Department of Mathematics

Ph.D. Course Work
(Applicable for the scholars admitted from the AY: 2024-25)

The credit requirement for the Ph.D. course work is a minimum of 12 credits including the courses on 'Research Methodology' and 'Research and Publication Ethics' for 2 credits each. The candidate must complete two domain-specific courses of 3 credits each, recommended by the respective Department Research Committee (DRC). These courses can be completed through MOOCs.

The candidate must present two research seminars before the completion of course work, typically within the first year. The first research seminar shall be before the end of first semester on introduction to the proposed research work, and the second seminar shall be before the end of the second semester or after the completion of course work on the research proposal, as per the format provided. Each research seminar will have one credit weightage. The course structure is presented in Table 1 and list of domain-specific courses is presented in Table 2.

Table 1: Course Structure

S.No.	Course Code	Name of the Course	Credit (s)
1	246UC001	Research Seminar -I	1
2	246UC002	Research Seminar -II	1
3	246UC003	Research Methodology	2
4	246UC004	Research and Publication Ethics	2
5	-	Domain Specific Course -1	3
6	-	Domain Specific Course -2	3
Total			**12**

Table 2: List of Domain-Specific Courses

S.No.	Course Code	Name of the Course
1	246MA001	Boundary Value Problems
2	246MA002	Ordinary Differential Equations
3	246MA003	Mathematical Methods
4	246MA004	Fundamentals of Probability and Logic
5	246MA005	Fuzzy Set Theory and Fuzzy Logic
6	246MA006	Universal Algebra
7	246MA007	Fluid Dynamics
8	246MA008	Non-linear Functional analysis
9	246MA009	Real Analysis
10	246MA010	Operations Research
11	246MA011	Abstract Algebra
12	246MA012	Lattice Theory
13	246MA013	Boolean Algebra
14	246MA014	Numerical Methods

Research Methodology

Course Code: 246UC003

UNIT -I:
Research Design
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys. Case Studies.

UNIT-II:
Data Collection and Sources
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT-III:
Data Analysis and Reporting
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT-IV:
Intellectual Property Rights
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT-V: Patents
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

Text Books:

1. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, Sage Publications, 4th Edition, 2015.
2. Intellectual Property: A Very Short Introduction, Siva Vaidhyanathan, Oxford University Press, 2017.
3. Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets" Deborah E. Bouchoux, Cengage India, 4th Edition, 2013.

Reference Books:

1. Research methodology: an introduction for science & engineering students, Stuart Melville and Wayne Goddard, Juta Academic, 2nd Edition, 2014.
2. Research design: Qualitative, quantitative, and mixed methods approaches, Creswell, J.W. and Creswell, J.D., Sage publications, 2017.
3. Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, Clause 8 Publishing; Volume I: Perspectives, Trade Secrets & Patents; 2023.

Web Links:

1. https://archive.nptel.ac.in/courses/121/106/121106007/#
2. https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview

Research and Publication Ethics

Course Code: 246UC004

Unit-I: Philosophy & Ethics
Introduction to Philosophy: Definition, Nature & Scope, Concept, Branches
Ethics: Definition, Moral Philosophy, Nature of Moral Judgements & Reactions

Unit-II: Scientific Conducts
Ethics with respect to Science and Research, Intellectual Honesty & Research Integrity
Scientific Misconducts: Falsification, Fabrication & Plagiarism
Redundant Publications: Duplicate & Overlapping Publication, Salami Slicing, SelectiveReporting & Misrepresentation of Data

Unit-III: Publication Ethics
Publication Ethics: Definition, Introduction and Importance
Best Practices/ Standard Setting Initiatives and Guidelines: COPE, WAVE, etc., Conflictsof Interest
Publication Misconduct: Definition, Concept, Problems that lead to unethical behaviour and vice-versa, types, Violation of Publication Ethics, Authorship and Contributorship, Identification of Publication Misconduct, Complaints and Appeals, Predatory Publishers and Journals

Unit-IV:Open Access Publishing
Open Access publications and Initiatives, SHERPA/ RoMEO online resource to check publisher copyright and self-achieving policies, Software tool to identify predatory publications developed by SPPU, Journal Finder/ Journal Suggestion tools viz. JANE, ELSEVIER, SPINGER, Journal suggester etc.

