NPTEL Video Course - Mathematics - Elementary Numerical Analysis

Subject Co-ordinator - Prof. Rekha P. Kulkarni

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Polynomial Approximation
Lecture 3 - Interpolating Polynomials
Lecture 4 - Properties of Divided Difference
Lecture 5 - Error in the Interpolating polynomial
Lecture 6 - Cubic Hermite Interpolation
Lecture 7 - Piecewise Polynomial Approximation
Lecture 8 - Cubic Spline Interpolation
Lecture 9 - Tutorial 1
Lecture 10 - Numerical Integration
Lecture 11 - Composite Numerical Integration
Lecture 12 - Gauss 2-point Rule
Lecture 13 - Gauss 2-point Rule
Lecture 14 - Convergence of Gaussian Integration
Lecture 15 - Tutorial 2
Lecture 16 - Numerical Differentiation
Lecture 17 - Gauss Elimination
Lecture 18 - L U decomposition
Lecture 19 - Cholesky decomposition
Lecture 20 - Gauss Elimination with partial pivoting
Lecture 21 - Vector and Matrix Norms
Lecture 22 - Perturbed Linear Systems
Lecture 23 - Ill-conditioned Linear System
Lecture 24 - Tutorial 3
Lecture 25 - Effect of Small Pivots
Lecture 26 - Solution of Non-linear Equations
Lecture 27 - Quadratic Convergence of Newton's Method
Lecture 28 - Jacobi Method
Lecture 29 - Gauss-Seidel Method

Lecture 30 - Tutorial 4
Lecture 31 - Initial Value Problem
Lecture 32 - Multi-step Methods
Lecture 33 - Predictor-Corrector Formulae
Lecture 34 - Boundary Value Problems
Lecture 35 - Eigenvalues and Eigenvectors
Lecture 36 - Spectral Theorem
Lecture 37 - Power Method
Lecture 38 - Inverse Power Method
Lecture 39 - Q R Decomposition
Lecture 40 - Q R Method

NPTEL Video Course - Mathematics - Measure and Integration

Subject Co-ordinator - Prof. Inder K Rana

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction, Extended Real numbers
Lecture 2 - Algebra and Sigma Algebra of a subset of a set
Lecture 3 - Sigma Algebra generated by a class
Lecture 4 - Monotone Class
Lecture 5 - Set function
Lecture 6 - The Length function and its properties
Lecture 7 - Countably additive set functions on intervals
Lecture 8 - Uniqueness Problem for Measure
Lecture 9 - Extension of measure
Lecture 10 - Outer measure and its properties
Lecture 11 - Measurable sets
Lecture 12 - Lebesgue measure and its properties
Lecture 13 - Characterization of Lebesque measurable sets
Lecture 14 - Measurable functions
Lecture 15 - Properties of measurable functions
Lecture 16 - Measurable functions on measure spaces
Lecture 17 - Integral of non negative simple measurable functions
Lecture 18 - Properties of non negative simple measurable functions
Lecture 19 - Monotone convergence theorem & Fatou's Lemma
Lecture 20 - Properties of Integral functions & Dominated Convergence Theorem
Lecture 21 - Dominated Convergence Theorem and applications
Lecture 22 - Lebesgue Integral and its properties
Lecture 23 - Denseness of continuous function
Lecture 24 - Product measures, an Introduction
Lecture 25 - Construction of Product Measure
Lecture 26 - Computation of Product Measure - I
Lecture 27 - Computation of Product Measure - II
Lecture 28 - Integration on Product spaces
Lecture 29 - Fubini's Theorems

Lecture 30 - Lebesgue Measure and integral on R2
Lecture 31 - Properties of Lebesgue Measure and integral on Rn
Lecture 32 - Lebesgue integral on R2
Lecture 33 - Integrating complex-valued functions
Lecture 34 - Lp - spaces
Lecture 35 - L2(X,S,mue)
Lecture 36 - Fundamental Theorem of calculas for Lebesgue Integral - I
Lecture 37 - Fundamental Theorem of calculus for Lebesgue Integral - II
Lecture 38 - Absolutely continuous measures
Lecture 39 - Modes of convergence
Lecture 40 - Convergence in Measure

NPTEL Video Course - Mathematics - Mathematics in India - From Vedic Period to Modern Times

Subject Co-ordinator - Prof. M.D. Srinivas, Prof. K. Ramasubramanian, Prof. M.S. Sriram

Co-ordinating Institute - Centre for Policy Studies, Chennai | IIT - Bombay | University of Madras, Chennai

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Indian Mathematics
Lecture 2 - Vedas and Sulbasutras - Part 1
Lecture 3 - Vedas and Sulbasutras - Part 2
Lecture 4 - Panini's Astadhyayi
Lecture 5 - Pingala's Chandahsastra
Lecture 6 - Decimal place value system
Lecture 7 - Aryabhatiya of Aryabhata - Part 1
Lecture 8 - Aryabhatiya of Aryabhata - Part 2
Lecture 9 - Aryabhatiya of Aryabhata - Part 3
Lecture 10 - Aryabhatiya of Aryabhata - Part 4 and Introduction to Jaina Mathematics
Lecture 11 - Brahmasphutasiddhanta of Brahmagupta - Part 1
Lecture 12 - Brahmasphutasiddhanta of Brahmagupta - Part 2
Lecture 13 - Brahmasphutasiddhanta of Brahmagupta - Part 3
Lecture 14 - Brahmasphutasiddhanta of Brahmagupta - Part 4 and The Bakhshali Manuscript
Lecture 15 - Mahaviras Ganitasarasangraha - Part 1
Lecture 16 - Mahaviras Ganitasarasangraha - Part 2
Lecture 17 - Mahaviras Ganitasarasangraha - Part 3
Lecture 18 - Development of Combinatorics - Part 1
Lecture 19 - Development of Combinatorics - Part 2
Lecture 20 - Lilavati of Bhaskaracarya - Part 1
Lecture 21 - Lilavati of Bhaskaracarya - Part 2
Lecture 22 - Lilavati of Bhaskaracarya - Part 3
Lecture 23 - Bijaganita of Bhaskaracarya - Part 1
Lecture 24 - Bijaganita of Bhaskaracarya - Part 2
Lecture 25 - Ganitakaumudi of Narayana Pandita - Part 1
Lecture 26 - Ganitakaumudi of Narayana Pandita - Part 2
Lecture 27 - Ganitakaumudi of Narayana Pandita - Part 3
Lecture 28 - Magic Squares - Part 1
Lecture 29 - Magic Squares - Part 2

Lecture 30 - Development of Calculus in India - Part 1
Lecture 31 - Development of Calculus in India - Part 2
Lecture 32 - Jyanayanam
Lecture 33 - Trigonometry and Spherical Trigonometry - Part 1
Lecture 34 - Trigonometry and Spherical Trigonometry - Part 2
Lecture 35 - Trigonometry and Spherical Trigonometry - Part 3
Lecture 36 - Proofs in Indian Mathematics - Part 1
Lecture 37 - Proofs in Indian Mathematics - Part 2
Lecture 38 - Proofs in Indian Mathematics - Part 3
Lecture 39 - Mathematics in Modern India - Part 1
Lecture 40 - Mathematics in Modern India - Part 2

NPTEL Video Course - Mathematics - NOC:Measure Theory

Subject Co-ordinator - Prof. Inder K Rana

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - (1A) Introduction, Extended Real Numbers
Lecture 2 - (1B) Introduction, Extended Real Numbers
Lecture 3 - (2A) Algebra and Sigma Algebra of Subsets of a Set
Lecture 4 - (2B) Algebra and Sigma Algebra of Subsets of a Set
Lecture 5 - (3A) Sigma Algebra generated by a Class
Lecture 6 - (3B) Sigma Algebra generated by a Class
Lecture 7 - (4A) Monotone Class
Lecture 8 - (4B) Monotone Class
Lecture 9 - (5A) Set Functions
Lecture 10 - (5B) Set Functions
Lecture 11 - (6A) The Length Function and its Properties
Lecture 12 - (6B) The Length Function and its Properties
Lecture 13 - (7A) Countably Additive Set Functions on Intervals
Lecture 14 - (7B) Countably Additive Set Functions on Intervals
Lecture 15 - (8A) Uniqueness Problem for Measure
Lecture 16 - (8B) Uniqueness Problem for Measure
Lecture 17 - (9A) Extension of Measure
Lecture 18 - (9B) Extension of Measure
Lecture 19 - (10A) Outer Measure and its Properties
Lecture 20 - (10B) Outer Measure and its Properties
Lecture 21 - (11A) Measurable Sets
Lecture 22 - (11B) Measurable Sets
Lecture 23 - (12A) Lebesgue Measure and its Properties
Lecture 24 - (12B) Lebesgue Measure and its Properties
Lecture 25 - (13A) Characterization of Lebesgue Measurable Sets
Lecture 26 - (13B) Characterization of Lebesgue Measurable Sets
Lecture 27 - (14A) Measurable Functions
Lecture 28 - (14B) Measurable Functions
Lecture 29 - (15A) Properties of Measurable Functions

Lecture 30 - (15B) Properties of Measurable Functions
Lecture 31 - (16A) Measurable Functions on Measure Spaces
Lecture 32 - (16B) Measurable Functions on Measure Spaces
Lecture 33 - (17A) Integral of Nonnegative Simple Measurable Functions
Lecture 34 - (17B) Integral of Nonnegative Simple Measurable Functions
Lecture 35 - (18A) Properties of Nonnegative Simple Measurable Functions
Lecture 36 - (18B) Properties of Nonnegative Simple Measurable Functions
Lecture 37 - (19A) Monotone Convergence Theorem and Fatou's Lemma
Lecture 38 - (19B) Monotone Convergence Theorem and Fatou's Lemma
Lecture 39 - (20A) Properties of Integrable Functions and Dominated Convergence Theorem
Lecture 40 - (20B) Properties of Integrable Functions and Dominated Convergence Theorem
Lecture 41 - (21A) Dominated Convergence Theorem and Applications
Lecture 42 - (21B) Dominated Convergence Theorem and Applications
Lecture 43 - (22A) Lebesgue Integral and its Properties
Lecture 44 - (22B) Lebesgue Integral and its Properties
Lecture 45 - (23A) Product Measure, an Introduction
Lecture 46 - (23B) Product Measure, an Introduction
Lecture 47 - (24A) Construction of Product Measures
Lecture 48 - (24B) Construction of Product Measures
Lecture 49 - (25A) Computation of Product Measure - I
Lecture 50 - (25B) Computation of Product Measure - I
Lecture 51 - (26A) Computation of Product Measure - II
Lecture 52 - (26B) Computation of Product Measure - II
Lecture 53 - (27A) Integration on Product Spaces
Lecture 54 - (27B) Integration on Product Spaces
Lecture 55 - (28A) Fubini's Theorems
Lecture 56 - (28B) Fubini's Theorems
Lecture 57 - (29A) Lebesgue Measure and Integral on R2
Lecture 58 - (29B) Lebesgue Measure and Integral on R2
Lecture 59 - (30A) Properties of Lebesgue Measure on R2
Lecture 60 - (30B) Properties of Lebesgue Measure on R2
Lecture 61 - (31A) Lebesgue Integral on R2
Lecture 62 - (31B) Lebesgue Integral on R2

NPTEL Video Course - Mathematics - NOC:Calculus for Economics, Commerce and Management

Subject Co-ordinator - Prof.Inder Kumar Rana

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to the Course
Lecture 2 - Concept of a Set, Ways of Representing Sets
Lecture 3 - Venn Diagrams, Operations on Sets
Lecture 4 - Operations on Sets, Cardinal Number, Real Numbers
Lecture 5 - Real Numbers, Sequences
Lecture 6 - Sequences, Convergent Sequences, Bounded Sequences
Lecture 7 - Limit Theorems, Sandwich Theorem, Monotone Sequences, Completeness of Real Numbers
Lecture 8 - Relations and Functions
Lecture 9 - Functions, Graph of a Functions, Function Formulas
Lecture 10 - Function Formulas, Linear Models
Lecture 11 - Linear Models, Elasticity, Linear Functions, Nonlinear Models, Quadratic Functions
Lecture 12 - Quadratic Functions, Quadratic Models, Power Function, Exponential Function
Lecture 13 - Exponential Function, Exponential Models, Logarithmic Function
Lecture 14 - Limit of a Function at a Point, Continuous Functions
Lecture 15 - Limit of a Function at a Point
Lecture 16 - Limit of a Function at a Point, Left and Right Limits
Lecture 17 - Computing Limits, Continuous Functions
Lecture 18 - Applications of Continuous Functions
Lecture 19 - Applications of Continuous Functions, Marginal of a Function
Lecture 20 - Rate of Change, Differentiation
Lecture 21 - Rules of Differentiation
Lecture 22 - Derivatives of Some Functions, Marginal, Elasticity
Lecture 23 - Elasticity, Increasing and Decreasing Functions, Optimization, Mean Value Theorem
Lecture 24 - Mean Value Theorem, Marginal Analysis, Local Maxima and Minima
Lecture 25 - Local Maxima and Minima
Lecture 26 - Local Maxima and Minima, Continuity Test, First Derivative Test, Successive Differentiation
Lecture 27 - Successive Differentiation, Second Derivative Test
Lecture 28 - Average and Marginal Product, Marginal of Revenue and Cost, Absolute Maximum and Minimum
Lecture 29 - Absolute Maximum and Minimum

Lecture 30 - Monopoly Market, Revenue and Elasticity
Lecture 31 - Property of Marginals, Monopoly Market, Publisher v/s Author Problem
Lecture 32 - Convex and Concave Functions
Lecture 33 - Derivative Tests for Convexity, Concavity and Points of Inflection, Higher Order Derivative Conc
Lecture 34 - Convex and Concave Functions, Asymptotes
Lecture 35 - Asymptotes, Curve Sketching
Lecture 36 - Functions of Two Variables, Visualizing Graph, Level Curves, Contour Lines
Lecture 37 - Partial Derivatives and Application to Marginal Analysis
Lecture 38 - Marginals in Cobb-Douglas model, partial derivatives and elasticity, chain rules
Lecture 39 - Chain Rules, Higher Order Partial Derivatives, Local Maxima and Minima, Critical Points
Lecture 40 - Saddle Points, Derivative Tests, Absolute Maxima and Minima
Lecture 41 - Some Examples, Constrained Maxima and Minima

NPTEL Video Course - Mathematics - NOC:Basic Linear Algebra

Subject Co-ordinator - Prof.Inder Kumar Rana

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction - I
Lecture 2 - Introduction - II
Lecture 3 - Introduction - III
Lecture 4 - Systems of Linear Equations - I
Lecture 5 - Systems of Linear Equations - II
Lecture 6 - Systems of Linear Equations - III
Lecture 7 - Reduced Row Echelon Form and Rank - I
Lecture 8 - Reduced Row Echelon Form and Rank - II
Lecture 9 - Reduced Row Echelon Form and Rank - III
Lecture 10 - Solvability of a Linear System, Linear Span, Basis - I
Lecture 11 - Solvability of a Linear System, Linear Span, Basis - II
Lecture 12 - Solvability of a Linear System, Linear Span, Basis - III
Lecture 13 - Linear Span, Linear Independence and Basis - I
Lecture 14 - Linear Span, Linear Independence and Basis - II
Lecture 15 - Linear Span, Linear Independence and Basis - III
Lecture 16 - Row Space, Column Space, Rank-Nullity Theorem - I
Lecture 17 - Row Space, Column Space, Rank-Nullity Theorem - II
Lecture 18 - Row Space, Column Space, Rank-Nullity Theorem - III
Lecture 19 - Determinants and their Properties - I
Lecture 20 - Determinants and their Properties - II
Lecture 21 - Determinants and their Properties - III
Lecture 22 - Linear Transformations - I
Lecture 23 - Linear Transformations - II
Lecture 24 - Linear Transformations - III
Lecture 25 - Orthonormal Basis, Geometry in R^2 - I
Lecture 26 - Orthonormal Basis, Geometry in R^2 - II
Lecture 27 - Orthonormal Basis, Geometry in R^2 - III
Lecture 28 - Isometries, Eigenvalues and Eigenvectors - I
Lecture 29 - Isometries, Eigenvalues and Eigenvectors - II

Lecture 30 - Isometries, Eigenvalues and Eigenvectors - III
Lecture 31 - Diagonalization and Real Symmetric Matrices - I
Lecture 32 - Diagonalization and Real Symmetric Matrices - II
Lecture 33 - Diagonalization and Real Symmetric Matrices - III
Lecture 34 - Diagonalization and its Applications - I
Lecture 35 - Diagonalization and its Applications - II
Lecture 36 - Diagonalization and its Applications - III
Lecture 37 - Abstract Vector Spaces - I
Lecture 38 - Abstract Vector Spaces - II
Lecture 39 - Abstract Vector Spaces - III
Lecture 40 - Inner Product Spaces - I
Lecture 41 - Inner Product Spaces - II

NPTEL Video Course - Mathematics - NOC:Commutative Algebra

Subject Co-ordinator - Prof. Dilip P. Patil

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Zariski Topology and K-Spectrum
Lecture 2 - Algebraic Varieties and Classical Nullstelensatz
Lecture 3 - Motivation for Krulls Dimension
Lecture 4 - Chevalleys dimension
Lecture 5 - Associated Prime Ideals of a Module
Lecture 6 - Support of a Module
Lecture 7 - Primary Decomposition
Lecture 8 - Primary Decomposition (Continued...)
Lecture 9 - Uniqueness of Primary Decomposition
Lecture 10 - Modules of Finite Length
Lecture 11 - Modules of Finite Length (Continued...)
Lecture 12 - Introduction to KrullÃ¢â ¬â ¢s Dimension
Lecture 13 - Noether Normalization Lemma (Classical Version)
Lecture 14 - Consequences of Noether Normalization Lemma
Lecture 15 - Nil Radical and Jacobson Radical of Finite type Algebras over a Field and digression of Integral
Lecture 16 - NagataÃ¢â ¬â ¢s version of NNL
Lecture 17 - Dimensions of Polynomial ring over Noetherian rings
Lecture 18 - Dimension of Polynomial Algebra over arbitrary Rings
Lecture 19 - Dimension Inequalities
Lecture 20 - HilbertÃ¢â ¬â ¢s Nullstelensatz
Lecture 21 - Computational rules for PoincarÃ Â© Series
Lecture 22 - Graded Rings, Modules and PoincarÃ Â© Series
Lecture 23 - Hilbert-Samuel Polynomials
Lecture 24 - Hilbert-Samuel Polynomials (Continued...)
Lecture 25 - Numerical Function of polynomial type
Lecture 26 - Hilbert-Samuel Polynomial of a Local ring
Lecture 27 - Filtration on a Module
Lecture 28 - Artin-Rees Lemma
Lecture 29 - Dimension Theorem

Lecture 30 - Dimension Theorem (Continued...)
Lecture 31 - Consequences of Dimension Theorem
Lecture 32 - Generalized KrullÃ¢â ¬â ¢s Principal Ideal Theorem
Lecture 33 - Second proof of KrullÃ¢â ¬â ¢s Principal Ideal Theorem
Lecture 34 - The Spec Functor
Lecture 35 - Prime ideals in Polynomial rings
Lecture 36 - Characterization of Equidimensional Affine Algebra
Lecture 37 - Connection between Regular local rings and associated graded rings
Lecture 38 - Statement of the Jacobian Criterion for Regularity
Lecture 39 - Hilbert function for Affine Algebra
Lecture 40 - Hilbert Serre Theorem
Lecture 41 - Jacobian Matrix and its Rank
Lecture 42 - Jacobian Matrix and its Rank (Continued...)
Lecture 43 - Proof of Jacobian Critrerion
Lecture 44 - Proof of Jacobian Critrerion (Continued...)
Lecture 45 - Preparation for Homological Dimension
Lecture 46 - Complexes of Modules and Homology
Lecture 47 - Projective Modules
Lecture 48 - Homological Dimension and Projective module
Lecture 49 - Global Dimension
Lecture 50 - Homological characterization of Regular Local Rings (RLR)
Lecture 51 - Homological characterization of Regular Local Rings (Continued...)
Lecture 52 - Homological Characterization of Regular Local Rings (Continued...)
Lecture 53 - Regular Local Rings are UFD
Lecture 54 - RLR-Prime ideals of height 1
Lecture 55 - Discrete Valuation Ring
Lecture 56 - Discrete Valuation Ring (Continued...)
Lecture 57 - Dedekind Domains
Lecture 58 - Fractionary Ideals and Dedekind Domains
Lecture 59 - Characterization of Dedekind Domain
Lecture 60 - Dedekind Domains and prime factorization of ideals

