cotes formulas and composite rules, Integration with Unequal Segments, Other ways to derive integration formulas, Romberg Integration, Quadrature rule, Gaussian quadrature. Taylor series method, Euler and Modified Euler's method, Runge-Kutta methods; Multistep methods: Milne's method, Adams-Moulton method, System of equations and higher order equations, Stiff equations. Finite difference method for BVP, Shooting method, Solution through a set of equations, Derivatives boundary conditions. Implementation of algorithms discussed in other units through MATLAB.

Text Book:

- Numerical Analysis, Richard L. Burden and J. Douglas Faires.
- Elementary Numerical Analysis: An Algorithmic Approach, S. D. Conte, C. d. Boor, 3rd edition, McGraw-Hill International Editions.
- M Heath: Scientific Computing - An introductory Survey.

Reference books:

- A friendly introduction to Numerical Analysis, Brian Bradie, Pearson Education, 2007.
- Applied Numerical Methods with MATLAB for Engineers and Scientists by Steve C Chapra, McGraw-Hill Science Engineering.
- In Introduction to Numerical Analysis, K. F. Atkinso

Title of the course: Ordinary Differential Equations

Course Code:

Pre-requisites: Calculus, Linear algebra

Topics:

Review of solution methods for first order, Existence and uniqueness of initial value problems: Picard's and Peano's Theorems, Gronwall's inequality, Picard's theorem for systems, Continuation of solutions and maximal interval of existence, Continuous dependence, Introduction, General solution of second order and higher equations, Higher order linear equations and linear Systems: fundamental solutions, Wronskian, variation of constants, Exponential matrix and asymptotic behaviour of solutions, Power series methods with properties of Legendre polynomials and Bessel functions. Introduction, Systems of First Order Equations, Fundamental Matrix, Non-homogeneous linear Systems, Linear Systems with Constant Coefficients, Phase Portraits-Introduction, Phase Portraits in R 2 (continued), Poincare Bendix on theorem,Sturm's Comparison Theorem, Elementary Linear Oscillations Sturm-Liouville Problem, Green's Functions, Introduction, Linear Systems with Constant Coefficients, Linear Systems with Variable Coefficients, Second Order Linear Differential Equations, Stability of Quasi-linear Systems, Stability of Autonomous Systems, Stability of Non-Autonomous, A Particular Lyapunov Function and Lyapunov methods.

Text Book:

- G.F. Simmons, Differential Equations with Applications and Historical Notes. New York: McGraw-Hill, 1991.

- L. Perko, Differential Equations and Dynamical Systems, Texts in Applied Mathematics, Vol. 7, 2nd ed., Springer Verlag, New York, 1998.
- Fred Brauer and J.A. Nohel, The Qualitative Theory of ordinary Diff. equations

Reference books:

- V Raghavendra, V Lakshmikantam, S Deo, Text book of ordinary differential equations, Tata McGraw-Hill Education, 2008

Semester III

Title of the course: Topology

Course Code: MTH7011

Pre-requisites: Analysis-I

Topics:

Topological spaces, Bases and subbases, Examples of Topological spaces including metric spaces, Subspace topology, continuous functions, homeomorphisms, examples of homeomorphic and non-homeomorphic spaces, Product topology, quotient topology, examples of quotient spaces like Mobius band, Torus, Projective plane, Klien bottle etc. Connected and path connected spaces, connected subsets of real line, component and path component, local connectedness and local path connectedness.Compact spaces, compact subspaces of Euclidean spaces, limit point compactness and local compactness, Nets and their convergence, The countability axioms, First countable spaces and second countable spaces, Separability, Lindelof spaces, Separation axioms including regular and completely regular spaces, Normal spaces.The Urysohn Lemma, The Tietze extension theorem and the Tychonoff theorem.

Text Book:

- J. R. Munkres, Topology, 2nd Edition, Pearson Education (India), 2001.

Reference Book:

- H. L. Royden, Real Analysis, 3rd edition, Prentice Hall of India, 1995.
- G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, New York, 1963.
- J. L. Kelley, General Topology, Van Nostrand, 1955.

Title of the Course: Functional Analysis

Course Code: MTH7021

Prerequisites: Analysis-1

Topics:

Normed linear spaces, Riesz lemma, characterization of finite dimensional spaces, Banach spaces, Examples, linear map on finite dimensional spaces, finite dimensional spaces are isomorphic, operator norm. Hahn-Banach theorems: Geometric and extension forms and their applications. Uniform boundedness principle, closed graph theorem, open mapping theorem, projection, and comparable norms. Dual spaces and adjoint of an operator: Duals of classical spaces, weak and weak* convergence, adjoint of an operator. Inner product spaces, orthonormal set, Gram-Schmidt ortho-normalization, Bessel's inequality, Orthonormal basis, Separable Hilbert spaces. Projection and Riesz representation theorem: Orthonormal complements, orthogonal projections, projection theorem, Riesz representation theorem. Adjoint, normal, unitary, self adjoint operators, compact operators, eigen values, eigen vectors. Spectral theorem for compact self adjoint operators, statement of spectral theorem for bounded self adjoint operators.

Textbook

- M. Thamban Nair, Functional Analysis: A First course, PHI publication, 2002.
- K. Yoshida, Functional Analysis, Springer.
- S. Nanda and B. Choudhari, Functional Analysis With Application, New Age International Ltd.
- S. C. Bose, Introduction to Functional Analysis, Macmillan India Ltd.