Unit-V: Publication
Misconduct Group
Discussions:
Subject-specific Ethical issues, FFP, Authorship, Conflicts of Interest, Complaints and Appeals: Examples and fraud from India and Abroad
Software tools:
Use of Plagiarism software like Turnitin, Urkund and other open source software tools
Database and Research Metrics:
Database:
Indexing database, Citation database: web of science, Scopus etc.
Impact factor of journal as per journal citation report, SNIP, SJR, IPP, cite score
Metrics: h-index, g-index, i-10 index, AL metrics etc.

Text Books:
1. Philosophy in Science, Bird A, Routledge, 2006.
2. A Short History of Ethics, MacIntyre, London, 1967.

Reference Book:
1. Ethics in Science, Education and Governance, Indian National Science Academy, 2019.

Weblinks:
1. www.niehs.nih.gov/research/resources/bioethics/whatis
2. https://onlinecourses.swayam2.ac.in/nou22_ge73/preview

Boundary Value Problems

Course Code: 246MA001

UNIT – I :

General theory for linear first order system of differential equations, Existence of solutions, Solution space. The first order non-homogeneous equation, variation of parameters. The adjoint nth order equation. Relation between scalar and vector adjoints.

UNIT – II:
The two point boundary value problems, Homogeneous two-point boundary value problems, the adjoint boundary problem, the non-homogeneous boundary problem, Green's matrix and self – adjoint boundary value problem.

UNIT – III:
Introduction to Eigen value problems, the vibrating string problem, Heat conduction problem, properties of the Green's operator. Existence of Eigen values and Eigen functions.

UNIT IV:
Non – linear boundary value problems, kinds of boundary value problems, the Generalized Lipschitz condition, failure of existence and uniqueness to Linear boundary value problem, relation between first and second boundary value problems. A more general Lipschitz condition, application to boundary value problems.

UNIT – V :
Stability: Definition and examples Liapunov method for uniform stability, Asymptotic stability. Linear and quasi-linear ordinary differential systems, Autonomous Ordinary differential systems, trajectories and critical points, linear systems of second order, critical points of quasi-linear systems of second order.

Text Books:
1. Theory of Ordinary and delay differential equations by R.D. Driver Kingston R.I., Nov, 1976(Springs Verlag)
2. Theory of ordinary differential equations by E.A. Coddington and N. Levinson.

Reference Books:
1. Theory of Ordinary Differential Equations. by R. H. Cole. Appleton-Century-Crofts, New York (1968).
2. Non-Linear two-point boundary value Problems by P.B. Bailey, L.F. Shampine and P.E. Waltman, Academic press, New York, London (1968)

Web links:
1. https://nptel.ac.in/courses/111105132
2. https://www.kuk.ac.in/lms/syllabus?did=Mjc=&sid=MTQ3OQ==&pn=TS5TYy4gKE1hdGhlbWF0aWNzKQ==

Ordinary Differential Equations

Course Code: 246MA002

UNIT-I:
Essential concepts from Real Function Theory – The basic problem -The fundamental existence and uniqueness theorem –examples to demonstrate the theory continuation of solutions.

UNIT-II:

Dependence of solutions on initial conditions – dependence of solutions on parameters (causal function f) - Existence and Uniqueness theorems for systems – existence and uniqueness theorems for Higher order equations – examples.

UNIT-III:
Introduction to the theory of Linear differential systems – Theory and properties of Homogeneous linear systems.

UNIT-IV:
Theory of non-homogeneous linear systems – Theory and properties of the nth order homogeneous linear differential equations.

UNIT-V:
Theory of nth order Non homogeneous Linear equations – Sturm theory – Sturm Liouville Boundary value.

Text Books:
1. Differential Equations (3rd edition), Shepley L. Ross (2007)., Wiley India.
2. Ordinary differential equations by S.G.Deo, V. Lakshmikantham and V. Raghavendra, second Edition, Tata McGraw - Hill Publishing Company Ltd., New Delhi, 2002.