NPTEL Video Course - Mathematics - NOC:Galois Theory

Subject Co-ordinator - Prof. Dilip P. Patil

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Historical Perspectives
Lecture 2 - Examples of Fields
Lecture 3 - Polynomials and Basic properties
Lecture 4 - Polynomial Rings
Lecture 5 - Unit and Unit Groups
Lecture 6 - Division with remainder and prime factorization
Lecture 7 - Zeroes of Polynomials
Lecture 8 - Polynomial functions
Lecture 9 - Algebraically closed Fields and statement of FTA
Lecture 10 - GaussÃ¢â ¬â ¢s Theorem(Uniqueness of factorization)
Lecture 11 - Digression on Rings homomorphism, Algebras
Lecture 12 - Kernel of homomorphisms and ideals in K[X],Z
Lecture 13 - Algebraic elements
Lecture 14 - Examples
Lecture 15 - Minimal Polynomials
Lecture 16 - Characterization of Algebraic elements
Lecture 17 - Theorem of Kronecker
Lecture 18 - Examples
Lecture 19 - Digression on Groups
Lecture 20 - Some examples and Characteristic of a Ring
Lecture 21 - Finite subGroups of the Unit Group of a Field
Lecture 22 - Construction of Finite Fields
Lecture 23 - Digression on Group action - I
Lecture 24 - Automorphism Groups of a Field Extension
Lecture 25 - Dedekind-Artin Theorem
Lecture 26 - Galois Extension
Lecture 27 - Examples of Galois extension
Lecture 28 - Examples of Automorphism Groups
Lecture 29 - Digression on Linear Algebra

Lecture 30 - Minimal and Characteristic Polynomials, Norms, Trace of elements
Lecture 31 - Primitive Element Theorem for Galois Extension
Lecture 32 - Fundamental Theorem of Galois Theory
Lecture 33 - Fundamental Theorem of Galois Theory (Continued...)
Lecture 34 - Cyclotomic extensions
Lecture 35 - Cyclotomic Polynomials
Lecture 36 - Irreducibility of Cyclotomic Polynomials over Q
Lecture 37 - Reducibility of Cyclotomic Polynomials over Finite Fields
Lecture 38 - Galois Group of Cyclotomic Polynomials
Lecture 39 - Extension over a fixed Field of a finite subGroup is Galois Extension
Lecture 40 - Digression on Group action - II
Lecture 41 - Correspondence of Normal SubGroups and Galois sub-extensions
Lecture 42 - Correspondence of Normal SubGroups and Galois sub-extensions (Continued...)
Lecture 43 - Inverse Galois problem for Abelian Groups
Lecture 44 - Elementary Symmetric Polynomials
Lecture 45 - Fundamental Theorem on Symmetric Polynomials
Lecture 46 - Gal (K[X1,X2,Ã¢â ¬Â¦,Xn]/K[S1,S2,...,Sn])
Lecture 47 - Digression on Symmetric and Alternating Group
Lecture 48 - Discriminant of a Polynomial
Lecture 49 - Zeroes and Embeddings
Lecture 50 - Normal Extensions
Lecture 51 - Existence of Algebraic Closure
Lecture 52 - Uniqueness of Algebraic Closure
Lecture 53 - Proof of The Fundamental Theorem of Algebra
Lecture 54 - Galois Group of a Polynomial
Lecture 55 - Perfect Fields
Lecture 56 - Embeddings
Lecture 57 - Characterization of finite Separable extension
Lecture 58 - Primitive Element Theorem
Lecture 59 - Equivalence of Galois extensions and Normal-Separable extensions
Lecture 60 - Operation of Galois Group of Polynomial on the set of zeroes
Lecture 61 - Discriminants
Lecture 62 - Examples for further study

NPTEL Video Course - Mathematics - NOC:Basic Real Analysis

Subject Co-ordinator - Prof. I. K. Rana

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Real Numbers and Sequences - Part I
Lecture 2 - Real Numbers and Sequences - Part II
Lecture 3 - Real Numbers and Sequences - Part III
Lecture 4 - Convergence of Sequences - Part I
Lecture 5 - Convergence of Sequences - Part II
Lecture 6 - Convergence of Sequences - Part III
Lecture 7 - The LUB Property and Consequences - Part I
Lecture 8 - The LUB Property and Consequences - Part II
Lecture 9 - The LUB Property and Consequences - Part III
Lecture 10 - Topology of Real Numbers
Lecture 11 - Topology of Real Numbers
Lecture 12 - Topology of Real Numbers
Lecture 13 - Topology of Real Numbers
Lecture 14 - Topology of Real Numbers
Lecture 15 - Topology of Real Numbers
Lecture 16 - Topology of Real Numbers
Lecture 17 - Topology of Real Numbers
Lecture 18 - Topology of Real Numbers
Lecture 19 - Topology of Real Numbers
Lecture 20 - Topology of Real Numbers
Lecture 21 - Topology of Real Numbers
Lecture 22 - Continuity and Uniform continuity - Part I
Lecture 23 - Continuity and Uniform continuity - Part II
Lecture 24 - Continuity and Uniform continuity - Part III
Lecture 25 - Uniform continuity and connected sets - Part I
Lecture 26 - Uniform continuity and connected sets - Part II
Lecture 27 - Uniform continuity and connected sets - Part III
Lecture 28 - Connected sets and continuity - Part I
Lecture 29 - Connected sets and continuity - Part II

Lecture 30 - Connected sets and continuity - Part III
Lecture 31 - Differentiability - Part I
Lecture 32 - Differentiability - Part II
Lecture 33 - Differentiability - Part III
Lecture 34 - Differentiability - Part IV
Lecture 35 - Differentiability - Part V
Lecture 36 - Differentiability - Part VI
Lecture 37 - Riemann Integration - Part I
Lecture 38 - Riemann Integration - Part II
Lecture 39 - Riemann Integration - Part III
Lecture 40 - Riemann Integration - Part IV
Lecture 41 - Riemann Integration - Part V
Lecture 42 - Riemann Integration - Part VI
Lecture 43 - Riemann Sum and Riemann Integrals - Part I
Lecture 44 - Riemann Sum and Riemann Integrals - Part II
Lecture 45 - Riemann Sum and Riemann Integrals - Part III
Lecture 46 - Optimization in several variables - Part I
Lecture 47 - Optimization in several variables - Part II
Lecture 48 - Optimization in several variables - Part III
Lecture 49 - Integration in several variables - Part I
Lecture 50 - Integration in several variables - Part II
Lecture 51 - Integration in several variables - Part III
Lecture 52 - Change of variables - Part I
Lecture 53 - Change of variables - Part II
Lecture 54 - Change of variables - Part III
Lecture 55 - Change of variables - Part IV
Lecture 56 - Metric Spaces - Part I
Lecture 57 - Metric Spaces - Part II
Lecture 58 - Metric Spaces - Part III
Lecture 59 - L^p Metrics - Part I
Lecture 60 - L^p Metrics - Part II
Lecture 61 - L^p Metrics - Part III
Lecture 62 - Pointwise and Uniform convergence - Part I
Lecture 63 - Pointwise and Uniform convergence - Part II
Lecture 64 - Pointwise and Uniform convergence - Part III
Lecture 65 - Pointwise and Uniform convergence - Part IV
Lecture 66 - Series of Numbers - Part I
Lecture 67 - Series of Numbers - Part II
Lecture 68 - Series of Numbers - Part III

Lecture 69 - Alternating Series and Power Series

NPTEL Video Course - Mathematics - NOC:A Basic Course in Number Theory

Subject Co-ordinator - Prof. Shripad Garge

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Integers
Lecture 2 - Divisibility and primes
Lecture 3 - Infinitude of primes
Lecture 4 - Division algorithm and the GCD
Lecture 5 - Computing the GCD and Euclidâ s lemma
Lecture 6 - Fundamental theorem of arithmetic
Lecture 7 - Stories around primes
Lecture 8 - Winding up on `Primes' and introducing Congruences'
Lecture 9 - Basic results in congruences
Lecture 10 - Residue classes modulo n
Lecture 11 - Arithmetic modulo n, theory and examples
Lecture 12 - Arithmetic modulo n, more examples
Lecture 13 - Solving linear polynomials modulo n - I
Lecture 14 - Solving linear polynomials modulo n - II
Lecture 15 - Solving linear polynomials modulo n - III
Lecture 16 - Solving linear polynomials modulo n - IV
Lecture 17 - Chinese remainder theorem, the initial cases
Lecture 18 - Chinese remainder theorem, the general case and examples
Lecture 19 - Chinese remainder theorem, more examples
Lecture 20 - Using the CRT, square roots of 1 in â ¤n
Lecture 21 - Wilson's theorem
Lecture 22 - Roots of polynomials over â ¤p
Lecture 23 - Euler ð• -function - I
Lecture 24 - Euler ð• -function - II
Lecture 25 - Primitive roots - I
Lecture 26 - Primitive roots - II
Lecture 27 - Primitive roots - III
Lecture 28 - Primitive roots - IV
Lecture 29 - Structure of Un - I

Lecture 30 - Structure of Un - II
Lecture 31 - Quadratic residues
Lecture 32 - The Legendre symbol
Lecture 33 - Quadratic reciprocity law - I
Lecture 34 - Quadratic reciprocity law - II
Lecture 35 - Quadratic reciprocity law - III
Lecture 36 - Quadratic reciprocity law - IV
Lecture 37 - The Jacobi symbol
Lecture 38 - Binary quadratic forms
Lecture 39 - Equivalence of binary quadratic forms
Lecture 40 - Discriminant of a binary quadratic form
Lecture 41 - Reduction theory of integral binary quadratic forms
Lecture 42 - Reduced forms up to equivalence - I
Lecture 43 - Reduced forms up to equivalence - II
Lecture 44 - Reduced forms up to equivalence - III
Lecture 45 - Sums of squares - I
Lecture 46 - Sums of squares - II
Lecture 47 - Sums of squares - III
Lecture 48 - Beyond sums of squares - I
Lecture 49 - Beyond sums of squares - II
Lecture 50 - Continued fractions - basic results
Lecture 51 - Dirichlet's approximation theorem
Lecture 52 - Good rational approximations
Lecture 53 - Continued fraction expansion for real numbers - I
Lecture 54 - Continued fraction expansion for real numbers - II
Lecture 55 - Convergents give better approximations
Lecture 56 - Convergents are the best approximations - I
Lecture 57 - Convergents are the best approximations - II
Lecture 58 - Quadratic irrationals as continued fractions
Lecture 59 - Some basics of algebraic number theory
Lecture 60 - Units in quadratic fields
Lecture 61 - Units in quadratic fields
Lecture 62 - Brahmagupta-Pell equations
Lecture 63 - Tying some loose ends

NPTEL Video Course - Mathematics - NOC:Introduction to Algebraic Topology - Part I

Subject Co-ordinator - Prof. Anant R. Shastri

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Basic Problem in Topology
Lecture 2 - Concept of homotopy
Lecture 3 - Bird's eye-view of the course
Lecture 4 - Path Homotopy
Lecture 5 - Composition of paths
Lecture 6 - Fundamental group Ï 1
Lecture 7 - Computation of Fund. Group of a circle
Lecture 8 - Computation (Continued...)
Lecture 9 - Computation concluded
Lecture 10 - Van-Kampen's Theorem
Lecture 11 - Function Spaces
Lecture 12 - Quotient Maps
Lecture 13 - Group Actions
Lecture 14 - Examples of Group Actions
Lecture 15 - Assorted Results on Quotient Spaces
Lecture 16 - Quotient Constructions Typical to Alg. Top
Lecture 17 - Quotient Constructions (Continued...)
Lecture 18 - Relative Homotopy
Lecture 19 - Construction of a typical SDR
Lecture 20 - Generalized construction of SDRs
Lecture 21 - A theoretical application
Lecture 22 - The Harvest
Lecture 23 - NDR pairs
Lecture 24 - General Remarks
Lecture 25 - Basics A ne Geometry
Lecture 26 - Abstract Simplicial Complex
Lecture 27 - Geometric Realization
Lecture 28 - Topology on |K|
Lecture 29 - Simplical maps

Lecture 30 - Polyhedrons
Lecture 31 - Point Set topological Aspects
Lecture 32 - Barycentric Subdivision
Lecture 33 - Finer Subdivisions
Lecture 34 - Simplical Approximation
Lecture 35 - Sperner Lemma
Lecture 36 - Invariance of domain
Lecture 37 - Proof of controled homotopy
Lecture 38 - Links and Stars
Lecture 39 - Homotopical Aspects of Simplicial Complexes
Lecture 40 - Homotopical Aspects
Lecture 41 - Covering Spaces and Fund. Groups
Lecture 42 - Lifting Properties
Lecture 43 - Homotopy Lifting
Lecture 44 - Relation with the fund. Group
Lecture 45 - Regular covering
Lecture 46 - Lifting Problem
Lecture 47 - Classification of Coverings
Lecture 48 - Classification
Lecture 49 - Existence of Simply connected coverings
Lecture 50 - Construction of Simply connected covering
Lecture 51 - Properties Shared by total space and base
Lecture 52 - Examples
Lecture 53 - G-coverings
Lecture 54 - Pull-backs
Lecture 55 - Classification of G-coverings
Lecture 56 - Proof of classification
Lecture 57 - Pushouts and Free products
Lecture 58 - Existence of Free Products, pushouts
Lecture 59 - Free Products and free groups
Lecture 60 - Seifert-Van Kampen Theorems
Lecture 61 - Applications
Lecture 62 - Applications (Continued...)

NPTEL Video Course - Mathematics - NOC:Introduction to Algebraic Topology - Part II

Subject Co-ordinator - Prof. Anant R. Shastri

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Attaching cells
Lecture 3 - Subcomplexes and Examples
Lecture 4 - More examples
Lecture 5 - More Examples
Lecture 6 - Topological Properties
Lecture 7 - Coinduced Topology
Lecture 8 - Compactly generated topology on Products
Lecture 9 - Product of Cell complexes
Lecture 10 - Product of Cell complexes (Continued...)
Lecture 11 - Partition of Unity on CW-complexes
Lecture 12 - Partition of Unity (Continued...)
Lecture 13 - Homotopical Aspects
Lecture 14 - Homotopical Aspects (Continued...)
Lecture 15 - Cellular Maps
Lecture 16 - Cellular Maps (Continued...)
Lecture 17 - Homotopy exact sequence of a pair
Lecture 18 - Homotopy exact sequence of a fibration
Lecture 19 - Categories-Definitions and Examples
Lecture 20 - More Examples
Lecture 21 - Functors
Lecture 22 - Equivalence of Functors (Continued...)
Lecture 23 - Universal Objects
Lecture 24 - Basic Homological Algebra
Lecture 25 - Diagram-Chasing
Lecture 26 - Homology of Chain Complexes
Lecture 27 - Euler Characteristics
Lecture 28 - Singular Homology Groups
Lecture 29 - Basic Properties of Singular Homology

Lecture 30 - Excision
Lecture 31 - Examples of Excision-Mayer Vietoris
Lecture 32 - Applications
Lecture 33 - Applications (Continued...)
Lecture 34 - The Singular Simplicial Homology
Lecture 35 - Simplicial Homology
Lecture 36 - Simplicial Homology (Continued...)
Lecture 37 - CW-Homology and Cellular Singular Homology
Lecture 38 - Construction of CW-chain complex
Lecture 39 - CW structure and CW homology of Lens Spaces
Lecture 40 - Assorted Topics
Lecture 41 - Some Applications of Homology
Lecture 42 - Applications of LFT
Lecture 43 - Jordan-Brouwer
Lecture 44 - Proof of Lemmas
Lecture 45 - Relation between ?1 and H1
Lecture 46 - All Postponed Proofs
Lecture 47 - Proofs (Continued...)
Lecture 48 - Definitions and Examples
Lecture 49 - Paracompactness
Lecture 50 - Manifolds with Boundary
Lecture 51 - Embeddings and Homotopical Aspects
Lecture 52 - Homotopical Aspects (Continued...)
Lecture 53 - Classification of 1-manifolds
Lecture 54 - Classification of 1-manifolds (Continued...)
Lecture 55 - Triangulation of Manifolds
Lecture 56 - Pseudo-Manifolds
Lecture 57 - One result due to PoincaÅ e and another due to Munkres
Lecture 58 - Some General Remarks
Lecture 59 - Classification of Compact Surface
Lecture 60 - Final Reduction-Completion of the Proof
Lecture 61 - Proof of Part B
Lecture 62 - Orientability

NPTEL Video Course - Mathematics - NOC:Partial Differential Equations

Subject Co-ordinator - Prof. Sivaji Ganesh

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Partial Differential Equations - Basic concepts and Nomenclature
Lecture 2 - First Order Partial Differential Equations- How they arise? Cauchy Problems, IVPs, IBVPs
Lecture 3 - First order Partial Differential Equations - Geometry of Quasilinear equations
Lecture 4 - FOPDE's - General Solutions to Linear and Semilinear equations
Lecture 5 - First order Partial Differential Equations- Lagrange's method for Quasilinear equations
Lecture 6 - Relation between Characteristic curves and Integral surfaces for Quasilinear equations
Lecture 7 - Relation between Characteristic curves and Integral surfaces for Quasilinear equations
Lecture 8 - FOPDE's - Method of characteristics for Quasilinear equations - 1
Lecture 9 - First order Partial Differential Equations - Failure of transversality condition
Lecture 10 - First order Partial Differential Equations - Tutorial of Quasilinear equations
Lecture 11 - FOPDE's - General nonlinear equations 1 - Search for a characteristic direction
Lecture 12 - FOPDE's - General nonlinear equations 2 - Characteristic direction and characteristic strip
Lecture 13 - FOPDE's - General nonlinear equations 3 - Finding an initial strip
Lecture 14 - FOPDE's - General nonlinear equations 4 - Local existence and uniqueness theorem
Lecture 15 - First order Partial Differential Equations - Tutorial on General nonlinear equations
Lecture 16 - First order Partial Differential Equations - Initial value problems for Burgers equation
Lecture 17 - FOPDE's - Conservation laws with a view towards global solutions to Burgers equation
Lecture 18 - Second Order Partial Differential Equations - Special Curves associated to a PDE
Lecture 19 - Second Order Partial Differential Equations - Curves of discontinuity
Lecture 20 - Second Order Partial Differential Equations - Classification
Lecture 21 - SOPDE's - Canonical form for an equation of Hyperbolic type
Lecture 22 - SOPDE's - Canonical form for an equation of Parabolic type
Lecture 23 - SOPDE's - Canonical form for an equation of Elliptic type
Lecture 24 - Second Order Partial Differential Equations - Characteristic Surfaces
Lecture 25 - SOPDE's - Canonical forms for constant coefficient PDEs
Lecture 26 - Wave Equation - A mathematical model for vibrating strings
Lecture 27 - Wave Equation in one space dimension - d'Alembert formula
Lecture 28 - Tutorial on One dimensional wave equation
Lecture 29 - Wave Equation in d space dimensions - Equivalent Cauchy problems via Spherical means