Title of the course: Partial Differential Equations

Course Code: MTH7031

Pre-requisite: ODEs, Functional Analysis

Topics:

First-Order Partial Differential Equations(PDEs)– Formation and classification of first-order PDEs, Linear and Quasi-linear first-order PDEs, Cauchy's problem for first order PDEs, The Cauchy Kowalevski Theorem, Integral surfaces passing through a given curve, Nonlinear first-order PDEs, The method of characteristics, Compatible systems, Charpit's method for nonlinear PDEs, Transport problem, Burgers Problem, Second-Order PDEs - Classification, Canonical forms, Well-posed problems, Superposition principle. The Heat Equation - Derivation of the heat equation, The maximum and minimum principles, Uniqueness, Continuous dependence, Method of separation of variables, Time-independent boundary conditions, Time-dependent boundary conditions, Duhamel's principle.Fundamental solution, Green's functions for the heat equations. The Wave Equation - Derivation of the wave equation, The infinite string problem, The D'Alembert solution of the wave equation, The semi-infinite string problem, The finite vibrating string problem, The method of separation variables, The inhomogeneous wave equation. Green's functions for the Wave equations, Laplace's Equation – Basic concepts, Types of boundary value problems, The maximum and minimum principle, Green's identity and fundamental solution, The Poisson integral formula, The method of separation of variables, The Dirichlet problem for the rectangle, The Dirichlet problem for Annuli and Disk, The exterior Dirichlet problem. Green's functions for the Laplace equations. The Fourier Transform Methods for PDEs –Review of Fourier transform, Fourier sine and cosine transform, Heat flow problem in an infinite and semi-infinite rod, Infinite string problem, Laplace equation in a half-plane.

Text Book:

- Partial Differential Equations: Classical Theory with a Modern Touch, A. K.Nandakumaran, P.S. Datti.
- F. John, Partial Differential Equations, 3rd, Narosa Publ. Co., New Delhi,1979.

Reference books:

- Ian N. Sneddon, Elements of Partial Differential Equations, Dover Publications, 2006.
- L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Vol.19, AMS, Providence, 1998.
- J David Logan, Applied Partial Differential Equations, Springer International Publishing, 2015.
- Robert C. McOwen: Partial Differential Equations, Pearson Education Inc.
- Alen Jeffrey: Applied Partial Differential Equations.

Semester IV

Title of the Course: Mathematical Methods

Course Code: MTH7041

Pre-requisites: Analysis

Topics:

Definition and classification of linear integral equations. Conversion of initial and boundary value problems into integral equations. Conversion of integral equations into differential equations. Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.Basic concepts of the calculus of variations such as functional, extremum, variations, function spaces.Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations. Invariance of Euler`s equations. Variational problem in parametric form. Fourier Series and Fourier Transforms: Orthogonal set of functions, Fourier series, Fourier sine and cosine series, Half range expansions, Fourier integral Theorem, Fourier Transform, Transforms of Derivatives, Fourier transforms of simple Functions, Fourier transforms of Rational Functions, Convolution, Fourier transform of convolution, Schwarz space, Fourier transform on Schwarz space, Inversion Theorem. Laplace Transform: Definition, Existence of Laplace transform, Inversion of Laplace transform, Transform of some elementary functions, Transform of Derivatives, relation involving Integrals, the error function, Transform of Bessel functions, Periodic functions, Impulse function, convolution of two functions, Inverse Laplace Transform of simple function, Solution of Differential Equations.

Text Book:

- Jerry, Abdul J., Introduction to Integral Equations with applications, Clarkson University Wiley Publishers, 2nd Revised edition edition (11 October 1999)
- Elsgolc, L.E.: Calculus of Variations, Dover Publications Inc. (15 January 2007)

- Loknath Debnath, Integral Transforms and their applications, Chapman and Hall/CRC; 2 edition ,2006.
- Donald A. Mc Quarrie: Mathematical Methods for Scientists & Engineers, University Science Books, Edition: 2008.

Reference Book:

- Cordumeanu, C. : Integral Equations and Applications, Cambridge University Press, 1991.
- Carl M. Bender and SteCurant, R. and D. Hilbert: Methods of Mathematical Physics, Vol I. Interscience Press, 1953.
- Ian N. Sneddon , The use of Integral Transforms ,McGraw Hill; Second Printing edition ,1972.
- Henrici, Fast Fourier Methods in Computational Complex Analysis, SIAM Review, Vol. 21, No. 4, 1979.

OTHER LINKS

- Director's Message (../../aboutus/directorsmessage.html)
- Photo Gallery (../../Photo_Gallery.html)
- Webmail (https://www.google.com/a/lnmiit.ac.in)
- Course Management System (../../Course_Management.html)
- Bus Time Table (../../Bus_Time_Table.html)
- Foundation (../../aboutus/foundation.html)
- WAY TO LNMIIT (../../uploaded_files/Way to LNMIIT.pdf)
- Plagiarism Prevention Software (../../Library/plagiarism_prevention_software.html)
- Rules & MOA (../../Rules_MOA.html)
- Tender Notification (../../Tender_Notification.html)
- Sankalp (https://sankalp.lnmiit.ac.in/)
- UGC (https://www.ugc.ac.in/)
- ASME LNMIIT (https://asme.lnmiit.ac.in)
- Counselling Cell (../../Councelling Cell.html)
- CSI (https://csi.lnmiit.ac.in)
- Vivacity (https://vivacity.lnmiit.ac.in/)
- E-Cell (https://ecell.lnmiit.ac.in/)
- SAE LNMIIT (https://saeindia.lnmiit.ac.in/)
- IEEE Student Branch (https://ieee.lnmiit.ac.in/)
- IUPC (https://iupc.lnmiit.ac.in/)
- Plinth (https://plinth.lnmiit.ac.in/)
- Innovation Club (https://innovationclub.lnmiit.ac.in/)
- Desportivos (https://desportivos.lnmiit.ac.in/)
- Archive Information (https://www.lnmiit.ac.in/Archive.aspx)