Reference Books:
1. Differential equations with applications and historical Notes by George F. Simmons,Tata McGraw - Hill publishing Company Ltd., New Delhi, 1972.
2. Ordinary and Delay Differential equations by R.D.Driver, Applied Mathematical Sciences 20,Springer-verlag New York-Heidelberg-Berlin

Web links:

1. https://archive.nptel.ac.in/courses/111/108/111108081/
2. http://www.digimat.in/nptel/courses/video/111108081/L35.html

Mathematical Methods

Course Code: 246MA003

UNIT-I:
Laplace Transforms – Inverse Laplace Transforms – Error functions – Application to boundary value problems (Heat equation Laplace equation) – Fourier transform – Fourier integral formula – Finite &infinite Fourier sine and cosine transforms – Application to integral equations and Boundary Value problems.

UNIT-II:
Special function: Bessel functions: recurrence relations for the Bessel coefficients – Series expansion for Bessel coefficients – Integral expression for the Bessel coefficients. The additions formula for the Bessel coefficients.
Numerical solution of partial differential equations – Introduction – Finite difference approximation to derivatives – Finite difference methods – Laplace's equation - parabolic equations – Crank – Nicholson Method – Jacobi Method - Gauss Siedel method.

UNIT-III:
Finite Element Methods - Integral formulation and Variational Methods: Need for Weighted-Integral forms – Some mathematical concepts and formulas – Boundary, Initial and Eigen value problems – Integral relations – Functionals – The Variational Symbol – Weak formulation of Boundary Value problems – Weighted – Integral and Weak formulations – Linear and Bilinear forms and Quadratic Functional – examples. Variational methods of approximation – The Rayleigh – Ritz Method , Petrov – Galerkin method.

UNIT-IV:
Maxima and Minima: The Simplest Case, Illustrative Examples, Natural Boundary Conditions and transition conditions, The Variational notation, The more general case, Constraints. Lagrange Multipliers, Variable end points, Sturm-Liouville problems.

UNIT-V:
Integral equations: Introduction, Relations between Differential and Integral Equations, The Green's function, Alternative Definition of the Green's function, Linear Equations i n Cause and Effect-The influence function.

Text Books:
1.Introductory Methods of Numerical Analysis by S. S. Sastry, Prentice Hall Publication.
2.An Introduction to The Finite Element Method ,G.N.Reddy, McGraw-Hill Inc. (Second Edition).

Reference Books:
1.Methods of Applied Mathematics, Francis B. Hildebrand, Second Edition, PHI Ltd, New Delhi.
2.Special functions of Mathematical physic and Chemistry, I.N. Sneddon, of Longman Publications.

Weblinks:
1. https://archive.nptel.ac.in/courses/111/106/111106111/
2. https://archive.nptel.ac.in/courses/111/107/111107103/

Fundamentals of Probability and Logic

Course Code: 246MA004

UNIT-I:
Probability: Baye's Theorem. Discrete and Continuous Random Variables, Mathematical Expectations, generating functions, Distributions: Binomial, Poisson, Normal Distributions and their Properties, Moments, Additive Properties, Fitting of distributions.

UNIT-II:
Statements and notations, Connectives, Well-formed formulas, Truth tables, tautology, equivalence implication, Normal forms, Theory of inference for the statement calculus, Rules of inference, Consistency of premises and indirect method of proof, Automatic Theorem Proving Predicate calculus: Predicates, statement functions, variables and quantifiers, predicate formulas, free & bound variables, universe of discourse, inference theory of predicate calculus.

UNIT-III:
Sets, Operations on sets, Sequences and Summations, Growth functions, Relations and their properties, n-ary relations and their applications, representation of relations, Closures of relations, Equivalence relation, Partial Ordering and Hasse diagram

UNIT-IV:
Fuzzy Sets and Relations: Operations, Properties, Cardinality of relations, Operations on relations, Properties, Fuzzy Cartesian Product and Compositions, Equivalence and Tolerance relations.

UNIT-V:
Fuzzy Logic: Tautologies, Contradiction, Equivalence and Logic Proofs, Other forms of Implication and Composition Operations

Text Books:
1. Probability, Statistics and Random Process, T.Veerarajan, Tata McGraw Hill
2. Discrete Mathematics and its Applications, Keneth. H.Rosen, Tata McGraw Hill Publishers, New Delhi

Reference Books:
1. George J.Klir and Bu Yuan, Fuzzy sets and Fuzzy logic Theory and applications , Prentice Hall of India, New Delhi.
2. Fuzzy Logic with Engineering Applications, Timothy Ross, McGraw Hill International Edition.