Lecture 30 - Cauchy problem for Wave Equation in 3 space dimensions - Poisson-Kirchhoff formulae
Lecture 31 - Cauchy problem for Wave Equation in 2 space dimensions - Hadamard's method of descent
Lecture 32 - Nonhomogeneous Wave Equation - Duhamel principle
Lecture 33 - Wellposedness of Cauchy problem for Wave Equation
Lecture 34 - Wave Equation on an interval in? - Solution to an IBVP from first principles
Lecture 35 - Tutorial on IBVPs for wave equation
Lecture 36 - IBVP for Wave Equation - Separation of Variables Method
Lecture 37 - Tutorial on Separation of variables method for wave equation
Lecture 38 - Qualitative analysis of Wave equation - Parallelogram identity
Lecture 39 - Qualitative analysis of Wave equation - Domain of dependence, domain of influence
Lecture 40 - Qualitative analysis of Wave equation - Causality Principle, Finite speed of propagation
Lecture 41 - Qualitative analysis of Wave equation - Uniqueness by Energy method
Lecture 42 - Qualitative analysis of Wave equation - Huygens Principle
Lecture 43 - Qualitative analysis of Wave equation - Generalized solutions to Wave equation
Lecture 44 - Qualitative analysis of Wave equation - Propagation of waves
Lecture 45 - Laplace equation - Associated Boundary value problems
Lecture 46 - Laplace equation - Fundamental solution
Lecture 47 - Dirichlet BVP for Laplace equation - Green's function and Poisson's formula
Lecture 48 - Laplace equation - Weak maximum principle and its applications
Lecture 49 - Laplace equation - Dirichlet BVP on a disk in R2 for Laplace equations
Lecture 50 - Tutorial 1 on Laplace equation
Lecture 51 - Laplace equation - Mean value property
Lecture 52 - Laplace equation - More qualitative properties
Lecture 53 - Laplace equation - Strong Maximum Principle and Dirichlet Principle
Lecture 54 - Tutorial 2 on Laplace equation
Lecture 55 - Cauchy Problem for Heat Equation - 1
Lecture 56 - Cauchy Problem for Heat Equation - 2
Lecture 57 - IBVP for Heat equation Subtitle: Method of Separation of Variables
Lecture 58 - Maximum principle for heat equation
Lecture 59 - Tutorial on heat equation
Lecture 60 - Heat equation Subheading : Infinite speed of propagation, Energy, Backward Problem

NPTEL Video Course - Mathematics - NOC:An Introduction to Point-Set-Topology - Part I

Subject Co-ordinator - Prof. Anant R Shastri

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Introduction
Lecture 3 - Introduction
Lecture 4 - Introduction
Lecture 5 - Introduction
Lecture 6 - Introduction
Lecture 7 - Introduction
Lecture 8 - Introduction
Lecture 9 - Introduction
Lecture 10 - Introduction
Lecture 11 - Introduction
Lecture 12 - Introduction
Lecture 13 - Introduction
Lecture 14 - Introduction
Lecture 15 - Introduction
Lecture 16 - Introduction
Lecture 17 - Introduction
Lecture 18 - Introduction
Lecture 19 - Introduction
Lecture 20 - Introduction
Lecture 21 - Introduction
Lecture 22 - Creating New Spaces
Lecture 23 - Creating New Spaces
Lecture 24 - Creating New Spaces
Lecture 25 - Creating New Spaces
Lecture 26 - Creating New Spaces
Lecture 27 - Creating New Spaces
Lecture 28 - Creating New Spaces
Lecture 29 - Creating New Spaces

Lecture 30 - Creating New Spaces
Lecture 31 - Creating New Spaces
Lecture 32
Lecture 33
Lecture 34
Lecture 35
Lecture 36
Lecture 37
Lecture 38 - Smallness Properties of Topological Spaces
Lecture 39 - Smallness Properties of Topological Spaces
Lecture 40 - Smallness Properties of Topological Spaces
Lecture 41 - Smallness Properties of Topological Spaces
Lecture 42 - Smallness Properties of Topological Spaces
Lecture 43 - Smallness Properties of Topological Spaces
Lecture 44 - Smallness Properties of Topological Spaces
Lecture 45 - Smallness Properties of Topological Spaces
Lecture 46 - Smallness Properties of Topological Spaces
Lecture 47 - Largeness properties
Lecture 48 - Largeness properties
Lecture 49 - Largeness properties
Lecture 50 - Largeness properties
Lecture 51 - Largeness properties
Lecture 52 - Largeness properties
Lecture 53 - Largeness properties
Lecture 54 - Largeness properties
Lecture 55 - Largeness properties
Lecture 56
Lecture 57
Lecture 58
Lecture 59
Lecture 60
Lecture 61

NPTEL Video Course - Mathematics - NOC:An Introduction to Point-Set-Topology - Part II

Subject Co-ordinator - Prof. Anant R Shastri

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Welcome Speech
Lecture 2 - Preliminaries from Banach spaces
Lecture 3 - Differentiation on Banach spaces
Lecture 4 - Preliminaries from one-variable real analysis
Lecture 5 - Implicit and Inverse function theorems
Lecture 6 - Compact Hausdorff spaces
Lecture 7 - Local Compactness
Lecture 8 - Local Compactness (Continued...)
Lecture 9 - The retraction functor k(X)
Lecture 10 - Compactly generated spaces
Lecture 11 - Paracompactness
Lecture 12 - Partition of Unity
Lecture 13 - Paracompactness (Continued...)
Lecture 14 - Paracompactness (Continued...)
Lecture 15 - Various Notions of Compactness
Lecture 16 - Total Boundedness
Lecture 17 - Arzel`a- Ascoli Theorem
Lecture 18 - Generalities on Compactification
Lecture 19 - AlexandroffÃ¢'s compactifiction
Lecture 20 - Proper maps
Lecture 21 - Stone-Cech compactification
Lecture 22 - Stone-WeierstrassÃ¢'s Theorems
Lecture 23 - Real Stone-Weierstrass Theorem
Lecture 24 - Complex and extended Stone-Weierstrass theorem
Lecture 25 - (Missing)
Lecture 26 - UrysohnÃ¢'s Metrization theorem
Lecture 27 - Nagata Smyrnov Metrization theorem
Lecture 28 - Nets
Lecture 29 - Cofinal families subnets

Lecture 30 - Basics of Filters
Lecture 31 - Convergence Properties of Filters
Lecture 32 - Ultrafilters and TychonoffÃ¢'s theorem
Lecture 33 - Ultraclosed filters
Lecture 34 - Wallman compactification
Lecture 35 - Wallman compactification (Continued...)
Lecture 36 - Global Separation of Sets
Lecture 37 - More examples
Lecture 38 - Knaster-Kuratowski Example
Lecture 39 - Separation of Sets (Continued...)
Lecture 40 - Definition of dimension and examples
Lecture 41 - Dimensions of subspaces and Unions
Lecture 42 - Sum theorem for higher dimensions
Lecture 43 - Analytic Proof of BrouwerÃ¢'s Fixed Point Theorem
Lecture 44 - Local Separation to Global Separation
Lecture 45 - Partially Ordered sets
Lecture 46 - Principle of Transfinite Induction
Lecture 47 - Order topology
Lecture 48 - Ordinals
Lecture 49 - Ordinal Topology (Continued...)
Lecture 50 - The Long Line
Lecture 51 - Motivation and definition
Lecture 52 - The Exponential Correspondence
Lecture 53 - An Application to Quotient Maps
Lecture 54 - Groups of Homeomoprhisms
Lecture 55 - Definition and Exampels of Manifolds
Lecture 56 - Manifolds with Boundary
Lecture 57 - Homogeneity
Lecture 58 - Homogeneity (Continued...)
Lecture 59 - Classification of 1-dim. manifolds
Lecture 60 - Classification of 1-dim. Manifolds (Continued...)
Lecture 61 - Surfaces
Lecture 62 - Connected Sum

NPTEL Video Course - Mathematics - NOC:Fourier Analysis and its Applications

Subject Co-ordinator - Prof. G. K Srinivasan

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Genesis and a little history
Lecture 2 - Basic convergence theorem
Lecture 3 - Riemann Lebesgue Lemma
Lecture 4 - The ubiquitous Gaussian
Lecture 5 - Jacobi theta function identity
Lecture 6 - The Riemann zeta function
Lecture 7 - Bessel's functions of the first kind
Lecture 8 - Least square approximation
Lecture 9 - Parseval formula. Isoperimetric theorem
Lecture 10 - Dirichlet problem for a disc
Lecture 11 - The Poisson kernel
Lecture 12 - Cesaro summability and Fejer's theorem
Lecture 13 - Fejer's theorem (Continued...)
Lecture 14 - Kronecker's theorem
Lecture 15 - Weyl's equidistribution theorem
Lecture 16 - Borel's theorem and beyond
Lecture 17 - Fourier transform and Schwartz space
Lecture 18 - Hermite's differential equation
Lecture 19 - Fourier inversion theorem Riemann Lebesgue lemma
Lecture 20 - Plancherel's Theorem
Lecture 21 - Heat equation. The heat kernel
Lecture 22 - The Airy's function
Lecture 23 - Exercises on Fourier Transform
Lecture 24 - Principle of equipartitioning of energy
Lecture 25 - A formula of Srinivasa Ramanujan
Lecture 26 - Sturm Liouville problems. Orthogonal systems
Lecture 27 - Vibrations of a circular membrane
Lecture 28 - Fourier Bessel Series
Lecture 29 - Properties of Legendre Polynomials

Lecture 30 - Properties of Legendre polynomials (Continued...)
Lecture 31 - Legendre polynomials - interlacing of zeros
Lecture 32 - Laplace's integrals for Legendre polynomials
Lecture 33 - Regular Sturm-Liouville problems
Lecture 34 - Variational properties of eigen-values
Lecture 35 - The Dirichlet principle
Lecture 36 - Regular Sturm-Liouville problems - Existence of eigen-values
Lecture 37 - The Bergman space
Lecture 38 - The Banach Steinhaus' Theorem
Lecture 39 - Hilbert space basics
Lecture 40 - Completeness of Hermite functions
Lecture 41 - Hermite, Laugerre and Tchebycheff's polynomials
Lecture 42 - Orthonormal bases in Hilbert spaces
Lecture 43 - Non-separable Hilbert-spaces. Almost periodic functions
Lecture 44 - Hilbert-Schmidt operators. Green's functions
Lecture 45 - Spectrum of a bounded linear operator
Lecture 46 - Weak (sequential) compactness of the closed unit ball
Lecture 47 - Compact self-adjoint operators. Existence of eigen values
Lecture 48 - Compact self-adjoint operators. Existence of eigen values (Continued...)
Lecture 49 - Celestial Mechanics
Lecture 50 - Inverting the Kepler equation using Fourier series
Lecture 51 - Odds and Ends
Lecture 52 - Dirichlet's Theorem on Fourier Series
Lecture 53 - Dirichlet's Theorem on Fourier Series (Continued...)
Lecture 54 - Topology on the Schwartz space
Lecture 55 - Examples of tempered distributions
Lecture 56 - Operations on distributions
Lecture 57 - Fourier Transform of tempered distribution
Lecture 58 - Support of a Distribution. Distributions with point support
Lecture 59 - Distributional solutions of ODEs. Continuity of the Fourier transform and differentiation
Lecture 60 - The Poisson summation formula

NPTEL Video Course - Mathematics - NOC:Numerical Analysis (2023)

Subject Co-ordinator - Prof. S. Baskar

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Mathematical Preliminaries: Taylor Approximation
Lecture 3 - Mathematical Preliminaries: Order of Convergence
Lecture 4 - Arithmetic Error: Floating-point Approximation
Lecture 5 - Arithmetic Error: Significant Digits
Lecture 6 - Arithmetic Error: Condition Number and Stable Computation
Lecture 7 - Tutorial Session-1: Problem Solving
Lecture 8 - Python Coding: Introduction
Lecture 9 - Linear Systems: Gaussian Elimination Method
Lecture 10 - Linear Systems: LU-Factorization (Doolittle and Crout)
Lecture 11 - Linear Systems: LU-Factorization (Cholesky)
Lecture 12 - Linear Systems: Operation Count for Direct Methods
Lecture 13 - Tutorial Session-2: Python Coding for Naive Gaussian Elimination Method
Lecture 14 - Tutorial Session-3: Python Coding for Thomas Algorithm
Lecture 15 - Matrix Norms: Subordinate Matrix Norms
Lecture 16 - Matrix Norms: Condition Number of a Matrix
Lecture 17 - Iterative Methods: Jacobi Method
Lecture 18 - Iterative Methods: Convergence of Jacobi Method
Lecture 19 - Iterative Methods: Gauss-Seidel Method
Lecture 20 - Iterative Methods: Convergence Analysis of Iterative Methods
Lecture 21 - Iterative Methods: Successive Over Relaxation Method
Lecture 22 - Tutorial Session-4: Python implementation of Jacobi Method
Lecture 23 - Eigenvalues and Eigenvectors: Power Method (Construction)
Lecture 24 - Eigenvalues and Eigenvectors: Power Method (Convergence Theorem)
Lecture 25 - Eigenvalues and Eigenvectors: Gerschgorin's Theorem and Applications
Lecture 26 - Eigenvalues and Eigenvectors: Power Method (Inverse and Shifted Methods)
Lecture 27 - Nonlinear Equations: Overview
Lecture 28 - Nonlinear Equations: Bisection Method
Lecture 29 - Tutorial Session-5: Implementation of Bisection Method

Lecture 30 - Nonlinear Equations: Regula-falsi and Secant Methods
Lecture 31 - Nonlinear Equations: Convergence Theorem of Secant Method
Lecture 32 - Nonlinear Equations: Newton-Raphson's method
Lecture 33 - Nonlinear Equations: Newton-Raphson's method (Convergence Theorem)
Lecture 34 - Nonlinear Equations: Fixed-point Iteration Methods
Lecture 35 - Nonlinear Equations: Fixed-point Iteration Methods (Convergence) and Modified Newton's Method
Lecture 36 - Nonlinear Equations: System of Nonlinear Equations
Lecture 37 - Nonlinear Equations: Implementation of Newton-Raphson's Method as Python Code
Lecture 38 - Polynomial Interpolation: Existence and Uniqueness
Lecture 39 - Polynomial Interpolation: Lagrange and Newton Forms
Lecture 40 - Polynomial Interpolation: Newtonâ s Divided Difference Formula
Lecture 41 - Polynomial Interpolation: Mathematical Error in Interpolating Polynomial
Lecture 42 - Polynomial Interpolation: Arithmetic Error in Interpolating Polynomials
Lecture 43 - Polynomial Interpolation: Implementation of Lagrange Form as Python Code
Lecture 44 - Polynomial Interpolation: Runge Phenomenon and Piecewise Polynomial Interpolation
Lecture 45 - Polynomial Interpolation: Hermite Interpolation
Lecture 46 - Polynomial Interpolation: Cubic Spline Interpolation
Lecture 47 - Polynomial Interpolation: Tutorial Session
Lecture 48 - Numerical Integration: Rectangle Rule
Lecture 49 - Numerical Integration: Trapezoidal Rule
Lecture 50 - Numerical Integration: Simpson's Rule
Lecture 51 - Numerical Integration: Gaussian Quadrature Rule
Lecture 52 - Numerical Integration: Tutorial Session
Lecture 53 - Numerical Differentiation: Primitive Finite Difference Formulae
Lecture 54 - Numerical Differentiation: Method of Undetermined Coefficients and Arithmetic Error
Lecture 55 - Numerical ODEs: Euler Methods
Lecture 56 - Numerical ODEs: Euler Methods (Error Analysis)
Lecture 57 - Numerical ODEs: Runge-Kutta Methods
Lecture 58 - Numerical ODEs: Modified Euler's Methods
Lecture 59 - Numerical ODEs: Multistep Methods
Lecture 60 - Numerical ODEs: Stability Analysis
Lecture 61 - Numerical ODEs: Two-point Boundary Value Problems

NPTEL Video Course - Mathematics - NOC:Point Set Topology

Subject Co-ordinator - Prof. Ronnie Sebastian

Co-ordinating Institute - IIT - Bombay

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Definition and examples of topological spaces
Lecture 2 - Examples of topological spaces
Lecture 3 - Basis for topology
Lecture 4 - Subspace Topology
Lecture 5 - Product Topology
Lecture 6 - Product Topology (Continued...)
Lecture 7 - Continuous maps
Lecture 8 - Continuity of addition and multiplication maps
Lecture 9 - Continuous maps to a product
Lecture 10 - Projection from a point
Lecture 11 - Closed subsets
Lecture 12 - Closure
Lecture 13 - Joining continuous maps
Lecture 14 - Metric spaces
Lecture 15 - Connectedness
Lecture 16 - Connectedness (Continued...)
Lecture 17 - Connectedness (Continued...)
Lecture 18 - Connected components
Lecture 19 - Path connectedness
Lecture 20 - Path connectedness (Continued...)
Lecture 21 - Connectedness of GL(n,R)^+ (math symbol)
Lecture 22 - Connectedness of GL(n,C), SL(n,C), SL(n,R)
Lecture 23 - Compactness
Lecture 24 - Compactness (Continued...)
Lecture 25 - Compactness (Continued...)
Lecture 26 - Compactness (Continued...)
Lecture 27 - SO(n) is connected
Lecture 28 - Compact metric spaces
Lecture 29 - Lebesgue Number Lemma

Lecture 30 - Locally compact spaces
Lecture 31 - One point compactification
Lecture 32 - One point compactification (Continued...)
Lecture 33 - Uniqueness of one point compatification
Lecture 34 - Part 1 : Quotient topology
Lecture 35 - Part 2 : Quotient topology on G/H
Lecture 36 - Part 3 : Grassmannian
Lecture 37 - Normal topological spaces
Lecture 38 - Urysohn's Lemma
Lecture 39 - Tietze Extension Theorem
Lecture 40 - Regular and Second Countable spaces
Lecture 41 - Product Topology on mathbb{R}^{mathbb{N}}
Lecture 42 - Urysohn's Metrization Theorem

NPTEL Video Course - Mathematics - Stochastic Processes

Subject Co-ordinator - Dr. S. Dharmaraja

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Stochastic Processes
Lecture 2 - Introduction to Stochastic Processes (Continued.)
Lecture 3 - Problems in Random Variables and Distributions
Lecture 4 - Problems in Sequences of Random Variables
Lecture 5 - Definition, Classification and Examples
Lecture 6 - Simple Stochastic Processes
Lecture 7 - Stationary Processes
Lecture 8 - Autoregressive Processes
Lecture 9 - Introduction, Definition and Transition Probability Matrix
Lecture 10 - Chapman-Kolmogrov Equations
Lecture 11 - Classification of States and Limiting Distributions
Lecture 12 - Limiting and Stationary Distributions
Lecture 13 - Limiting Distributions, Ergodicity and Stationary Distributions
Lecture 14 - Time Reversible Markov Chain, Application of Irreducible Markov Chain in Queueing Models
Lecture 15 - Reducible Markov Chains
Lecture 16 - Definition, Kolmogrov Differential Equations and Infinitesimal Generator Matrix
Lecture 17 - Limiting and Stationary Distributions, Birth Death Processes
Lecture 18 - Poisson Processes
Lecture 19 - M/M/1 Queueing Model
Lecture 20 - Simple Markovian Queueing Models
Lecture 21 - Queueing Networks
Lecture 22 - Communication Systems
Lecture 23 - Stochastic Petri Nets
Lecture 24 - Conditional Expectation and Filtration
Lecture 25 - Definition and Simple Examples
Lecture 26 - Definition and Properties
Lecture 27 - Processes Derived from Brownian Motion
Lecture 28 - Stochastic Differential Equations
Lecture 29 - Ito Integrals

Lecture 30 - Ito Formula and its Variants
Lecture 31 - Some Important SDE`s and Their Solutions
Lecture 32 - Renewal Function and Renewal Equation
Lecture 33 - Generalized Renewal Processes and Renewal Limit Theorems
Lecture 34 - Markov Renewal and Markov Regenerative Processes
Lecture 35 - Non Markovian Queues
Lecture 36 - Non Markovian Queues Cont,,
Lecture 37 - Application of Markov Regenerative Processes
Lecture 38 - Galton-Watson Process
Lecture 39 - Markovian Branching Process