Weblinks:
1. https://www.khanacademy.org/math/statistics-probability
2. https://onlinecourses.nptel.ac.in/noc22_ee21/preview

Fuzzy Set Theory and Fuzzy Logic

Course Code: 246MA005

UNIT – I :
Fuzzy Sets
Basic concepts of fuzzy set – t-norm – t-conorms – Membership function – α-cut – Algebra of fuzzy sets – Distance between fuzzy sets – Fuzzy relation.

UNIT – II:
Fuzzy Arithmetic
Fuzzy numbers – Arithmetic operations of fuzzy numbers – Extension principle – Interval arithmetic – Defuzzification.

UNIT – III :
Fuzzy Function
Fuzzy valued functions – Fuzzy equations, fuzzy inequalities , system of fuzzy linear equations – Maximum and minimum of fuzzy functions.

UNIT – IV:
Fuzzy Logic
Classical Logic – Multi-valued Logics – Fuzzy Propositions – Fuzzy Quantifiers – Linguistic hedges – Inference from conditional Fuzzy proposition.

UNIT – V:
Applications Of Fuzzy Set Theory
Fuzzy sets in Decision making – Optimization in Fuzzy environment – Fuzzy set application in image processing – Fuzzy set application in pattern reorganization.

Text Books:
1. George J.Klir and Bu Yuan, Fuzzy sets and Fuzzy logic Theory and applications , Prentice Hall of India, New Delhi.
2. Fuzzy Sets and Systems, Didier Dubois and Henri Prade Academic Press.

Reference Books:
1. An Introduction to Fuzzy logic and Fuzzy sets James J Buckley, Esfandiar Eslami, (Springer).
2. Fuzzy set theory and application ,H.J.Zimmernman , (Allied Publication in Association with KLUWER).

Weblinks:
1.https://www.javatpoint.com/fuzzy-logic
2.https://www.geeksforgeeks.org/difference-between-fuzzification-and-defuzzification/

Universal Algebra

Course Code: 246MA006

UNIT-I:
Definitions of Lattices – Isomorphic lattices and Sublattices – Distributive and Modular Lattices – Complete Lattices, Equivalences and Algebraic Lattices – Closure Operators.

UNIT-II:

Definitions and Examples of Algebras – Isomorphic Algebras and Subalgebras – Algebraic Lattices and Sub universes – The Irredundant basis theorem – Congruences and Quotient Algebras – Homomorphisms and the Homomorphism and Isomorphism theorems.

UNIT-III:
Direct Products, Factor congruneces and Directly indecomposable algebras – Subdirect products, subdirectly irreducible algebras and simple algebras – Class operators and Varieties – Terms, Term algebras and Free algebras – Identities, Free algebras and Birkhoff Theorem – Malcev Conditions.

UNIT-IV:
Boolean algebras – Boolean rings – Filters and Ideals – Stone Duality – Boolean Powers – Ultra products and congruences.

UNIT-V:
Distributive varieties – Primal algebras – Boolean products – Discriminator varieties – Quasi primal algebras functionally complete algebras and Skew free varieties.

Text Book:
1. A Course in Universal Algebra by Stanley Burris and H.P. Sankappanavar, Springer Verlag Publications.

Reference Book:
1. Universal Algebra by George Grätzer, Springer New York, NY.

Weblinks:
1. https://www.math.uwaterloo.ca/~snburris/htdocs/ualg.html
2. https://en.wikipedia.org/wiki/Universal_algebra

Fluid Dynamics

Course Code: 246MA007

UNIT-I:
Kinematics of Fluids in motion: Real fluids and Ideal fluids- Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid – Conditions at a rigid boundary.

UNIT-II:
Equations of motion of a fluid: Pressure at a point in a fluid at rest - Pressure at a point

in a moving fluid - Conditions at a boundary of two inviscid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.

UNIT-III:
Some two-dimensional flows: Meaning of two-dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional, irrotational in compressible flow - Complex velocity potentials for standard two-dimensional flows - Some worked examples – Two-dimensional Image systems

UNIT-IV:
Some three-dimensional flows: Introduction- Sources, ranks and doublets - Images in a rigid infinite plane - Axis symmetric flows – Stokes stream function.

UNIT-V:
Viscous flows: Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid element - The rate of strain quadric and principle stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain- The coefficient of viscosity and Laminar flow - The Navier – Stokes equations of motion of a Viscous fluid.

Text Books:
1. F. Chorlton, Text Book of Fluid Dynamics, CBS Publications. Delhi,1985.
2. G.K. Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi, 1984.

Reference Books:
1. O'Neill and F. Chorlton, Ideal and Incompressible Fluid Dynamics, Cambridge University press,1986.
2. A.J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics, Springer- Verlag, New York, 1993.

Weblinks:
1. https://archive.nptel.ac.in/courses/112/105/112105269/
2. https://archive.nptel.ac.in/courses/112/106/112106200/

Non-Linear Functional Analysis

Course Code: 246MA008

UNIT I:
Banach's contraction mapping principle- Generalization of Banach's contraction theorem; Schauder's theorem for non-expansive mappings.

UNIT II:

Nonlinear alternative of Leray- Schauder type for non-expansive mappings, Homotopy for contractions, nonlinear alternative of Leray-Schauder type for contractive mappings and their generalizations to non-expansive mappings, Brouwer's theorem.

UNIT III:
Schauder's theorem; Monch's theorem; Applications to a discrete boundary value problem and a second order homogeneous Dirichlet problem.

UNIT IV:
Fixed point theory for non-self-mappings in Banach spaces; Nonlinear alternative for continuous compact non-self-mappings using Schauder's theorem and Monch's theorem; Nonlinear alternatives for κ – set contractive mappings; the essential mapping approach of Granas; the Schauder-Tychonoff theorem.

UNIT V:
Fixed point theorems in Conical shells; Krasnoselskii's theorems; Applications to Fredholm integral equations.

Text Books:

1. Fixed Point Theory and Applications by R.P.Agarwal, M.Meehan an D.O'Regan, Cambridge Tracts in Mathematics 141, Cambridge University Press 2004.
2. An Introduction to Metric Spaces and Fixed Point Theory by M.A.Khamsi and W.A. Kirk, John Wiley & Sons INC, 2001.

Reference Books:

1. Nonlinear Functional Analysis by K.Deimling-Verlag 1985.
2. Fixed Point Theory for Lipschitzian-type Mappings with Applications by Ravi P.Agarwal, Donal O'Regan, and D.R.Sahu, Volume 6, Springer 2009.
3. Handbook of Topological Fixed Point Theory by R.F.Brown, M.Furi, L.Gorniewicz and B.Jiang, Springer 2005

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc21_ma25/preview
2. https://www.ams.org/books/pspum/045.1/pspum045.1-endmatter.pdf

Real Analysis

Course Code: 246MA009

UNIT-I:
Basic Topology: Finite, Countable, and Uncountable Sets, Metric spaces, Compact sets, Connected sets.

UNIT-II:
Numerical Sequences and Series: Convergent sequences, Subsequences, Cauchy sequences, Upper and Lower limits, Some special sequences, Series, Series of non-negative terms, number e , The Root and Ratio tests, Power series , Summation by parts ,AbsoluteConvergence , Addition and Multiplication of series, Rearrangements.

UNIT-III:
Continuity: Limits of Functions, Continuous Functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotone Functions, Infinite Limits and Limits at Infinity.

UNIT-IV:
Differentiation: The Derivative of a Real Function, Mean Value Theorems, The Continuityof Derivatives, L' Hospital's Rule, Derivatives of Higher order, Taylor's theorem, Differentiation of Vector- valued Functions.

UNIT-V:
Riemann-Stieltjes Integral: Definition and existence of the Riemann Stieltjes Integral,Properties of the Integral, Integration and Differentiation, the fundamental theorem of calculus, Integral of Vector- valued Functions, Rectifiable curves.

Text Books:
1. Principles of Mathematical Analysis by Walter Rudin, International StudentEdition, 3rd Edition, 1985.
2. Mathematical Analysis by Tom M. Apostal, Narosa Publishing House, 2nd Edition, 1985.