NPTEL Video Course - Mathematics - NOC:Stochastic Processes - 1

Subject Co-ordinator - Dr. S. Dharmaraja

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction and motivation for studying stochastic processes
Lecture 2 - Probability space and conditional probability
Lecture 3 - Random variable and cumulative distributive function
Lecture 4 - Discrete Uniform Distribution, Binomial Distribution, Geometric Distribution, Continuous Uniform
Lecture 5 - Joint Distribution of Random Variables
Lecture 6 - Independent Random Variables, Covariance and Correlation Coefficient and Conditional Distributio
Lecture 7 - Conditional Expectation and Covariance Matrix
Lecture 8 - Generating Functions, Law of Large Numbers and Central Limit Theorem
Lecture 9 - Problems in Random variables and Distributions
Lecture 10 - Problems in Random variables and Distributions (Continued...)
Lecture 11 - Problems in Random variables and Distributions (Continued...)
Lecture 12 - Problems in Random variables and Distributions (Continued...)
Lecture 13 - Problems in Sequences of Random Variables
Lecture 14 - Problems in Sequences of Random Variables (Continued...)
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Lecture 17 - Definition of Stochastic Processes, Parameter and State Spaces
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Lecture 25 - Introduction to Discrete time Markov Chain
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Lecture 29 - Introduction to Chapman-Kolmogorov equations

Lecture 30 - State Transition Diagram and Examples
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Lecture 38 - Example of Classification of states (Continued...)
Lecture 39 - Example of Classification of states (Continued...)
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Lecture 41 - Example of Limiting Distribution and Ergodicity
Lecture 42 - Stationary Distribution and Examples
Lecture 43 - Examples of Stationary Distributions
Lecture 44 - Time Reversible Markov Chain and Examples
Lecture 45 - Definition of Reducible Markov Chains and Types of Reducible Markov Chains
Lecture 46 - Stationary Distributions and Types of Reducible Markov chains
Lecture 47 - Type of Reducible Markov Chains (Continued...)
Lecture 48 - Gambler's Ruin Problem
Lecture 49 - Introduction to Continuous time Markov Chain
Lecture 50 - Waiting time Distribution
Lecture 51 - Chapman-Kolmogorov Equation
Lecture 52 - Infinitesimal Generator Matrix
Lecture 53 - Introduction and Example Of Continuous time Markov Chain
Lecture 54 - Limiting and Stationary Distributions
Lecture 55 - Time reversible CTMC and Birth Death Process
Lecture 56 - Steady State Distributions, Pure Birth Process and Pure Death Process
Lecture 57 - Introduction to Poisson Process
Lecture 58 - Definition of Poisson Process
Lecture 59 - Superposition and Deposition of Poisson Process
Lecture 60 - Compound Poisson Process and Examples
Lecture 61 - Introduction to Queueing Systems and Kendall Notations
Lecture 62 - M/M/1 Queueing Model
Lecture 63 - Little's Law, Distribution of Waiting Time and Response Time
Lecture 64 - Burke's Theorem and Simulation of M/M/1 queueing Model
Lecture 65 - M/M/c Queueing Model
Lecture 66 - M/M/1/N Queueing Model
Lecture 67 - M/M/c/K Model, M/M/c/c Loss System, M/M/? Self Service System
Lecture 68 - Transient Solution of Finite Birth Death Process and Finite Source Markovian Queueing Model

Lecture 69 - Queueing Networks Characteristics and Types of Queueing Networks
Lecture 70 - Tandem Queueing Networks
Lecture 71 - Stationary Distribution and Open Queueing Network
Lecture 72 - Jackson's Theorem, Closed Queueing Networks, Gordon and Newell Results
Lecture 73 - Wireless Handoff Performance Model and System Description
Lecture 74 - Description of 3G Cellular Networks and Queueing Model
Lecture 75 - Simulation of Queueing Systems
Lecture 76 - Definition and Basic Components of Petri Net and Reachability Analysis
Lecture 77 - Arc Extensions in Petri Net, Stochastic Petri Nets and examples

NPTEL Video Course - Mathematics - NOC:Stochastic Processes

Subject Co-ordinator - Dr. S. Dharmaraja

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

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Lecture 2 - Probability space and conditional probability
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Lecture 11 - Problems in Random variables and Distributions (Continued...)
Lecture 12 - Problems in Random variables and Distributions (Continued...)
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Lecture 14 - Problems in Sequences of Random Variables (Continued...)
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Lecture 23 - Poisson Process (Continued...)
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Lecture 26 - Introduction to Discrete time Markov Chain (Continued...)
Lecture 27 - Examples of Discrete time Markov Chain
Lecture 28 - Examples of Discrete time Markov Chain (Continued...)
Lecture 29 - Introduction to Chapman-Kolmogorov equations

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Lecture 37 - Example of Classification of states (Continued...)
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Lecture 47 - Type of Reducible Markov Chains (Continued...)
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Lecture 74 - Description of 3G Cellular Networks and Queueing Model
Lecture 75 - Simulation of Queueing Systems
Lecture 76 - Definition and Basic Components of Petri Net and Reachability Analysis
Lecture 77 - Arc Extensions in Petri Net, Stochastic Petri Nets and examples
Lecture 78 - Generalized Stochastic Petri Net
Lecture 79 - Generalized Stochastic Petri Net (Continued...)
Lecture 80 - Conditional Expectation and Examples
Lecture 81 - Filtration in Discrete time
Lecture 82 - Remarks of Conditional Expectation and Adaptabilty
Lecture 83 - Definition and Examples of Martingale
Lecture 84 - Examples of Martingale (Continued...)
Lecture 85 - Examples of Martingale (Continued...)
Lecture 86 - Doob's Martingale Process, Sub martingale and Super Martingale
Lecture 87 - Definition of Brownian Motion
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Lecture 90 - Processes Derived from Brownian Motion
Lecture 91 - Processes Derived from Brownian Motion (Continued...)
Lecture 92 - Processes Derived from Brownian Motion (Continued...)
Lecture 93 - Stochastic Differential Equations
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Lecture 95 - Stochastic Differential Equations (Continued...)
Lecture 96 - Ito Integrals
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Lecture 98 - Ito Integrals (Continued...)
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Lecture 101 - Renewal Function and Renewal Equation (Continued...)
Lecture 102 - Generalized Renewal Processes and Renewal Limit Theorems
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Lecture 104 - Generalized Renewal Processes and Renewal Limit Theorems (Continued...)
Lecture 105 - Markov Renewal and Markov Regenerative Processes
Lecture 106 - Markov Renewal and Markov Regenerative Processes (Continued...)
Lecture 107 - Markov Renewal and Markov Regenerative Processes (Continued...)

Lecture 108 - Markov Renewal and Markov Regenerative Processes (Continued...)
Lecture 109 - Non Markovian Queues
Lecture 110 - Non Markovian Queues (Continued...)
Lecture 111 - Non Markovian Queues (Continued...)
Lecture 112 - Stationary Processes
Lecture 113 - Stationary Processes (Continued...)
Lecture 114 - Stationary Processes (Continued...)
Lecture 115 - Stationary Processes (Continued...) and Ergodicity
Lecture 116 - G1/M/1 queue
Lecture 117 - G1/M/1 queue (Continued...)
Lecture 118 - G1/M/1/N queue and examples
Lecture 119 - Galton-Watson Process
Lecture 120 - Examples and Theorems
Lecture 121 - Theorems and Examples (Continued...)
Lecture 122 - Markov Branching Process
Lecture 123 - Markov Branching Process Theorems and Properties
Lecture 124 - Markov Branching Process Theorems and Properties (Continued...)

NPTEL Video Course - Mathematics - NOC:Chaotic Dynamical Systems

Subject Co-ordinator - Dr. Anima Nagar

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - The beginning
Lecture 2 - Elementary Concepts
Lecture 3 - Elementary Concepts (Continued...)
Lecture 4 - More on orbits
Lecture 5 - Peiods of Periodic Points
Lecture 6 - Scrambled Sets
Lecture 7 - Sensitive Dependence on Initial Conditions
Lecture 8 - A Population Dynamics Model
Lecture 9 - Bifurcations
Lecture 10 - Nonlinear Systems
Lecture 11 - Horseshoe Attractor
Lecture 12 - Dynamics of the Horseshoe Attractor
Lecture 13 - Recurrence
Lecture 14 - Recurrence (Continued...)
Lecture 15 - Transitivity
Lecture 16 - Devaneyâ s Chaos
Lecture 17 - Transitivity = Chaos on Intervals
Lecture 18 - Stronger forms of Transitivity
Lecture 19 - Chaotic Properties of Mixing Systems
Lecture 20 - Weakly Mixing and Chaos
Lecture 21 - Strongly Transitive Systems
Lecture 22 - Strongly Transitive Systems (Continued...)
Lecture 23 - Introduction to Symbolic Dynamics
Lecture 24 - Shift Spaces
Lecture 25 - Subshifts of Finite Type
Lecture 26 - Subshifts of Finite Type (Continued...), Chatoic Dynamical Systems
Lecture 27 - Measuring Chaos - Topological Entropy
Lecture 28 - Topological Entropy - Adlerâ s Version
Lecture 29 - Bowenâ s Definition of Topological Entropy

Lecture 30 - Equivalance of the two definitions of Topological Entropy
Lecture 31 - Linear Systems in Two Dimentions
Lecture 32 - Asymptotic Properties of Orbits of Linear Transformation in IR2
Lecture 33 - Hyperbolic Toral Automorphisms
Lecture 34 - Chaos in Toral Automorphisms
Lecture 35 - Chaotic Attractors of Henon Maps

NPTEL Video Course - Mathematics - NOC:Introduction to Probability Theory and Stochastic Processes

Subject Co-ordinator - Dr. S. Dharmaraja

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Random experiment, sample space, axioms of probability, probability space
Lecture 2 - Random experiment, sample space, axioms of probability, probability space (Continued...)
Lecture 3 - Random experiment, sample space, axioms of probability, probability space (Continued...)
Lecture 4 - Conditional probability, independence of events.
Lecture 5 - Multiplication rule, total probability rule, Bayes's theorem.
Lecture 6 - Definition of Random Variable, Cumulative Distribution Function
Lecture 7 - Definition of Random Variable, Cumulative Distribution Function (Continued...)
Lecture 8 - Definition of Random Variable, Cumulative Distribution Function (Continued...)
Lecture 9 - Type of Random Variables, Probability Mass Function, Probability Density Function
Lecture 10 - Type of Random Variables, Probability Mass Function, Probability Density Function (Continued...)
Lecture 11 - Distribution of Function of Random Variables
Lecture 12 - Mean and Variance
Lecture 13 - Mean and Variance (Continued...)
Lecture 14 - Higher Order Moments and Moments Inequalities
Lecture 15 - Higher Order Moments and Moments Inequalities (Continued...)
Lecture 16 - Generating Functions
Lecture 17 - Generating Functions (Continued...)
Lecture 18 - Common Discrete Distributions
Lecture 19 - Common Discrete Distributions (Continued...)
Lecture 20 - Common Continuous Distributions
Lecture 21 - Common Continuous Distributions (Continued...)
Lecture 22 - Applications of Random Variable
Lecture 23 - Applications of Random Variable (Continued...)
Lecture 24 - Random vector and joint distribution
Lecture 25 - Joint probability mass function
Lecture 26 - Joint probability density function
Lecture 27 - Independent random variables
Lecture 28 - Independent random variables (Continued...)
Lecture 29 - Functions of several random variables

Lecture 30 - Functions of several random variables (Continued...)
Lecture 31 - Some important results
Lecture 32 - Order statistics
Lecture 33 - Conditional distributions
Lecture 34 - Random sum
Lecture 35 - Moments and Covariance
Lecture 36 - Variance Covariance matrix
Lecture 37 - Multivariate Normal distribution
Lecture 38 - Probability generating function and Moment generating function
Lecture 39 - Correlation coefficient
Lecture 40 - Conditional Expectation
Lecture 41 - Conditional Expectation (Continued...)
Lecture 42 - Modes of Convergence
Lecture 43 - Mode of Convergence (Continued...)
Lecture 44 - Law of Large Numbers
Lecture 45 - Central Limit Theorem
Lecture 46 - Central Limit Theorem (Continued...)
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Lecture 48 - Definition of a Stochastic Process
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Lecture 50 - Examples of Stochastic Process
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Lecture 53 - Poisson Process
Lecture 54 - Poisson Process (Continued...)
Lecture 55 - Simple Random Walk
Lecture 56 - Time Series and Related Definitions
Lecture 57 - Strict Sense Stationary Process
Lecture 58 - Wide Sense Stationary Process and Examples
Lecture 59 - Examples of Stationary Processes (Continued...)
Lecture 60 - Discrete Time Markov Chain (DTMC)
Lecture 61 - DTMC (Continued...)
Lecture 62 - Examples of DTMC
Lecture 63 - Examples of DTMC (Continued...)
Lecture 64 - Chapman-Kolmogorov equations and N-step transition matrix
Lecture 65 - Examples based on N-step transition matrix
Lecture 66 - Examples (Continued...)
Lecture 67 - Classification of states
Lecture 68 - Classification of states (Continued...)

Lecture 69 - Calculation of N-Step - 9
Lecture 70 - Calculation of N-Step - 10
Lecture 71 - Limiting and Stationary distributions
Lecture 72 - Limiting and Stationary distributions (Continued...)
Lecture 73 - Continuous time Markov chain (CTMC)
Lecture 74 - CTMC (Continued...)
Lecture 75 - State transition diagram and Chapman-Kolmogorov equation
Lecture 76 - Infinitesimal generator and Kolmogorov differential equations
Lecture 77 - Limiting distribution
Lecture 78 - Limiting and Stationary distributions - 1
Lecture 79 - Birth death process
Lecture 80 - Birth death process (Continued...)
Lecture 81 - Poisson process - 1
Lecture 82 - Poisson process (Continued...)
Lecture 83 - Poisson process (Continued...)
Lecture 84 - Non-homogeneous and compound Poisson process
Lecture 85 - Introduction to Queueing Models and Kendall Notation
Lecture 86 - M/M/1 Queueing Model
Lecture 87 - M/M/1 Queueing Model (Continued...)
Lecture 88 - M/M/1 Queueing Model and Burke's Theorem
Lecture 89 - M/M/c Queueing Model
Lecture 90 - M/M/c (Continued...) and M/M/1/N Model
Lecture 91 - Other Markovian Queueing Models
Lecture 92 - Transient Solution of Finite Capacity Markovian Queues

NPTEL Video Course - Mathematics - NOC:Statistical Inference

Subject Co-ordinator - Prof. Nilladri Chaterjee

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Statistical Inference - 1
Lecture 2 - Statistical Inference - 2
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NPTEL Video Course - Mathematics - NOC:Integral Transforms and their Applications

Subject Co-ordinator - Prof. Sarthok Sircar

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Fourier Transforms - Part 1
Lecture 2 - Introduction to Fourier Transforms - Part 2
Lecture 3 - Introduction to Fourier Transforms - Part 3
Lecture 4 - Properties of Fourier transforms, Shannon Sampling Theorem, Gibb's Phenomena - Part 1
Lecture 5 - Properties of Fourier transforms, Shannon Sampling Theorem, Gibb's Phenomena - Part 2
Lecture 6 - Properties of Fourier transforms, Shannon Sampling Theorem, Gibb's Phenomena - Part 3
Lecture 7 - Applications of Fourier Transforms - Part 1
Lecture 8 - Applications of Fourier Transforms - Part 2
Lecture 9 - Applications of Fourier Transforms - Part 3
Lecture 10 - Introduction to Laplace Transforms - Part 1
Lecture 11 - Introduction to Laplace Transforms - Part 2
Lecture 12 - Introduction to Laplace Transforms - Part 3
Lecture 13 - Inverse Laplace Transform, Initial and Final Value Theorems - Part 1
Lecture 14 - Inverse Laplace Transform, Initial and Final Value Theorems - Part 2
Lecture 15 - Inverse Laplace Transform, Initial and Final Value Theorems - Part 3
Lecture 16 - Applications of Laplace Transforms - Part 1
Lecture 17 - Applications of Laplace Transforms - Part 2
Lecture 18 - Applications of Laplace Transforms - Part 3
Lecture 19 - Applications of Laplace Transforms (Continued) - Part 1
Lecture 20 - Applications of Laplace Transforms (Continued) - Part 2
Lecture 21 - Applications of Laplace Transforms (Continued) - Part 3
Lecture 22 - Applications of Fourier-Laplace Transforms - Part 1
Lecture 23 - Applications of Fourier-Laplace Transforms - Part 2
Lecture 24 - Applications of Fourier-Laplace Transforms - Part 3
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Lecture 27 - Introduction to Hankel Transforms - Part 3
Lecture 28 - Introduction to Mellin Transforms - Part 1
Lecture 29 - Introduction to Mellin Transforms - Part 2

Lecture 30 - Introduction to Mellin Transforms - Part 3
Lecture 31 - Introduction to Hilbert Transforms - Part 1
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Lecture 35 - Applications of Hilbert Transfroms, Introduction to Stieltjes Transform - Part 2
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Lecture 37 - Applications of Stieltjes Transform, Generalized Stieltjes Transform - Part 1
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Lecture 46 - Inverse Z-transfrom, Applciations of Z-Transform - Part 1
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Lecture 48 - Inverse Z-transfrom, Applciations of Z-Transform - Part 3
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Lecture 51 - Introduction to Radon Transform - Part 3
Lecture 52 - Inverse Radon Transform, Applications to Radon Transform - Part 1
Lecture 53 - Inverse Radon Transform, Applications to Radon Transform - Part 2
Lecture 54 - Inverse Radon Transform, Applications to Radon Transform - Part 3
Lecture 55 - Introduction to Fractional Calculus - Part 1
Lecture 56 - Introduction to Fractional Calculus - Part 2
Lecture 57 - Introduction to Fractional Calculus - Part 3
Lecture 58 - Fractional ODEs, Abel's Integral Equations - Part 1
Lecture 59 - Fractional ODEs, Abel's Integral Equations - Part 2
Lecture 60 - Fractional ODEs, Abel's Integral Equations - Part 3
Lecture 61 - Fractional PDEs - Part 1
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Lecture 63 - Fractional PDEs - Part 3
Lecture 64 - Fractional ODEs and PDEs (Continued) - Part 1
Lecture 65 - Fractional ODEs and PDEs (Continued) - Part 2
Lecture 66 - Fractional ODEs and PDEs (Continued) - Part 3
Lecture 67 - Introduction to Wavelet Transform - Part 1
Lecture 68 - Introduction to Wavelet Transform - Part 2

Lecture 69 - Introduction to Wavelet Transform - Part 3
Lecture 70 - Discrete Haar, Shanon and Debauchies Wavelet - Part 1
Lecture 71 - Discrete Haar, Shanon and Debauchies Wavelet - Part 2
Lecture 72 - Discrete Haar, Shanon and Debauchies Wavelet - Part 3

NPTEL Video Course - Mathematics - NOC:Introduction to Fuzzy Set Theory, Arithmetic and Logic

Subject Co-ordinator - Prof. Nilladri Chaterjee

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

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Lecture 4 - Fuzzy Sets Arithmetic and Logic - 4
Lecture 5 - Fuzzy Sets Arithmetic and Logic - 5
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Lecture 28 - Fuzzy Sets Arithmetic and Logic - 28
Lecture 29 - Fuzzy Sets Arithmetic and Logic - 29

Lecture 30 - Fuzzy Sets Arithmetic and Logic - 30

NPTEL Video Course - Mathematics - NOC:Introduction to Methods of Applied Mathematics

Subject Co-ordinator - Prof. Vivek Kumar Aggarwal

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to First Order Differential Equations
Lecture 2 - Introduction to First Order Differential Equations (Continued...)
Lecture 3 - Introduction to Second Order Linear Differential Equations
Lecture 4 - Second Order Linear Differential Equations With Constant Coefficients
Lecture 5 - Second Order Linear Differential Equations With Constant Coefficients (Continued...)
Lecture 6 - Second Order Linear Differential Equations With Variable Coefficients
Lecture 7 - Factorization of Second order Differential Operator and Euler Cauchy Equation
Lecture 8 - Power Series Solution of General Differential Equation
Lecture 9 - Green's function
Lecture 10 - Method of Green's Function for Solving Initial Value and Boundary Value Problems
Lecture 11 - Adjoint Linear Differential Operator
Lecture 12 - Adjoint Linear Differential Operator (Continued...)
Lecture 13 - Sturm-Liouvile Problems
Lecture 14 - Laplace transformation
Lecture 15 - Laplace transformation (Continued...)
Lecture 16 - Laplace Transform Method for Solving Ordinary Differential Equations
Lecture 17 - Laplace Transform Applied to Differential Equations and Convolution
Lecture 18 - Fourier Series
Lecture 19 - Fourier Series (Continued...)
Lecture 20 - Gibbs Phenomenon and Parseval's Identity
Lecture 21 - Fourier Integral and Fourier Transform
Lecture 22 - Fourier Integral and Fourier Transform (Continued...)
Lecture 23 - Fourier Transform Method for Solving Ordinary Differential Equations
Lecture 24 - Frames, Riesz Bases and Orthonormal Bases
Lecture 25 - Frames, Riesz Bases and Orthonormal Bases (Continued...)
Lecture 26 - Fourier Series and Fourier Transform
Lecture 27 - Time-Frequency Analysis and Gabor Transform
Lecture 28 - Window Fourier Transform and Multiresolution Analysis
Lecture 29 - Construction of Scaling Functions and Wavelets Using Multiresolution Analysis

Lecture 30 - Daubechies Wavelet
Lecture 31 - Daubechies Wavelet (Continued...)
Lecture 32 - Wavelet Transform and Shannon Wavelet

NPTEL Video Course - Mathematics - NOC:Advanced Probability Theory

Subject Co-ordinator - Prof. Niladri Chatterjee

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Advanced Probability Theory
Lecture 2 - Advanced Probability Theory
Lecture 3 - Advanced Probability Theory
Lecture 4 - Advanced Probability Theory
Lecture 5 - Advanced Probability Theory
Lecture 6 - Advanced Probability Theory
Lecture 7 - Advanced Probability Theory
Lecture 8 - Advanced Probability Theory
Lecture 9 - Advanced Probability Theory
Lecture 10 - Advanced Probability Theory
Lecture 11 - Advanced Probability Theory
Lecture 12 - Advanced Probability Theory
Lecture 13 - Advanced Probability Theory
Lecture 14 - Advanced Probability Theory
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Lecture 25 - Advanced Probability Theory
Lecture 26 - Advanced Probability Theory
Lecture 27 - Advanced Probability Theory
Lecture 28 - Advanced Probability Theory
Lecture 29 - Advanced Probability Theory

Lecture 30 - Advanced Probability Theory

NPTEL Video Course - Mathematics - NOC:Scientific Computing using Matlab

Subject Co-ordinator - Prof. Vivek Kumar Aggarwal, Prof. Mani Mehra

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Matlab
Lecture 2 - Plotting of Functions in Matlab
Lecture 3 - Symbolic Computation in Matlab
Lecture 4 - Functions definition in Matlab
Lecture 5 - In continuation of basics of Matlab
Lecture 6 - In continuation of basics of Matlab (Continued...)
Lecture 7 - Floating point representation of a number
Lecture 8 - Errors arithmetic
Lecture 9 - Iterative method for solving nonlinear equations
Lecture 10 - Bisection method for solving nonlinear equations
Lecture 11 - Order of Convergence of an Iterative Method
Lecture 12 - Regula-Falsi and Secant Method for Solving Nonlinear Equations
Lecture 13 - Raphson method for solving nonlinear equations
Lecture 14 - Newton-Raphson Method for Solving Nonlinear System of Equations
Lecture 15 - Matlab Code for Fixed Point Iteration Method
Lecture 16 - Matlab Code for Newton-Raphson and Regula-Falsi Method
Lecture 17 - Matlab Code for Newton Method for Solving System of Equations
Lecture 18 - Linear System of Equations
Lecture 19 - Linear System of Equations (Continued...)
Lecture 20 - Gauss Elimination Method for solving Linear System of Equation
Lecture 21 - Matlab Code for Gauss Elimination Method
Lecture 22 - LU Decomposition Method for Solving Linear System of Equations
Lecture 23 - LU Decomposition Method for Solving Linear System of Equations (Continued...)
Lecture 24 - Iterative Method for Solving Linear System of Equations
Lecture 25 - Iterative Method for Solving Linear System of Equations (Continued...)
Lecture 26 - Matlab Code for Gauss Jacobi Method
Lecture 27 - Matlab Code for Gauss Seidel Method
Lecture 28 - Matlab Code for Gauss Seidel Method
Lecture 29 - Power Method for Solving Eigenvalues of a Matrix

Lecture 30 - Power Method for Solving Eigenvalues of a Matrix (Continued...)
Lecture 31 - Gershgorin Circle Theorem for Estimating Eigenvalues of a Matrix
Lecture 32 - Gershgorin Circle Theorem for Estimating Eigenvalues of a Matrix
Lecture 33 - Matlab Code for Power Method/ Shifted Inverse Power Method
Lecture 34 - Interpolation
Lecture 35 - Interpolation (Continued...)
Lecture 36 - Interpolation (Continued...)
Lecture 37 - Interpolating Polynomial Using Newton's Forward Difference Formula
Lecture 38 - Error Estimates in Polynomial Approximation
Lecture 39 - Interpolating Polynomial Using Newton's Backward Difference Formula
Lecture 40 - Stirling's Formula and Lagrange's Interpolating Polynomial
Lecture 41 - In Continuation of Lagrange's Interpolating Formula
Lecture 42 - Interpolating Polynomial Using Newton's Divided Difference Formula
Lecture 43 - Examples Based on Lagrange's and Newton's Divided Difference Interpolation
Lecture 44 - Spline Interpolation
Lecture 45 - Cubic Spline
Lecture 46 - Cubic Spline (Continued...)
Lecture 47 - Curve Fitting
Lecture 48 - Quadratic Polynomial Fitting and Code for Lagrange's Interpolating Polynomial using Octave
Lecture 49 - Matlab Code for Newton's Divided Difference and Least Square Approximation
Lecture 50 - Matlab Code for Cubic Spline
Lecture 51 - Numerical Differentiation
Lecture 52 - Various Numerical Differentiation Formulas
Lecture 53 - Higher Order Accurate Numerical Differentiation Formula For First Order Derivative
Lecture 54 - Higher Order Accurate Numerical Differentiation Formula For Second Order Derivative
Lecture 55 - Numerical Integration
Lecture 56 - Trapezoidal Rule for Numerical Integration
Lecture 57 - Simpson's 1/3 rule for Numerical Integration
Lecture 58 - Simpson's 3/8 Rule for Numerical Integration
Lecture 59 - Method of Undetermined Coefficients
Lecture 60 - Octave Code for Trapezoidal and Simpson's Rule
Lecture 61 - Taylor Series Method for Ordinary Differential Equations
Lecture 62 - Linear Multistep Method (LMM) for Ordinary Differential Equations
Lecture 63 - Convergence and Zero Stability for LMM
Lecture 64 - Matlab/Octave Code for Initial Value Problems
Lecture 65 - Advantage of Implicit and Explicit Methods Over Each other via Matlab/Octave Codes for Initial v

NPTEL Video Course - Mathematics - NOC:Non-parametric Statistical Inference

Subject Co-ordinator - Prof. Niladri Chatterjee

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1
Lecture 2
Lecture 3
Lecture 4
Lecture 5
Lecture 6
Lecture 7
Lecture 8
Lecture 9
Lecture 10

NPTEL Video Course - Mathematics - NOC:Matrix Computation and its applications

Subject Co-ordinator - Prof. Vivek K. Aggarwal

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Binary Operation and Groups
Lecture 2 - Vector Spaces
Lecture 3 - Some Examples of Vector Spaces
Lecture 4 - Some Examples of Vector Spaces (Continued...)
Lecture 5 - Subspace of a Vector Space
Lecture 6 - Spanning Set
Lecture 7 - Properties of Subspaces
Lecture 8 - Properties of Subspaces (Continued...)
Lecture 9 - Linearly Independent and Dependent Vectors
Lecture 10 - Linearly Independent and Dependent Vectors (Continued...)
Lecture 11 - Properties of Linearly Independent and Dependent Vectors
Lecture 12 - Properties of Linearly Independent and Dependent Vectors (Continued...)
Lecture 13 - Basis and Dimension of a Vector Space
Lecture 14 - Example of Basis and Standard Basis of a Vector Space
Lecture 15 - Linear Functions
Lecture 16 - Range Space of a Matrix and Row Reduced Echelon Form
Lecture 17 - Row Equivalent Matrices
Lecture 18 - Row Equivalent Matrices (Continued...)
Lecture 19 - Null Space of a Matrix
Lecture 20 - Four Subspaces Associated with a Given Matrix
Lecture 21 - Four Subspaces Associated with a Given Matrix (Continued...)
Lecture 22 - Linear Independence of the rows and columns of a Matrix
Lecture 23 - Application of Diagonal Dominant Matrices
Lecture 24 - Application of Zero Null Space: Interpolating Polynomial and Wronskian Matrix
Lecture 25 - Characterization of basic of a Vector Space and its Subspaces
Lecture 26 - Coordinate of a Vector with respect to Ordered Basis
Lecture 27 - Examples of different subspaces of a vector space of polynomials having degree less than or equa
Lecture 28 - Linear Transformation
Lecture 29 - Properties of Linear Transformation

Lecture 30 - Determining Linear Transformation on a Vector Space by its value on the basis element
Lecture 31 - Range space and null space of a Linear Transformation
Lecture 32 - Rank and Nuility of a Linear Transformation
Lecture 33 - Rank Nuility Theorem
Lecture 34 - Application of Rank Nuility Theorem and Inverse of a Linear Transformation
Lecture 35 - Matrix Associated with Linear Transformation
Lecture 36 - Matrix Representation of a Linear Transformation Relative to Ordered Bases
Lecture 37 - Matrix Representation of a Linear Transformation Relative to Ordered Bases (Continued...)
Lecture 38 - Linear Map Associated with a Matrix
Lecture 39 - Similar Matrices and Diagonalisation of Matrix
Lecture 40 - Orthonormal bases of a Vector Space
Lecture 41 - Gram-Schmidt Orthogonalisation Process
Lecture 42 - QR Factorisation
Lecture 43 - Inner Product Spaces
Lecture 44 - Inner Product of different real vector spaces and basics of complex vector space
Lecture 45 - Inner Product on complex vector spaces and Cauchy-Schwarz inequality
Lecture 46 - Norm of a Vector
Lecture 47 - Matrix Norm
Lecture 48 - Sensitivity Analysis of a System of Linear Equations
Lecture 49 - Orthoganality of the four subspaces associated with a matrix
Lecture 50 - Best Approximation: Least Square Method
Lecture 51 - Best Approximation: Least Square Method (Continued...)
Lecture 52 - Jordan-Canonical Form
Lecture 53 - Some examples on the Jordan form of a given matrix and generalised eigon vectors
Lecture 54 - Singular value decomposition (SVD) theorem
Lecture 55 - Matlab/Octave code for Solving SVD
Lecture 56 - Pseudo-Inverse/Moore-Penrose Inverse
Lecture 57 - Householder Transformation
Lecture 58 - Matlab/Octave code for Householder Transformation

NPTEL Video Course - Mathematics - NOC:Introduction to Probability Theory and Statistics

Subject Co-ordinator - Prof. S Dharmaraja

Co-ordinating Institute - IIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Random experiment, sample space, axioms of probability, probability space
Lecture 2 - Random experiment, sample space, axioms of probability, probability space (Continued...)
Lecture 3 - Random experiment, sample space, axioms of probability, probability space (Continued...)
Lecture 4 - Conditional probability, independence of events
Lecture 5 - Multiplication rule, total probability rule, Bayes's theorem
Lecture 6 - Definition of Random Variable, Cumulative Distribution Function
Lecture 7 - Definition of Random Variable, Cumulative Distribution Function (Continued...)
Lecture 8 - Definition of Random Variable, Cumulative Distribution Function (Continued...)
Lecture 9 - Type of Random Variables, Probability Mass Function, Probability Density Function
Lecture 10 - Type of Random Variables, Probability Mass Function, Probability Density Function (Continued...)
Lecture 11 - Distribution of Function of Random Variables
Lecture 12 - Mean and Variance
Lecture 13 - Mean and Variance (Continued...)
Lecture 14 - Higher Order Moments and Moments Inequalities
Lecture 15 - Higher Order Moments and Moments Inequalities (Continued...)
Lecture 16 - Generating Functions
Lecture 17 - Generating Functions (Continued...)
Lecture 18 - Common Discrete Distributions
Lecture 19 - Common Discrete Distributions (Continued...)
Lecture 20 - Common Continuous Distributions
Lecture 21 - Common Continuous Distributions (Continued...)
Lecture 22 - Applications of Random Variable
Lecture 23 - Applications of Random Variable (Continued...)
Lecture 24 - Random vector and joint distribution
Lecture 25 - Joint probability mass function
Lecture 26 - Joint probability density function
Lecture 27 - Independent random variables
Lecture 28 - Independent random variables (Continued...)
Lecture 29 - Functions of several random variables

Lecture 30 - Functions of several random variables (Continued...)
Lecture 31 - Some important results
Lecture 32 - Order statistics
Lecture 33 - Conditional distributions
Lecture 34 - Random sum
Lecture 35 - Moments and Covariance
Lecture 36 - Variance Covariance matrix
Lecture 37 - Multivariate Normal distribution
Lecture 38 - Probability generating function and Moment generating function
Lecture 39 - Correlation coefficient
Lecture 40 - Conditional Expectation
Lecture 41 - Conditional Expectation (Continued...)
Lecture 42 - Mode of Convergence
Lecture 43 - Mode of Convergence (Continued...)
Lecture 44 - Law of Large Numbers
Lecture 45 - Central Limit Theorem
Lecture 46 - Central Limit Theorem (Continued...)
Lecture 47 - Descriptive Statistics and Sampling Distributions
Lecture 48 - Descriptive Statistics and Sampling Distributions (Continued...)
Lecture 49 - Descriptive Statistics and Sampling Distributions (Continued...)
Lecture 50 - Point estimation
Lecture 51 - Methods of Point estimation
Lecture 52 - Interval Estimation
Lecture 53 - Testing of Statistical Hypothesis
Lecture 54 - Nonparametric Statistical Tests
Lecture 55 - Analysis of Variance
Lecture 56 - Correlation
Lecture 57 - Regression
Lecture 58 - Logistic Regression

NPTEL Video Course - Mathematics - Formal Languages and Automata Theory

Subject Co-ordinator - Dr. K.V. Krishna, Dr. Diganta Goswami

Co-ordinating Institute - IIT - Guwahati

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Alphabet, Strings, Languages
Lecture 3 - Finite Representation
Lecture 4 - Grammars (CFG)
Lecture 5 - Derivation Trees
Lecture 6 - Regular Grammars
Lecture 7 - Finite Automata
Lecture 8 - Nondeterministic Finite Automata
Lecture 9 - NFA <=> DFA
Lecture 10 - Myhill-Nerode Theorem
Lecture 11 - Minimization
Lecture 12 - RE => FA
Lecture 13 - FA => RE
Lecture 14 - FA <=> RG
Lecture 15 - Variants of FA
Lecture 16 - Closure Properties of RL
Lecture 17 - Homomorphism
Lecture 18 - Pumping Lemma
Lecture 19 - Simplification of CFG
Lecture 20 - Normal Forms of CFG
Lecture 21 - Properties of CFLs
Lecture 22 - Pushdown Automata
Lecture 23 - PDA <=> CFG
Lecture 24 - Turing Machines
Lecture 25 - Turing Computable Functions
Lecture 26 - Combining Turing Machines
Lecture 27 - Multi Input
Lecture 28 - Turing Decidable Languages
Lecture 29 - Varients of Turing Machines

Lecture 30 - Structured Grammars
Lecture 31 - Decidability
Lecture 32 - Undecidability 1
Lecture 33 - Undecidability 2
Lecture 34 - Undecidability 3
Lecture 35 - Time Bounded Turing Machines
Lecture 36 - P and NP
Lecture 37 - NP-Completeness
Lecture 38 - NP-Complete Problems 1
Lecture 39 - NP-Complete Problems 2
Lecture 40 - NP-Complete Problems 3
Lecture 41 - Chomsky Hierarchy

NPTEL Video Course - Mathematics - Complex Analysis

Subject Co-ordinator - Prof. P.A.S. Sree Krishna

Co-ordinating Institute - IIT - Guwahati

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Introduction to Complex Numbers
Lecture 3 - de Moivreâ s Formula and Stereographic Projection
Lecture 4 - Topology of the Complex Plane - Part-I
Lecture 5 - Topology of the Complex Plane - Part-II
Lecture 6 - Topology of the Complex Plane - Part-III
Lecture 7 - Introduction to Complex Functions
Lecture 8 - Limits and Continuity
Lecture 9 - Differentiation
Lecture 10 - Cauchy-Riemann Equations and Differentiability
Lecture 11 - Analytic functions; the exponential function
Lecture 12 - Sine, Cosine and Harmonic functions
Lecture 13 - Branches of Multifunctions; Hyperbolic Functions
Lecture 14 - Problem Solving Session I
Lecture 15 - Integration and Contours
Lecture 16 - Contour Integration
Lecture 17 - Introduction to Cauchyâ s Theorem
Lecture 18 - Cauchyâ s Theorem for a Rectangle
Lecture 19 - Cauchyâ s theorem - Part-II
Lecture 20 - Cauchyâ s Theorem - Part-III
Lecture 21 - Cauchyâ s Integral Formula and its Consequences
Lecture 22 - The First and Second Derivatives of Analytic Functions
Lecture 23 - Moreraâ s Theorem and Higher Order Derivatives of Analytic Functions
Lecture 24 - Problem Solving Session II
Lecture 25 - Introduction to Complex Power Series
Lecture 26 - Analyticity of Power Series
Lecture 27 - Taylorâ s Theorem
Lecture 28 - Zeroes of Analytic Functions
Lecture 29 - Counting the Zeroes of Analytic Functions

Lecture 30 - Open mapping theorem - Part-I
Lecture 31 - Open mapping theorem - Part-II
Lecture 32 - Properties of Mobius Transformations - Part-I
Lecture 33 - Properties of Mobius Transformations - Part-II
Lecture 34 - Problem Solving Session III
Lecture 35 - Removable Singularities
Lecture 36 - Poles Classification of Isolated Singularities
Lecture 37 - Essential Singularity & Introduction to Laurent Series
Lecture 38 - Laurentâ s Theorem
Lecture 39 - Residue Theorem and Applications
Lecture 40 - Problem Solving Session IV

NPTEL Video Course - Mathematics - NOC:Mathematical Finance

Subject Co-ordinator - Prof. Siddhartha Pratim Chakrabarty

Co-ordinating Institute - IIT - Guwahati

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Financial Markets and Bonds
Lecture 2 - Introduction to Stocks, Futures and Forwards and Swaps
Lecture 3 - Introduction to Options
Lecture 4 - Interest Rates and Present Value
Lecture 5 - Present and Future Values, Annuities, Amortization and Bond Yield
Lecture 6 - Price Yield Curve and Term Structure of Interest Rates
Lecture 7 - Markowitz Theory, Return and Risk and Two Asset Portfolio
Lecture 8 - Minimum Variance Portfolio and Feasible Set
Lecture 9 - Multi Asset Portfolio, Minimum Variance Portfolio, Efficient Frontier and Minimum Variance Line
Lecture 10 - Minimum Variance Line (Continued), Market Portfolio
Lecture 11 - Capital Market Line, Capital Asset Pricing Model
Lecture 12 - Performance Analysis
Lecture 13 - No-Arbitrage Principle and Pricing of Forward Contracts
Lecture 14 - Futures, Options and Put-Call-Parity
Lecture 15 - Bounds on Options
Lecture 16 - Derivative Pricing in a Single Period Binomial Model
Lecture 17 - Derivative Pricing in Multiperiod Binomial Model
Lecture 18 - Derivative Pricing in Binomial Model and Path Dependent Options
Lecture 19 - Discrete Probability Spaces
Lecture 20 - Filtrations and Conditional Expectations
Lecture 21 - Properties of Conditional Expectations
Lecture 22 - Examples of Conditional Expectations, Martingales
Lecture 23 - Risk-Neutral Pricing of European Derivatives in Binomial Model
Lecture 24 - Actual and Risk-Neutral Probabilities, Markov Process, American Options
Lecture 25 - General Probability Spaces, Expectations, Change of Measure
Lecture 26 - Filtrations, Independence, Conditional Expectations
Lecture 27 - Brownian Motion and its Properties
Lecture 28 - ItÃ´ Integral and its Properties
Lecture 29 - ItÃ´ Formula, ItÃ´ Processes