Reference Books:
1. Real Analysis by H.L. Royden and P.M. Fitzpatrick, 4th Edition ,2010, Pearson.
2. Real Analysis: Modern Techniques and Their Applications by Gerald B. Folland 2nd Edition, 1999, Wiley.

Weblinks:
1. https://archive.nptel.ac.in/courses/111/106/111106142/
2.https://archive.nptel.ac.in/courses/111/101/111101134/

Operations Research

Course Code: 246MA010

UNIT-I:
Introduction to Linear programming problem method -Simplex Method-big M-method and Dual Simplex methods

UNIT-II:

Transportation problems – Assignment models and The traveling salesman (Routing) Problem. **Job sequencing**: Introduction – Terminology and notations – Principal assumptions – Solution of sequencing problem – Processing n jobs through 2 machines – Processing n jobs through 3 machines – Processing 2 jobs through m machines – Processing n jobs through m machines.

UNIT-III:

Game Theory: Game Theory in job sequencing Minimax (Maximin) Criterion and optimal strategy – Saddle point, optimal strategies and the value of game – Solution of games with seddle point(s) – Illustrative examples – Rectangular games without saddle point – Minimax-Maximin principle for mixed strategy games – Equivalence of Rectangular game and Linear programming – Minimax Theorem (Fundamental theorem of game theory) – solution of m x n games by linear programming – Two by-two (2 x 2) games – Principle of dominance to reduce the size of the game – Graphical method for (2 x n) and (m x 2) games – Matrix method for m x n games;

UNIT-IV:

Inventory models and Queuing theory Deterministic Elementary inventory models: Concept of average inventory – Concept of economic ordering quantity(EOQ) – the EOQ model without shortage – The EOQ model with shortages – Multi-item deterministic models (The EOQ with constraints).

UNIT-V:

Queueing Theory: Solution of queueing models and limitations for the applications – Model (M |M |1) : FCFS) : Birth and Death model – Model ii (A) General Erlang queueing model (Birth-Death process) – Model III, (M |M |1) : (N | FCFS) – Model IV (A), (M |M |s) : (∞ |FCFS) – Non-Poisson queueing model.

Text Book:

1. Operations Research, S. D. Sharma, Kedar Nath Ram Nath & Co. Publishers.

Reference Book:

1. Operations Research: An Introduction, 10 th Edition, H.A.Taha, Pearson Publications

Weblinks:

1. https://archive.nptel.ac.in/courses/112/106/112106131/
2. https://archive.nptel.ac.in/courses/112/106/112106134/

Abstract Algebra

Course Code: 246MA011

UNIT-I:

Groups : Binary Operation, Algebraic structure, semi group-monoid , Group definition and elementary properties Finite and Infinite groups, examples , order of a group, Composition tables with examples.

UNIT-II:
Subgroup: Complex Definition, Multiplication of two complexes Inverse of a complex-Subgroup definition, examples-criterion for a complex to be a subgroup, Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups, Co-sets and Lagrange's Theorem: Cosets Definition, properties of Cosets, Index of a subgroups of a finite group–Lagrange's Theorem.

UNIT-III:
Normal Subgroups: Definition of normal subgroup, proper and improper normal subgroup, Hamilton group , criterion for a subgroup to be a normal subgroup, intersection of two normal subgroups, Sub group of index 2 is a normal sub group, quotient group, criteria for the existence of a quotient group.

UNIT-IV:
Homomorphism: Definition of homomorphism, Image of homomorphism elementary properties of homomorphism, Isomorphism, automorphism definitions and elementary properties, kernel of a homomorphism, fundamental theorem on Homomorphism**.**

UNIT-V:
Rings: Definition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws Rings, Integral Domains, Division Ring and Fields, The characteristic of a ring, The characteristic of an Integral Domain, The characteristic of a Field. Sub Rings.

Text Book:
1. Abstract Algebra by J.B. Fraleigh, published by Narosa publishing house.

Reference Books:
1. Basic Abstract Algebra by P.B.Bhattacharya, S.K.Jain, S.R.Nagpaul, published by Cambridge University Press
2. Rings and Linear Algebra by Pundir & Pundir, published by Pragathi Prakashan

Weblinks:
1. https://archive.nptel.ac.in/courses/111/106/111106113/
2. https://mathworld.wolfram.com/classroom/classes/AbstractAlgebra.html

Lattice Theory

Course Code: 246MA012

UNIT-I:
Two Definitions of Lattices, How to Describe Lattices, Some Algebraic Concepts, Polynomials, Identities and Inequalities.