Lecture 30 - Multivariable Stochastic Calculus, Stochastic Differential Equations
Lecture 31 - Black-Scholes-Merton (BSM) Model, BSM Equation, BSM Formula
Lecture 32 - Greeks, Put-Call Parity, Change of Measure
Lecture 33 - Girsanov Theorem, Risk-Neutral Pricing of Derivatives, BSM Formula
Lecture 34 - MRT and Hedging, Multidimensional Girsanov and MRT
Lecture 35 - Multidimensional BSM Model, Fundamental Theorems of Asset Pricing
Lecture 36 - BSM Model with Dividend-Paying Stocks

NPTEL Video Course - Mathematics - NOC:Mathematical Portfolio Theory

Subject Co-ordinator - Prof. Siddhartha Pratim Chakrabarty

Co-ordinating Institute - IIT - Guwahati

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Probability space and their properties, Random variables
Lecture 2 - Mean, variance, covariance and their properties
Lecture 3 - Linear regression; Binomial and normal distribution; Central Limit Theorem
Lecture 4 - Financial markets
Lecture 5 - Bonds and stocks
Lecture 6 - Binomial and geometric Brownian motion (gBm) asset pricing models
Lecture 7 - Expected return, risk and covariance of returns
Lecture 8 - Expected return and risk of a portfolio; Minimum variance portfolio
Lecture 9 - Multi-asset portfolio and Efficient frontier
Lecture 10 - Capital Market Line and Derivation of efficient frontier
Lecture 11 - Capital Asset Pricing Model and Single index model
Lecture 12 - Portfolio performance analysis
Lecture 13 - Utility functions and expected utility
Lecture 14 - Risk preferences of investors
Lecture 15 - Absolute Risk Aversion and Relative Risk Aversion
Lecture 16 - Portfolio theory with utility functions
Lecture 17 - Geometric Mean Return and Roy's Safety-First Criterion
Lecture 18 - Kataoka's Safety-First Criterion and Telser's Safety-First Criterion
Lecture 19 - Semi-variance framework
Lecture 20 - Stochastic dominance; First order stochastic dominance
Lecture 21 - Second order stochastic dominance and Third order stochastic dominance
Lecture 22 - Discrete time model and utility function
Lecture 23 - Optimal portfolio for single-period discrete time model
Lecture 24 - Optimal portfolio for multi-period discrete time model; Discrete Dynamic Programming
Lecture 25 - Continuous time model; Hamilton-Jacobi-Bellman PDE
Lecture 26 - Hamilton-Jacobi-Bellman PDE; Duality/Martingale Approach
Lecture 27 - Duality/Martingale Approach in Discrete and Continuous Time
Lecture 28 - Interest rates and bonds; Duration
Lecture 29 - Duration; Immunization

Lecture 30 - Convexity; Hedging and Immunization
Lecture 31 - Quantiles and their properties
Lecture 32 - Value-at-Risk and its properties
Lecture 33 - Average Value-at-Risk and its properties
Lecture 34 - Asset allocation
Lecture 35 - Portfolio optimization
Lecture 36 - Portfolio optimization with constraints, Value-at-Risk

NPTEL Video Course - Mathematics - NOC:Discrete-time Markov Chains and Poission Processes

Subject Co-ordinator - Prof. Ayon Ganguly, Prof. Subhamay Saha

Co-ordinating Institute - IIT - Guwahati

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Review of Basic Probability - I
Lecture 2 - Review of Basic Probability - II
Lecture 3 - Review of Basic Probability - III
Lecture 4 - Stochastic Processes
Lecture 5 - Definition of Markov Chain and Transition Probabilities
Lecture 6 - Markov Property and Chapman-Kolmogorov Equations
Lecture 7 - Chapman-Kolmogorov Equations: Examples
Lecture 8 - Accessibility and Communication of States
Lecture 9 - Hitting Time - I
Lecture 10 - Hitting Time - II
Lecture 11 - Hitting Time - III
Lecture 12 - Strong Markov Property
Lecture 13 - Passage Time and Excursion
Lecture 14 - Number of Visits
Lecture 15 - Class Property
Lecture 16 - Transience and Recurrence of Random Walks
Lecture 17 - Stationary Distribution - I
Lecture 18 - Stationary Distribution - II
Lecture 19 - Stationary Distribution - III
Lecture 20 - Limit Theorems - I
Lecture 21 - Limit Theorems - II
Lecture 22 - Some Problems - I
Lecture 23 - Some Problems - II
Lecture 24 - Time Reversibility
Lecture 25 - Properties of Exponential Distribution
Lecture 26 - Some Problems
Lecture 27 - Order Statistics
Lecture 28 - Poisson Processes
Lecture 29 - Poisson Thinning - I

Lecture 30 - Poisson Thinning - II
Lecture 31 - Conditional Arrival Times
Lecture 32 - Independent Poisson Processes
Lecture 33 - Some Problems
Lecture 34 - Compound Poisson Processes

NPTEL Video Course - Mathematics - NOC:Introduction to Queueing Theory

Subject Co-ordinator - Prof. N. Selvaraju

Co-ordinating Institute - IIT - Guwahati

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Queueing Systems, System Performance Measures
Lecture 2 - Characteristics of Queueing Systems, Kendall's Notation
Lecture 3 - Little's Law, General Relationships
Lecture 4 - Laplace and Laplace-Stieltjes Transforms, Probability Generating Functions
Lecture 5 - An Overview of Stochastic Processes
Lecture 6 - Markov Chains: Definition, Transition Probabilities
Lecture 7 - Classification Properties of Markov Chains
Lecture 8 - Long-Term Behaviour of Markov Chains
Lecture 9 - Exponential Distribution and its Properties, Poisson Process
Lecture 10 - Poisson Process and its Properties, Generalizations
Lecture 11 - Continuous-Time Markov Chains, Generator Matrix, Kolmogorov Equations
Lecture 12 - Stationary and Limiting Distributions of CTMC, Balance Equations, Birth-Death Processes
Lecture 13 - Birth-Death Queues: General Theory, M/M/1 Queues and their Steady State Solution
Lecture 14 - M/M/1 Queues: Performance Measures, PASTA Property, Waiting Time Distributions
Lecture 15 - M/M/c Queues, Erlang Delay Formula
Lecture 16 - M/M/c/K Queues
Lecture 17 - Erlang's Loss System, Erlang Loss Formula, Infinite-Server Queues
Lecture 18 - Finite-Source Queues, Engset Loss System, State-Dependent Queues, Queues with Impatience
Lecture 19 - Transient Solutions: M/M/1/1, Infinite-Server and M/M/1 Queues, Busy Period Analysis
Lecture 20 - Queues with Bulk Arrivals
Lecture 21 - Queues with Bulk Service
Lecture 22 - Erlang and Phase-Type Distributions
Lecture 23 - Erlangian Queues: Erlangian Arrivals, Erlangian Service Times
Lecture 24 - Nonpreemptive Priority Queues
Lecture 25 - Nonpreemptive and Preemptive Priority Queues
Lecture 26 - M/M/1 Retrial Queues
Lecture 27 - Discrete-Time Queues: Geo/Geo/1 (EAS), Geo/Geo/1 (LAS)
Lecture 28 - Introduction to Queueing Networks, Two-Node Network
Lecture 29 - Burke's Theorem, General Setup, Tandem Networks

Lecture 30 - Queueing Networks with Blocking, Open Jackson Networks
Lecture 31 - Waiting Times and Multiple Classes in Open Jackson Networks
Lecture 32 - Closed Jackson Networks
Lecture 33 - Closed Jackson Networks, Convolution Algorithm
Lecture 34 - Mean-Value Analysis Algorithm
Lecture 35 - Cyclic Queueing Networks, Extensions of Jackson Networks
Lecture 36 - Renewal Processes
Lecture 37 - Regenerative Processes, Semi-Markov Processes
Lecture 38 - M/G/1 Queues, The Pollaczek-Khinchin Mean Formula
Lecture 39 - M/G/1 Queues, The Pollaczek-Khinchin Transform Formula
Lecture 40 - M/G/1 Queues: Waiting Times and Busy Period
Lecture 41 - M/G/1/K Queues, Additional Insights on M/G/1 Queues
Lecture 42 - M/G/c, M/G/â   and M/G/c/c Queues
Lecture 43 - G/M/1 Queues
Lecture 44 - G/G/1 Queues: Lindley's Integral Equation
Lecture 45 - G/G/1 Queues: Bounds
Lecture 46 - Vacation Queues: Introduction, M/M/1 Queues with Vacations
Lecture 47 - M/G/1 Queues with Vacations

NPTEL Video Course - Mathematics - Applied Multivariate Analysis

Subject Co-ordinator - Dr. Sharmishtha Mitra

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Prologue
Lecture 2 - Basic concepts on multivariate distribution
Lecture 3 - Basic concepts on multivariate distribution
Lecture 4 - Multivariate normal distribution â I
Lecture 5 - Multivariate normal distribution â II
Lecture 6 - Multivariate normal distribution â III
Lecture 7 - Some problems on multivariate distributions â I
Lecture 8 - Some problems on multivariate distributions â II
Lecture 9 - Random sampling from multivariate normal distribution and Wishart distribution - I
Lecture 10 - Random sampling from multivariate normal distribution and Wishart distribution - II
Lecture 11 - Random sampling from multivariate normal distribution and Wishart distribution - III
Lecture 12 - Wishart distribution and itâ s properties - I
Lecture 13 - Wishart distribution and itâ s properties - II
Lecture 14 - Hotellingâ s T2 distribution and itâ s applications
Lecture 15 - Hotellingâ s T2 distribution and various confidence intervals and regions
Lecture 16 - Hotellingâ s T2 distribution and Profile analysis
Lecture 17 - Profile analysis - I
Lecture 18 - Profile analysis - II
Lecture 19 - MANOVA - I
Lecture 20 - MANOVA - II
Lecture 21 - MANOVA - III
Lecture 22 - MANOVA & Multiple Correlation Coefficient
Lecture 23 - Multiple Correlation Coefficient
Lecture 24 - Principal Component Analysis
Lecture 25 - Principal Component Analysis
Lecture 26 - Principal Component Analysis
Lecture 27 - Cluster Analysis
Lecture 28 - Cluster Analysis
Lecture 29 - Cluster Analysis

Lecture 30 - Cluster Analysis
Lecture 31 - Discriminant Analysis and Classification
Lecture 32 - Discriminant Analysis and Classification
Lecture 33 - Discriminant Analysis and Classification
Lecture 34 - Discriminant Analysis and Classification
Lecture 35 - Discriminant Analysis and Classification
Lecture 36 - Discriminant Analysis and Classification
Lecture 37 - Discriminant Analysis and Classification
Lecture 38 - Factor_Analysis
Lecture 39 - Factor_Analysis
Lecture 40 - Factor_Analysis
Lecture 41 - Cannonical Correlation Analysis
Lecture 42 - Cannonical Correlation Analysis
Lecture 43 - Cannonical Correlation Analysis
Lecture 44 - Cannonical Correlation Analysis

NPTEL Video Course - Mathematics - Calculus of Variations and Integral Equations

Subject Co-ordinator - Dr. Malay Banerjee, Prof. D. Bahuguna

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Calculus of Variations and Integral Equations
Lecture 2 - Calculus of Variations and Integral Equations
Lecture 3 - Calculus of Variations and Integral Equations
Lecture 4 - Calculus of Variations and Integral Equations
Lecture 5 - Calculus of Variations and Integral Equations
Lecture 6 - Calculus of Variations and Integral Equations
Lecture 7 - Calculus of Variations and Integral Equations
Lecture 8 - Calculus of Variations and Integral Equations
Lecture 9 - Calculus of Variations and Integral Equations
Lecture 10 - Calculus of Variations and Integral Equations
Lecture 11 - Calculus of Variations and Integral Equations
Lecture 12 - Calculus of Variations and Integral Equations
Lecture 13 - Calculus of Variations and Integral Equations
Lecture 14 - Calculus of Variations and Integral Equations
Lecture 15 - Calculus of Variations and Integral Equations
Lecture 16 - Calculus of Variations and Integral Equations
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Lecture 26 - Calculus of Variations and Integral Equations
Lecture 27 - Calculus of Variations and Integral Equations
Lecture 28 - Calculus of Variations and Integral Equations
Lecture 29 - Calculus of Variations and Integral Equations

Lecture 30 - Calculus of Variations and Integral Equations
Lecture 31 - Calculus of Variations and Integral Equations
Lecture 32 - Calculus of Variations and Integral Equations
Lecture 33 - Calculus of Variations and Integral Equations
Lecture 34 - Calculus of Variations and Integral Equations
Lecture 35 - Calculus of Variations and Integral Equations
Lecture 36 - Calculus of Variations and Integral Equations
Lecture 37 - Calculus of Variations and Integral Equations
Lecture 38 - Calculus of Variations and Integral Equations
Lecture 39 - Calculus of Variations and Integral Equations
Lecture 40 - Calculus of Variations and Integral Equations

NPTEL Video Course - Mathematics - Linear programming and Extensions

Subject Co-ordinator - Prof. Prabha Sharma

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Linear Programming Problems
Lecture 2 - Vector space, Linear independence and dependence, basis
Lecture 3 - Moving from one basic feasible solution to another, optimality criteria
Lecture 4 - Basic feasible solutions, existence & derivation
Lecture 5 - Convex sets, dimension of a polyhedron, Faces, Example of a polytope
Lecture 6 - Direction of a polyhedron, correspondence between bfs and extreme points
Lecture 7 - Representation theorem, LPP solution is a bfs, Assignment 1
Lecture 8 - Development of the Simplex Algorithm, Unboundedness, Simplex Tableau
Lecture 9 - Simplex Tableau & algorithm ,Cycling, Blandâ s anti-cycling rules, Phase I & Phase II
Lecture 10 - Big-M method,Graphical solutions, adjacent extreme pts and adjacent bfs
Lecture 11 - Assignment 2, progress of Simplex algorithm on a polytope, bounded variable LPP
Lecture 12 - LPP Bounded variable, Revised Simplex algorithm, Duality theory, weak duality theorem
Lecture 13 - Weak duality theorem, economic interpretation of dual variables, Fundamental theorem of duality
Lecture 14 - Examples of writing the dual, complementary slackness theorem
Lecture 15 - Complementary slackness conditions, Dual Simplex algorithm, Assignment 3
Lecture 16 - Primal-dual algorithm
Lecture 17 - Problem in lecture 16, starting dual feasible solution, Shortest Path Problem
Lecture 18 - Shortest Path Problem, Primal-dual method, example
Lecture 19 - Shortest Path Problem-complexity, interpretation of dual variables, post-optimality analysis-cha
Lecture 20 - Assignment 4, postoptimality analysis, changes in b, adding a new constraint, changes in {aij} ,
Lecture 21 - Parametric LPP-Right hand side vector
Lecture 22 - Parametric cost vector LPP
Lecture 23 - Parametric cost vector LPP, Introduction to Min-cost flow problem
Lecture 24 - Mini-cost flow problem-Transportation problem
Lecture 25 - Transportation problem degeneracy, cycling
Lecture 26 - Sensitivity analysis
Lecture 27 - Sensitivity analysis
Lecture 28 - Bounded variable transportation problem, min-cost flow problem
Lecture 29 - Min-cost flow problem

Lecture 30 - Starting feasible solution, Lexicographic method for preventing cycling ,strongly feasible solut
Lecture 31 - Assignment 6, Shortest path problem, Shortest Path between any two nodes,Detection of negative c
Lecture 32 - Min-cost-flow Sensitivity analysis Shortest path problem sensitivity analysis
Lecture 33 - Min-cost flow changes in arc capacities , Max-flow problem, assignment 7
Lecture 34 - Problem 3 (assignment 7), Min-cut Max-flow theorem, Labelling algorithm
Lecture 35 - Max-flow - Critical capacity of an arc, starting solution for min-cost flow problem
Lecture 36 - Improved Max-flow algorithm
Lecture 37 - Critical Path Method (CPM)
Lecture 38 - Programme Evaluation and Review Technique (PERT)
Lecture 39 - Simplex Algorithm is not polynomial time- An example
Lecture 40 - Interior Point Methods

NPTEL Video Course - Mathematics - Convex Optimization

Subject Co-ordinator - Dr. Joydeep Dutta

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Convex Optimization
Lecture 2 - Convex Optimization
Lecture 3 - Convex Optimization
Lecture 4 - Convex Optimization
Lecture 5 - Convex Optimization
Lecture 6 - Convex Optimization
Lecture 7 - Convex Optimization
Lecture 8 - Convex Optimization
Lecture 9 - Convex Optimization
Lecture 10 - Convex Optimization
Lecture 11 - Convex Optimization
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Lecture 19 - Convex Optimization
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Lecture 36 - Convex Optimization
Lecture 37 - Convex Optimization
Lecture 38 - Convex Optimization
Lecture 39 - Convex Optimization
Lecture 40 - Convex Optimization
Lecture 41 - Convex Optimization
Lecture 42 - Convex Optimization

NPTEL Video Course - Mathematics - Foundations of Optimization

Subject Co-ordinator - Dr. Joydeep Dutta

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Optimization
Lecture 2 - Optimization
Lecture 3 - Optimization
Lecture 4 - Optimization
Lecture 5 - Optimization
Lecture 6 - Optimization
Lecture 7 - Optimization
Lecture 8 - Optimization
Lecture 9 - Optimization
Lecture 10 - Optimization
Lecture 11 - Optimization
Lecture 12 - Optimization
Lecture 13 - Optimization
Lecture 14 - Optimization
Lecture 15 - Optimization
Lecture 16 - Optimization
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Lecture 30 - Optimization
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Lecture 32 - Optimization
Lecture 33 - Optimization
Lecture 34 - Optimization
Lecture 35 - Optimization
Lecture 36 - Optimization
Lecture 37 - Optimization
Lecture 38 - Optimization

NPTEL Video Course - Mathematics - Probability Theory and Applications

Subject Co-ordinator - Prof. Prabha Sharma

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Basic principles of counting
Lecture 2 - Sample space, events, axioms of probability
Lecture 3 - Conditional probability, Independence of events
Lecture 4 - Random variables, cumulative density function, expected value
Lecture 5 - Discrete random variables and their distributions
Lecture 6 - Discrete random variables and their distributions
Lecture 7 - Discrete random variables and their distributions
Lecture 8 - Continuous random variables and their distributions
Lecture 9 - Continuous random variables and their distributions
Lecture 10 - Continuous random variables and their distributions
Lecture 11 - Function of random variables, Momement generating function
Lecture 12 - Jointly distributed random variables, Independent r. v. and their sums
Lecture 13 - Independent r. v. and their sums
Lecture 14 - Chi â square r. v., sums of independent normal r. v., Conditional distr
Lecture 15 - Conditional disti, Joint distr. of functions of r. v., Order statistics
Lecture 16 - Order statistics, Covariance and correlation
Lecture 17 - Covariance, Correlation, Cauchy- Schwarz inequalities, Conditional expectation
Lecture 18 - Conditional expectation, Best linear predictor
Lecture 19 - Inequalities and bounds
Lecture 20 - Convergence and limit theorems
Lecture 21 - Central limit theorem
Lecture 22 - Applications of central limit theorem
Lecture 23 - Strong law of large numbers, Joint mgf
Lecture 24 - Convolutions
Lecture 25 - Stochastic processes
Lecture 26 - Transition and state probabilities
Lecture 27 - State prob., First passage and First return prob
Lecture 28 - First passage and First return prob. Classification of states
Lecture 29 - Random walk, periodic and null states