UNIT-II:

Free Lattices, Special Elements, Characterization Theorems and Representation Theorems, Congruence Relations.

UNIT-III:
Boolean Algebras R – generated by Distributive Lattices, Topological Representation, Distributive Lattices with Pseudo Complementation.

UNIT-IV:
Weak protectivity and Congruences, Distributive, Standard and Neutral elements, Distributive, Standard and Neutral Ideals, Structure theorems.

UNIT-V:
Modular Lattices, Semi modular Lattices, Geometric Lattices, Partition Lattices, Complemented Modular Lattices.

Text Book:
1. General Lattice Theory by George Gratzer, Academic press, New York.

Reference Book:
2. Lattice theory by G. Birkhoff, American Mathematical Society, USA.

Weblinks:
1. https://nptel.ac.in/courses/128106009
2. https://en.wikipedia.org/wiki/Lattice_(order)

Boolean Algebra

Course Code: 246MA013

UNIT-I:
Boolean rings – Boolean algebras – Fields of sets.

UNIT-II:
Elementary relations- Order – Infinite operations – Subalgebras

UNIT-III:
Homo morphisms- Free Algebras- Ideals and filters – The Homo morphisms theorem.

UNIT-IV:
Boolean o-algebras- The countable chain condition – Measure algebras – Atoms.

UNIT-V:
Boolean spaces – The representation theorem -Duality for ideals – Duality for Homo morphisms.

Text Book:
1. Lectures on Boolean Algebras, by Paul R. Halmos, D. Van Nostrand Company, Inc. Princeton, New Jersey.

Reference Book:
1. Boolean Algebra and Its Applications, J. Eldon Whitesitt, Courier Corporation, 2010

Weblinks:
1. http://www.digimat.in/nptel/courses/video/111107058/L33.html
2. https://math.libretexts.org/Bookshelves/Combinatorics_and_Discrete_Mathematics/Applied_Discrete_Structures_(Doerr_and_Levasseur)/13%3A_Boolean_Algebra
3. https://euclid.colorado.edu/~monkd/monk47.pdf

Numerical Methods

Course Code: 246MA014

UNIT-I:
System of Linear Algebraic Equations:
Introduction, Solution of Centro-symmetric Equations, Direct Methods, LU- Decomposition Methods, Iterative Methods, III-conditioned Linear Systems. Jacobi's Method, Gauss-Seidel Method, SOR Method

UNIT-II:

Numerical Differentiation and Integration:

Introduction, Numerical Differentiation, Numerical Integration, Euler-Maclaurin Formula, Adaptive Quadrature Methods, Gaussian Integration, Singular Integrals, Fourier Integrals, Numerical Double Integration

UNIT-III:

Numerical Solution of Ordinary Differential Equations:

Introduction, Solution by Taylor's, Picard's Method, Euler's Method, Runge-Kutta Methods, Predictor-Corrector Methods, Simultaneous and Higher OrderEquations, Boundary Value Problems: Finite-Difference Method, The Shooting Method,

UNIT-IV:

Numerical Solution of Partial Differential Equations:

Introduction, Finite Difference Methods, Elliptic Equations-Laplace's Equation and Poisson equation, Parabolic Equations (one dimensional heat equation), Hyperbolic Equations (one dimensional wave equation).

UNIT-V:

The Finite Element Method:

Functionals- Base Function Methods of Approximation- The Rayleigh –Ritz Method –The Galerkin Method, Application to two dimensional problems- Finite element Method for one and two dimensional problems.

Text Books:

1.Niyogi, Pradip, Numerical Analysis and Algorithms, Tata McGraw –Hill Publications.
2.Balagurusamy,E., Numerical Methods, Tata McGraw –Hill Publications.

Reference Book:

1. Sastry, S.S., Introduction Methods of Numerical Analysis, PHI

Weblinks:

1. https://archive.nptel.ac.in/courses/112/105/112105308/
2. https://archive.nptel.ac.in/courses/111/107/111107063/