Lecture 30 - Reducible Markov chains
Lecture 31 - Time reversible Markov chains
Lecture 32 - Poisson Processes
Lecture 33 - Inter-arrival times, Properties of Poisson processes
Lecture 34 - Queuing Models
Lecture 35 - Analysis of L, Lq ,W and Wq , M/M/S model
Lecture 36 - M/M/S , M/M/I/K models
Lecture 37 - M/M/I/K and M/M/S/K models
Lecture 38 - Application to reliability theory failure law
Lecture 39 - Exponential failure law, Weibull law
Lecture 40 - Reliability of systems

NPTEL Video Course - Mathematics - NOC:Basic Calculus for Engineers, Scientists and Economists

Subject Co-ordinator - Dr. Joydeep Dutta

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Numbers
Lecture 2 - Functions-1
Lecture 3 - Sequence-1
Lecture 4 - Sequence-2
Lecture 5 - Limits and Continuity-1
Lecture 6 - Limits and Continuity-2
Lecture 7 - Limits And Continuity-3
Lecture 8 - Derivative-1
Lecture 9 - Derivative-2
Lecture 10 - Maxima And Minima
Lecture 11 - Mean-Value Theorem And Taylors Expansion-1
Lecture 12 - Mean-Value Theorem And Taylors Expansion-2
Lecture 13 - Integration-1
Lecture 14 - Integration-2
Lecture 15 - Integration By Parts
Lecture 16 - Definite Integral
Lecture 17 - Riemann Integration-1
Lecture 18 - Riemann Integration-2
Lecture 19 - Functions Of Two Or More Variables
Lecture 20 - Limits And Continuity Of Functions Of Two Variable
Lecture 21 - Differentiation Of Functions Of Two Variables-1
Lecture 22 - Differentiation Of Functions Of Two Variables-2
Lecture 23 - Unconstrained Minimization Of Funtions Of Two Variables
Lecture 24 - Constrained Minimization And Lagrange Multiplier Rules
Lecture 25 - Infinite Series-1
Lecture 26 - Infinite Series-2
Lecture 27 - Infinite Series-3
Lecture 28 - Multiple Integrals-1
Lecture 29 - Multiple Integrals-2

Lecture 30 - Multiple Integrals-3

NPTEL Video Course - Mathematics - NOC:Probability and Stochastics for finance

Subject Co-ordinator - Dr. Joydeep Dutta

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Basic Probability
Lecture 2 - Interesting Problems In Probability
Lecture 3 - Random variables, distribution function and independence
Lecture 4 - Chebyshev inequality, Borel-Cantelli Lemmas and related issues
Lecture 5 - Law of Large Number and Central Limit Theorem
Lecture 6 - Conditional Expectation - I
Lecture 7 - Conditional Expectation - II
Lecture 8 - Martingales
Lecture 9 - Brownian Motion - I
Lecture 10 - Brownian Motion - II
Lecture 11 - Brownian Motion - III
Lecture 12 - Ito Integral - I
Lecture 13 - Ito Integral - II
Lecture 14 - Ito Calculus - I
Lecture 15 - Ito Calculus - II
Lecture 16 - Ito Integral In Higher Dimension
Lecture 17 - Application to Ito Integral - I
Lecture 18 - Application to Ito Integral - II
Lecture 19 - Black Scholes Formula - I
Lecture 20 - Black Scholes Formula - II

NPTEL Video Course - Mathematics - NOC:Differential Calculus in Several Variables

Subject Co-ordinator - Prof. Sudipta Dutta

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Several Variables and Notion Of distance in Rn
Lecture 2 - Countinuity And Compactness
Lecture 3 - Countinuity And Connectdness
Lecture 4 - Derivatives
Lecture 5 - Matrix Of Linear Transformation
Lecture 6 - Examples for Differentiable function
Lecture 7 - Sufficient condition of differentiability
Lecture 8 - Chain Rule
Lecture 9 - Mean Value Theorem
Lecture 10 - Higher Order Derivatives
Lecture 11 - Taylor's Formula
Lecture 12 - Maximum And Minimum
Lecture 13 - Second derivative test for maximum, minimum and saddle point
Lecture 14 - We formalise the second derivative test discussed in Lecture 2 and do examples
Lecture 15 - Specialisation to functions of two variables
Lecture 16 - Implicit Function Theorem
Lecture 17 - Implicit Function Theorem -a
Lecture 18 - Application of IFT
Lecture 19 - Application of IFT
Lecture 20 - Application of IFT
Lecture 21 - Application of IFT

NPTEL Video Course - Mathematics - NOC:Curves and Surfaces

Subject Co-ordinator - Prof. Sudipta Dutta

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Level curves and locus, definition of parametric curves, tangent, arc length, arc length parametr
Lecture 2 - How much a curve is Â curvedÂ , signed unit normal and signed curvature, rigid motions, constant
Lecture 3 - Curves in R^3, principal normal and binormal, torsion
Lecture 4 - Frenet-Serret formula
Lecture 5 - Simple closed curve and isoperimetric inequality
Lecture 6 - Surfaces and parametric surfaces, examples, regular surface and non-example of regular surface, t
Lecture 7 - Transition maps of smooth surfaces, smooth function between surfaces, diffeomorphism
Lecture 8 - Reparameterization
Lecture 9 - Tangent, Normal
Lecture 10 - Orientable surfaces
Lecture 11 - Examples of Surfaces
Lecture 12 - First Fundamental Form
Lecture 13 - Conformal Mapping
Lecture 14 - Curvature of Surfaces
Lecture 15 - Euler's Theorem
Lecture 16 - Regular Surfaces locally as Quadratic Surfaces
Lecture 17 - Geodesics
Lecture 18 - Existence of Geodesics, Geodesics on Surfaces of revolution
Lecture 19 - Geodesics on surfaces of revolution; Clairaut's Theorem
Lecture 20 - Pseudosphere
Lecture 21 - Classification of Quadratic Surface
Lecture 22 - Surface Area and Equiareal Map

NPTEL Video Course - Mathematics - NOC:Linear Regression Analysis and Forecasting

Subject Co-ordinator - Prof. Shalabh

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Basic Fundamental Concepts Of Modelling
Lecture 2 - Regression Model - A Statistical Tool
Lecture 3 - Simple Linear Regression Analysis
Lecture 4 - Estimation Of Parameters In Simple Linear Regression Model
Lecture 5 - Estimation Of Parameters In Simple Linear Regression Model (Continued...)
Lecture 6 - Estimation Of Parameters In Simple Linear Regression Model (Continued...)
Lecture 7 - Maximum Likelihood Estimation of Parameters in Simple Linear Regression Model
Lecture 8 - Testing of Hypotheis and Confidence Interval Estimation in Simple Linear Regression Model
Lecture 9 - Testing of Hypotheis and Confidence Interval Estimation in Simple Linear Regression Model (Contin
Lecture 10 - Software Implementation in Simple Linear Regression Model using MINITAB
Lecture 11 - Multiple Linear Regression Model
Lecture 12 - Estimation of Model Parameters in Multiple Linear Regression Model
Lecture 13 - Estimation of Model Parameters in Multiple Linear Regression Model (Continued...)
Lecture 14 - Standardized Regression Coefficients and Testing of Hypothesis
Lecture 15 - Testing of Hypothesis (Continued...) and Goodness of Fit of the Model
Lecture 16 - Diagnostics in Multiple Linear Regression Model
Lecture 17 - Diagnostics in Multiple Linear Regression Model (Continued...)
Lecture 18 - Diagnostics in Multiple Linear Regression Model (Continued...)
Lecture 19 - Software Implementation of Multiple Linear Regression Model using MINITAB
Lecture 20 - Software Implementation of Multiple Linear Regression Model using MINITAB (Continued...)
Lecture 21 - Forecasting in Multiple Linear Regression Model
Lecture 22 - Within Sample Forecasting
Lecture 23 - Outside Sample Forecasting
Lecture 24 - Software Implementation of Forecasting using MINITAB

NPTEL Video Course - Mathematics - NOC:Introduction to R Software

Subject Co-ordinator - Prof. Shalabh

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - How to Learn and Follow the Course
Lecture 2 - Why R and Installation Procedure
Lecture 3 - Introduction _Help_ Demo examples_ packages_ libraries
Lecture 4 - Introduction _Command line_ Data editor _ Rstudio
Lecture 5 - Basics in Calculations
Lecture 6 - Basics of Calculations _ Calculator _Built in Functions Assignments
Lecture 7 - Basics of Calculations _Functions _Matrices
Lecture 8 - Basics Calculations
Lecture 9 - Basics Calculations
Lecture 10 - Basics Calculations
Lecture 11 - Basics Calculations
Lecture 12 - Basics Calculations
Lecture 13 - Basics Calculations
Lecture 14 - Basics Calculations
Lecture 15 - Data management - Sequences
Lecture 16 - Data management - sequences
Lecture 17 - Data management - Repeats
Lecture 18 - Data management - Sorting and Ordering
Lecture 19 - Data management - Lists
Lecture 20 - Data management - Lists (Continued...)
Lecture 21 - Data management - Vector indexing
Lecture 22 - Data management - Vector Indexing (Continued...)
Lecture 23 - Data management - Factors
Lecture 24 - Data management - factors (Continued...)
Lecture 25 - Strings - Display and Formatting, Print and Format Functions
Lecture 26 - Strings - Display and Formatting, Print and Format with Concatenate
Lecture 27 - Strings - Display and Formatting, Paste Function
Lecture 28 - Strings - Display and Formatting, Splitting
Lecture 29 - Strings - Display and Formatting, Replacement_ Manipulations _Alphabets

Lecture 30 - Strings - Display and Formatting, Replacement and Evaluation of Strings
Lecture 31 - Data frames
Lecture 32 - Data frames (Continued...)
Lecture 33 - Data frames (Continued...)
Lecture 34 - Data Handling - Importing CSV and Tabular Data Files
Lecture 35 - Data Handling - Importing Data Files from Other Software
Lecture 36 - Statistical Functions - Frequency and Partition values
Lecture 37 - Statistical Functions - Graphics and Plots
Lecture 38 - Statistical Functions - Central Tendency and Variation
Lecture 39 - Statistical Functions - Boxplots, Skewness and Kurtosis
Lecture 40 - Statistical Functions - Bivariate three dimensional plot
Lecture 41 - Statistical Functions - Correlation and Examples of Programming
Lecture 42 - Examples of Programming
Lecture 43 - Examples of More Programming

NPTEL Video Course - Mathematics - NOC:Descriptive Statistics with R Software

Subject Co-ordinator - Prof. Shalabh

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to R Software
Lecture 2 - Basics and R as a Calculator
Lecture 3 - Calculations with Data Vectors
Lecture 4 - Built-in Commands and Missing Data Handling
Lecture 5 - Operations with Matrices
Lecture 6 - Objectives, Steps and Basic Definitions
Lecture 7 - Variables and Types of Data
Lecture 8 - Absolute Frequency, Relative Frequency and Frequency Distribution
Lecture 9 - Frequency Distribution and Cumulative Distribution Function
Lecture 10 - Bar Diagrams
Lecture 11 - Subdivided Bar Plots and Pie Diagrams
Lecture 12 - 3D Pie Diagram and Histogram
Lecture 13 - Kernel Density and Stem - Leaf Plots
Lecture 14 - Arithmetic Mean
Lecture 15 - Median
Lecture 16 - Quantiles
Lecture 17 - Mode, Geometric Mean and Harmonic Mean
Lecture 18 - Range, Interquartile Range and Quartile Deviation
Lecture 19 - Absolute Deviation and Absolute Mean Deviation
Lecture 20 - Mean Squared Error, Variance and Standard Deviation
Lecture 21 - Coefficient of Variation and Boxplots
Lecture 22 - Raw and Central Moments
Lecture 23 - Sheppard's Correction, Absolute Moments and Computation of Moments
Lecture 24 - Skewness and Kurtosis
Lecture 25 - Univariate and Bivariate Scatter Plots
Lecture 26 - Smooth Scatter Plots
Lecture 27 - Quantile- Quantile and Three Dimensional Plots
Lecture 28 - Correlation Coefficient
Lecture 29 - Correlation Coefficient Using R Software

Lecture 30 - Rank Correlation Coefficient
Lecture 31 - Measures of Association for Discrete and Counting Variables - Part 1
Lecture 32 - Measures of Association for Discrete and Counting Variables - Part 2
Lecture 33 - Least Squares Method - One Variable
Lecture 34 - Least Squares Method - R Commands and More than One Variables

NPTEL Video Course - Mathematics - NOC:Calculus of Several Real Variables

Subject Co-ordinator - Dr. Joydeep Dutta

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Vectors in plane and space
Lecture 2 - Inner product and distance
Lecture 3 - Application to real world problems
Lecture 4 - Matrices and determinants
Lecture 5 - Cross product of two vectors
Lecture 6 - Higher dimensional Euclidean space
Lecture 7 - Functions of more than one real-variable
Lecture 8 - Partial derivatives and Continuity
Lecture 9 - Vector-valued maps and Jacobian matrix
Lecture 10 - Chain rule for partial derivatives
Lecture 11 - The Gradient Vector and Directional Derivative
Lecture 12 - The Implicit Function Theorem
Lecture 13 - Higher Order Partial Derivatives
Lecture 14 - Taylor's Theorem in Higher Dimension
Lecture 15 - Maxima and Minima for Several Variables
Lecture 16 - Second Derivative Test for Maximum and Minimum
Lecture 17 - Constrained Optimization and The Lagrange Multiplier Rule
Lecture 18 - Vector Valued Function and Classical Mechanics
Lecture 19 - Arc Length
Lecture 20 - Vector Fields
Lecture 21 - Multiple Integral - I
Lecture 22 - Multiple Integral - II
Lecture 23 - Multiple Integral - III
Lecture 24 - Multiple Integral - IV
Lecture 25 - Cylindrical and Spherical Coordinates
Lecture 26 - Multiple Integrals and Mechanics
Lecture 27 - Line Integral - I
Lecture 28 - Line Integral - II
Lecture 29 - Parametrized Surfaces

Lecture 30 - Area of a surface Integral
Lecture 31 - Area of parametrized surface
Lecture 32 - Surface Integrals
Lecture 33 - Green's Theorem
Lecture 34 - Stoke's Theorem
Lecture 35 - Examples of Stoke's Theorem
Lecture 36 - Gauss Divergence Theorem
Lecture 37 - Facts about vector fields

NPTEL Video Course - Mathematics - NOC:Linear Algebra (Prof. A.K. Lal)

Subject Co-ordinator - Prof. A.K. Lal

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Notations, Motivation and Definition
Lecture 2 - Matrix: Examples, Transpose and Addition
Lecture 3 - Matrix Multiplication
Lecture 4 - Matrix Product Recalled
Lecture 5 - Matrix Product (Continued...)
Lecture 6 - Inverse of a Matrix
Lecture 7 - Introduction to System of Linear Equations
Lecture 8 - Some Initial Results on Linear Systems
Lecture 9 - Row Echelon Form (REF)
Lecture 10 - LU Decomposition - Simplest Form
Lecture 11 - Elementary Matrices
Lecture 12 - Row Reduced Echelon Form (RREF)
Lecture 13 - Row Reduced Echelon Form (RREF) (Continued...)
Lecture 14 - RREF and Inverse
Lecture 15 - Rank of a matrix
Lecture 16 - Solution Set of a System of Linear Equations
Lecture 17 - System of n Linear Equations in n Unknowns
Lecture 18 - Determinant
Lecture 19 - Permutations and the Inverse of a Matrix
Lecture 20 - Inverse and the Cramer's Rule
Lecture 21 - Vector Spaces
Lecture 22 - Vector Subspaces and Linear Span
Lecture 23 - Linear Combination, Linear Independence and Dependence
Lecture 24 - Basic Results on Linear Independence
Lecture 25 - Results on Linear Independence (Continued...)
Lecture 26 - Basis of a Finite Dimensional Vector Space
Lecture 27 - Fundamental Spaces associated with a Matrix
Lecture 28 - Rank - Nullity Theorem
Lecture 29 - Fundamental Theorem of Linear Algebra

Lecture 30 - Definition and Examples of Linear Transformations
Lecture 31 - Results on Linear Transformations
Lecture 32 - Rank-Nullity Theorem and Applications
Lecture 33 - Isomorphism of Vector Spaces
Lecture 34 - Ordered Basis of a Finite Dimensional Vector Space
Lecture 35 - Ordered Basis (Continued...)
Lecture 36 - Matrix of a Linear Transformation
Lecture 37 - Matrix of a Linear Transformation (Continued...)
Lecture 38 - Matrix of a Linear Transformation (Continued...)
Lecture 39 - Similarity of Matrices
Lecture 40 - Inner Product Space
Lecture 41 - Inner Product (Continued...)
Lecture 42 - Cauchy Schwartz Inequality
Lecture 43 - Projection on a Vector
Lecture 44 - Results on Orthogonality
Lecture 45 - Results on Orthogonality (Continued...)
Lecture 46 - Gram-Schmidt Orthonormalization Process
Lecture 47 - Orthogonal Projections
Lecture 48 - Gram-Schmidt Process: Applications
Lecture 49 - Examples and Applications on QR-decomposition
Lecture 50 - Recapitulate ideas on Inner Product Spaces
Lecture 51 - Motivation on Eigenvalues and Eigenvectors
Lecture 52 - Examples and Introduction to Eigenvalues and Eigenvectors
Lecture 53 - Results on Eigenvalues and Eigenvectors
Lecture 54 - Results on Eigenvalues and Eigenvectors (Continued...)
Lecture 55 - Results on Eigenvalues and Eigenvectors (Continued...)
Lecture 56 - Diagonalizability
Lecture 57 - Diagonalizability (Continued...)
Lecture 58 - Schur's Unitary Triangularization (SUT)
Lecture 59 - Applications of Schur's Unitary Triangularization
Lecture 60 - Spectral Theorem for Hermitian Matrices
Lecture 61 - Cayley Hamilton Theorem
Lecture 62 - Quadratic Forms
Lecture 63 - Sylvester's Law of Inertia
Lecture 64 - Applications of Quadratic Forms to Analytic Geometry
Lecture 65 - Examples of Conics and Quartics
Lecture 66 - Singular Value Decomposition (SVD)

NPTEL Video Course - Mathematics - NOC:Computational Number Theory and Algebra

Subject Co-ordinator - Prof. Nitin Saxena

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Background
Lecture 3 - GCD algorithm and Chinese Remainder Theorem
Lecture 4 - Fast polynomial multiplication
Lecture 5 - Fast polynomial multiplication (Continued...)
Lecture 6 - Fast integer multiplication and division
Lecture 7 - Fast integer arithmetic and matrix multiplication
Lecture 8 - Matrix Multiplication Tensor
Lecture 9 - Polynomial factoring over finite fields
Lecture 10 - Equi-degree factorization and idea of Berlekamp's algorithm
Lecture 11 - Berlekamp's algorithm as a reduction method
Lecture 12 - Factoring over finite fields
Lecture 13 - Reed Solomon Error Correcting Codes
Lecture 14 - List Decoding
Lecture 15 - Bivariate Factorization - Hensel Lifting
Lecture 16 - Bivariate polynomial factoring (Continued...)
Lecture 17 - Multivariate Polynomial Factorization
Lecture 18 - Multivariate Factoring - Hilbert's Irreducibility Theorem
Lecture 19 - Multivariate factoring (Continued...)
Lecture 20 - Analysis of LLL algorithm
Lecture 21 - Analysis of LLL algorithm (Continued...)
Lecture 22 - Analysis of LLL-reduced basis algorithm and Introduction to NTRU cryptosystem
Lecture 23 - NTRU cryptosystem (Continued...) and Introduction to Primality testing
Lecture 24 - Randomized Primality testing
Lecture 25 - Deterministic primality test (AKS) and RSA cryptosystem
Lecture 26 - Integer factoring
Lecture 27 - Pollard's p-1, Fermat, Morrison-Brillhart, Quadratic and Number field sieve methods

NPTEL Video Course - Mathematics - NOC:Basic Calculus 1 and 2

Subject Co-ordinator - Prof. Parasar Mohanty

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Real numbers and Archimedean property
Lecture 2 - Supremum and Decimal representation of Reals
Lecture 3 - Functions
Lecture 4 - Functions continued and Limits
Lecture 5 - Limits (Continued...)
Lecture 6 - Limits (Continued...) and Continuity
Lecture 7 - Continuity and Intermediate Value Property
Lecture 8 - Differentiation
Lecture 9 - Chain Rule
Lecture 10 - Nth derivative of a function
Lecture 11 - Local extrema and Rolle's theorem
Lecture 12 - Mean value theorem and Monotone functions
Lecture 13 - Local extremum tests
Lecture 14 - Concavity and points of inflection
Lecture 15 - Asymptotes and plotting graph of functions
Lecture 16 - Optimization and L'Hospital Rule
Lecture 17 - L'Hospital Rule continued and Cauchy Mean value theorem
Lecture 18 - Approximation of Roots
Lecture 19 - Antiderivative and Riemann Integration
Lecture 20 - Riemann's criterion for Integrability
Lecture 21 - Integration and its properties
Lecture 22 - Area and Mean value theorem for integrals
Lecture 23 - Fundamental theorem of Calculus
Lecture 24 - Integration by parts and Trapezoidal rule
Lecture 25 - Simpson's rule and Substitution in integrals
Lecture 26 - Area between curves
Lecture 27 - Arc Length and Parametric curves
Lecture 28 - Polar Co-ordinates
Lecture 29 - Area of curves in polar coordinates

Lecture 30 - Volume of solids
Lecture 31 - Improper Integrals
Lecture 32 - Sequences
Lecture 33 - Algebra of sequences and Sandwich theorem
Lecture 34 - Subsequences
Lecture 35 - Series
Lecture 36 - Comparison tests for Series
Lecture 37 - Ratio and Root test for series
Lecture 38 - Integral test and Leibniz test for series
Lecture 39 - Revision - I
Lecture 40 - Revision - II

NPTEL Video Course - Mathematics - NOC:Advanced Partial Differential Equations

Subject Co-ordinator - Prof. Kaushik Bal

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

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Lecture 32
Lecture 33

NPTEL Video Course - Mathematics - NOC:Essentials of Data Science With R Software 1: Probability and Statisti

Subject Co-ordinator - Prof. Shalabh

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Data Science - Why, What, and How?
Lecture 2 - Installation and Working with R
Lecture 3 - Installation and Working with R Studio
Lecture 4 - Calculations with R as a Calculator
Lecture 5 - Calculations with Data Vectors
Lecture 6 - Built-in Commands and Bivariate Plots
Lecture 7 - Logical Operators and Selection of Sample
Lecture 8 - Introduction to Probability
Lecture 9 - Sample Space and Events
Lecture 10 - Set Theory and Events using Venn Diagrams
Lecture 11 - Relative Frequency and Probability
Lecture 12 - Probability and Relative Frequency - An Example
Lecture 13 - Axiomatic Definition of Probability
Lecture 14 - Some Rules of Probability
Lecture 15 - Basic Principles of Counting - Ordered Set, Unordered Set, and Permutations
Lecture 16 - Basic Principles of Counting - Combination
Lecture 17 - Conditional Probability
Lecture 18 - Multiplication Theorem of Probability
Lecture 19 - Bayes' Theorem
Lecture 20 - Independent Events
Lecture 21 - Computation of Probability using R
Lecture 22 - Random Variables - Discrete and Continuous
Lecture 23 - Cumulative Distribution and Probability Density Function
Lecture 24 - Discrete Random Variables, Probability Mass Function and Cumulative Distribution Function
Lecture 25 - Expectation of Variables
Lecture 26 - Moments and Variance
Lecture 27 - Data Based Moments and Variance in R Software
Lecture 28 - Skewness and Kurtosis
Lecture 29 - Quantiles and Tschebyschevâ s Inequality

Lecture 30 - Degenerate and Discrete Uniform Distributions
Lecture 31 - Discrete Uniform Distribution in R
Lecture 32 - Bernoulli and Binomial Distribution
Lecture 33 - Binomial Distribution in R
Lecture 34 - Poisson Distribution
Lecture 35 - Poisson Distribution in R
Lecture 36 - Geometric Distribution
Lecture 37 - Geometric Distribution in R
Lecture 38 - Continuous Random Variables and Uniform Distribution
Lecture 39 - Normal Distribution
Lecture 40 - Normal Distribution in R
Lecture 41 - Normal Distribution - More Results
Lecture 42 - Exponential Distribution
Lecture 43 - Bivariate Probability Distribution for Discrete Random Variables
Lecture 44 - Bivariate Probability Distribution in R Software
Lecture 45 - Bivariate Probability Distribution for Continuous Random Variables
Lecture 46 - Examples in Bivariate Probability Distribution Functions
Lecture 47 - Covariance and Correlation
Lecture 48 - Covariance and Correlation â • Examples and R Software
Lecture 49 - Bivariate Normal Distribution
Lecture 50 - Chi square Distribution
Lecture 51 - t-Distribution
Lecture 52 - F-Distribution
Lecture 53 - Distribution of Sample Mean, Convergence in Probability and Weak Law of Large Numbers
Lecture 54 - Central Limit Theorem
Lecture 55 - Needs for Drawing Statistical Inferences
Lecture 56 - Unbiased Estimators
Lecture 57 - Efficiency of Estimators
Lecture 58 - CramÃ©râ Rao Lower Bound and Efficiency of Estimators
Lecture 59 - Consistency and Sufficiency of Estimators
Lecture 60 - Method of Moments
Lecture 61 - Method of Maximum Likelihood and Rao Blackwell Theorem
Lecture 62 - Basic Concepts of Confidence Interval Estimation
Lecture 63 - Confidence Interval for Mean in One Sample with Known Variance
Lecture 64 - Confidence Interval for Mean and Variance
Lecture 65 - Basics of Tests of Hypothesis and Decision Rules
Lecture 66 - Test Procedures for One Sample Test for Mean with Known Variance
Lecture 67 - One Sample Test for Mean with Unknown Variance
Lecture 68 - Two Sample Test for Mean with Known and Unknown Variances

Lecture 69 - Test of Hypothesis for Variance in One and Two Samples

NPTEL Video Course - Mathematics - NOC:Essentials of Data Science With R Software 2: Sampling Theory and Line

Subject Co-ordinator - Prof. Shalabh

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - What is Data Science ?
Lecture 2 - Installation and Working with R
Lecture 3 - Calculations with R as a Calculator
Lecture 4 - Calculations with Data Vectors
Lecture 5 - Built-in Commands and Missing Data Handling
Lecture 6 - Operations with Matrices
Lecture 7 - Data Handling
Lecture 8 - Graphics and Plots
Lecture 9 - Sampling, Sampling Unit, Population and Sample
Lecture 10 - Terminologies and Concepts
Lecture 11 - Ensuring Representativeness and Type of Surveys
Lecture 12 - Conducting Surveys and Ensuring Representativeness
Lecture 13 - SRSWOR, SRSWR, and Selection of Unit - 1
Lecture 14 - SRSWOR, SRSWR, and Selection of Unit - 2
Lecture 15 - Probabilities of Selection of Samples
Lecture 16 - SRSWOR and SRSWR with R with sample Package
Lecture 17 - Examples of SRS with R using sample Package
Lecture 18 - Simple Random Sampling : SRS with R using sampling and sample Packages
Lecture 19 - Simple Random Sampling : Estimation of Population Mean
Lecture 20 - Simple Random Sampling : Estimation of Population Variance
Lecture 21 - Simple Random Sampling : Estimation of Population Variance
Lecture 22 - SRS: Confidence Interval Estimation of Population Mean
Lecture 23 - SRS: Estimation of Mean, Variance and Confidence Interval in SRSWOR using R
Lecture 24 - SRS: Estimation of Mean, Variance and Confidence Interval in SRSWR using R
Lecture 25 - Sampling for Proportions and Percentages : Basic Concepts
Lecture 26 - Sampling for Proportions and Percentages : Mean and Variance of Sample Proportion
Lecture 27 - Sampling for Proportions and Percentages : Sampling for Proportions with R
Lecture 28 - Stratified Random Sampling : Drawing the Sample and Sampling Procedure
Lecture 29 - Stratified Random Sampling : Estimation of Population Mean, Population Variance and Confidence I

Lecture 30 - Stratified Random Sampling : Sample Allocation and Variances Under Allocation
Lecture 31 - Stratified Random Sampling : Drawing of Sample Using sampling and strata Packages in R
Lecture 32 - Stratified Random Sampling : Drawing of Sample Using survey Package in R
Lecture 33 - Bootstrap Methodology : What is Bootstrap and Methodology
Lecture 34 - Bootstrap Methodology : EDF, Bootstrap Bias and Bootstrap Standard Errors
Lecture 35 - Bootstrap Methodology : Bootstrap Analysis Using boot Package in R
Lecture 36 - Bootstrap Methodology : Bootstrap Confidence Interval
Lecture 37 - Bootstrap Methodology : Bootstrap Confidence Interval Using boot and bootstrap Packages in R
Lecture 38 - Bootstrap Methodology : Example of Bootstrap Analysis Using boot Package
Lecture 39 - Introduction to Linear Models and Regression : Introduction and Basic Concepts
Lecture 40 - Simple Linear Regression Analysis : Basic Concepts and Least Squares Estimation
Lecture 41 - Simple Linear Regression Analysis : Fitting Linear Model With R Software
Lecture 42 - Simple Linear Regression Analysis : Properties of Least Squares Estimators
Lecture 43 - Simple Linear Regression Analysis : Maximum Likelihood and Confidence Interval Estimation
Lecture 44 - Simple Linear Regression Analysis : Test of Hypothesis and Confidence Interval Estimation With R
Lecture 45 - Multiple Linear Regression Analysis : Basic Concepts
Lecture 46 - Multiple Linear Regression Analysis : OLSE, Fitted Model and Residuals
Lecture 47 - Multiple Linear Regression Analysis : Model Fitting With R Software
Lecture 48 - Multiple Linear Regression Analysis : Properties of OLSE and Maximum Likelihood Estimation
Lecture 49 - Multiple Linear Regression Analysis : Test of Hypothesis and Confidence Interval Estimation on I
Lecture 50 - Analysis of Variance and Implementation in R Software
Lecture 51 - Goodness of Fit and Implementation in R Software
Lecture 52 - Variable Selection using LASSO Regression : Introduction and Basic Concepts
Lecture 53 - Variable Selection using LASSO Regression : LASSO with R

NPTEL Video Course - Mathematics - NOC:Measure Theoretic Probability 1

Subject Co-ordinator - Prof. Suprio Bhar

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to the course Measure Theoretic Probability 1
Lecture 2 - Sigma-fields and Measurable spaces
Lecture 3 - Fields and Generating sets for Sigma-fields
Lecture 4 - Borel Sigma-field on R and other sets
Lecture 5 - Limits of sequences of sets and Monotone classes
Lecture 6 - Measures and Measure spaces
Lecture 7 - Probability Measures
Lecture 8 - Properties of Measures - I
Lecture 9 - Properties of Measures - II
Lecture 10 - Properties of Measures - III
Lecture 11 - Measurable functions
Lecture 12 - Borel Measurable functions
Lecture 13 - Algebraic properties of Measurable functions
Lecture 14 - Limiting behaviour of measurable functions
Lecture 15 - Random Variables and Random Vectors
Lecture 16 - Law or Distribution of an RV
Lecture 17 - Distribution Function of an RV
Lecture 18 - Decomposition of Distribution functions
Lecture 19 - Construction of RVs with a specified law
Lecture 20 - Caratheodery Extension Theorem
Lecture 21 - From Distribution Functions to Probability Measures - I
Lecture 22 - From Distribution Functions to Probability Measures - II
Lecture 23 - Lebesgue-Stieltjes Measures
Lecture 24 - Properties of Lebesgue Measure on R
Lecture 25 - Distribution Functions and Probability Measures in higher dimensions
Lecture 26 - Integration of measurable functions
Lecture 27 - Properties of Measure Theoretic Integration - I
Lecture 28 - Properties of Measure Theoretic Integration - II
Lecture 29 - Monotone Convergence Theorem

Lecture 30 - Computation of Expectation for Discrete RVs
Lecture 31 - MCT and the Linearity of Measure Theoretic Integration
Lecture 32 - Sets of measure zero and Measure Theoretic Integration
Lecture 33 - Fatou's Lemma and Dominated Convergence Theorem
Lecture 34 - Riemann and Lebesgue integration
Lecture 35 - Computations involving Lebesgue Integration
Lecture 36 - Decomposition of Measures
Lecture 37 - Absolutely Continuous RVs
Lecture 38 - Expectation of Absolutely Continuous RVs
Lecture 39 - Inequalities involving moments of RVs
Lecture 40 - Conclusion to the course Measure Theoretic Probability 1

NPTEL Video Course - Mathematics - NOC:Foundations of R Software

Subject Co-ordinator - Prof. Shalabh

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1
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NPTEL Video Course - Mathematics - NOC:Foundations of R Software (In Hindi)

Subject Co-ordinator - Prof. Shalabh

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

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NPTEL Video Course - Mathematics - NOC:An Introduction to Hyperbolic Geometry

Subject Co-ordinator - Prof. Abhijit Pal

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

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NPTEL Video Course - Mathematics - NOC:A Primer to Mathematical Optimization

Subject Co-ordinator - Prof. Debdas Ghosh

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction and History of Optimization
Lecture 2 - Basics of Linear Algebra
Lecture 3 - Definiteness of Matrices
Lecture 4 - Sets in R^n
Lecture 5 - Limit Superior and Limit Inferior
Lecture 6 - Order of Convergence
Lecture 7 - Lipschitz and Uniform Continuity
Lecture 8 - Partial and Directional Derivatives and Differnentiability (8,9)
Lecture 9 - Taylor's Theorem
Lecture 10 - Convex Sets and Convexity Preserving Operations
Lecture 11 - Sepration Results
Lecture 12 - Theorems of Alternatives (13 and 14)
Lecture 13 - Convex Functions
Lecture 14 - Properties and Zeroth Order Characterization of Convex Function
Lecture 15 - First-Order and Second-Order Characterization of Convex Functions
Lecture 16 - Convexity Preserving Operations
Lecture 17 - Optimality and Coerciveness
Lecture 18 - First-Order Optimality Condition (20 Part 1)
Lecture 19 - Second-Order Optimality Condition (20 Part 2)
Lecture 20 - General Structure of Unconstrained Optimization Algorithms
Lecture 21 - Inexact Line Search
Lecture 22 - Globel Convergence of Descent Methods (23,24)
Lecture 23 - Where Do Descent Methods Converge?
Lecture 24 - Scaling of Variables
Lecture 25 - Practical Stoping Criteria
Lecture 26 - Steepest Descent Method (28,29)
Lecture 27 - Newton's Method (30,31,32)
Lecture 28 - Quasi Newton Methods (33,34,35)
Lecture 29 - Conjugate Direction Methods (36,37)

Lecture 30 - Trust Region Methods - Part I
Lecture 31 - Trust Region Methods - Part II
Lecture 32 - A Revisit to Lagrange Multipliears Method
Lecture 33 - Special Cones for Contrained Optimization
Lecture 34 - Tangent Cone
Lecture 35 - First-Order KKT Optimality Conditions (42,43)
Lecture 36 - Second-Order KKT Optimality Conditions
Lecture 37 - Constraint Qualifications
Lecture 38 - Lagrangian Duality Theory (46 to 50)
Lecture 39 - Methods for Linearly Constrained Problems (51,52,53)
Lecture 40 - Interior-Point Method for QPP
Lecture 41 - Penalty Methods
Lecture 42 - Sequential Quadratic Programming Method

NPTEL Video Course - Mathematics - NOC:Measure Theoretic Probability 2

Subject Co-ordinator - Prof. Suprio Bhar

Co-ordinating Institute - IIT - Kanpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

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Lecture 42
Lecture 43
Lecture 44

NPTEL Video Course - Mathematics - Advanced Engineering Mathematics

Subject Co-ordinator - Dr. P. Panigrahi, Prof. J. Kumar, Prof. P.D. Srivastava, Prof. Somesh Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Review Groups, Fields and Matrices
Lecture 2 - Vector Spaces, Subspaces, Linearly Dependent/Independent of Vectors
Lecture 3 - Basis, Dimension, Rank and Matrix Inverse
Lecture 4 - Linear Transformation, Isomorphism and Matrix Representation
Lecture 5 - System of Linear Equations, Eigenvalues and Eigenvectors
Lecture 6 - Method to Find Eigenvalues and Eigenvectors, Diagonalization of Matrices
Lecture 7 - Jordan Canonical Form, Cayley Hamilton Theorem
Lecture 8 - Inner Product Spaces, Cauchy-Schwarz Inequality
Lecture 9 - Orthogonality, Gram-Schmidt Orthogonalization Process
Lecture 10 - Spectrum of special matrices,positive/negative definite matrices
Lecture 11 - Concept of Domain, Limit, Continuity and Differentiability
Lecture 12 - Analytic Functions, C-R Equations
Lecture 13 - Harmonic Functions
Lecture 14 - Line Integral in the Complex
Lecture 15 - Cauchy Integral Theorem
Lecture 16 - Cauchy Integral Theorem (Continued.)
Lecture 17 - Cauchy Integral Formula
Lecture 18 - Power and Taylor's Series of Complex Numbers
Lecture 19 - Power and Taylor's Series of Complex Numbers (Continued.)
Lecture 20 - Taylor's, Laurent Series of f(z) and Singularities
Lecture 21 - Classification of Singularities, Residue and Residue Theorem
Lecture 22 - Laplace Transform and its Existence
Lecture 23 - Properties of Laplace Transform
Lecture 24 - Evaluation of Laplace and Inverse Laplace Transform
Lecture 25 - Applications of Laplace Transform to Integral Equations and ODEs
Lecture 26 - Applications of Laplace Transform to PDEs
Lecture 27 - Fourier Series
Lecture 28 - Fourier Series (Continued.)
Lecture 29 - Fourier Integral Representation of a Function

Lecture 30 - Introduction to Fourier Transform
Lecture 31 - Applications of Fourier Transform to PDEs
Lecture 32 - Laws of Probability - I
Lecture 33 - Laws of Probability - II
Lecture 34 - Problems in Probability
Lecture 35 - Random Variables
Lecture 36 - Special Discrete Distributions
Lecture 37 - Special Continuous Distributions
Lecture 38 - Joint Distributions and Sampling Distributions
Lecture 39 - Point Estimation
Lecture 40 - Interval Estimation
Lecture 41 - Basic Concepts of Testing of Hypothesis
Lecture 42 - Tests for Normal Populations

NPTEL Video Course - Mathematics - Functional Analysis

Subject Co-ordinator - Prof. P.D. Srivastava

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Metric Spaces with Examples
Lecture 2 - Holder Inequality and Minkowski Inequality
Lecture 3 - Various Concepts in a Metric Space
Lecture 4 - Separable Metrics Spaces with Examples
Lecture 5 - Convergence, Cauchy Sequence, Completeness
Lecture 6 - Examples of Complete and Incomplete Metric Spaces
Lecture 7 - Completion of Metric Spaces + Tutorial
Lecture 8 - Vector Spaces with Examples
Lecture 9 - Normed Spaces with Examples
Lecture 10 - Banach Spaces and Schauder Basic
Lecture 11 - Finite Dimensional Normed Spaces and Subspaces
Lecture 12 - Compactness of Metric/Normed Spaces
Lecture 13 - Linear Operators-definition and Examples
Lecture 14 - Bounded Linear Operators in a Normed Space
Lecture 15 - Bounded Linear Functionals in a Normed Space
Lecture 16 - Concept of Algebraic Dual and Reflexive Space
Lecture 17 - Dual Basis & Algebraic Reflexive Space
Lecture 18 - Dual Spaces with Examples
Lecture 19 - Tutorial - I
Lecture 20 - Tutorial - II
Lecture 21 - Inner Product & Hilbert Space
Lecture 22 - Further Properties of Inner Product Spaces
Lecture 23 - Projection Theorem, Orthonormal Sets and Sequences
Lecture 24 - Representation of Functionals on a Hilbert Spaces
Lecture 25 - Hilbert Adjoint Operator
Lecture 26 - Self Adjoint, Unitary & Normal Operators
Lecture 27 - Tutorial - III
Lecture 28 - Annihilator in an IPS
Lecture 29 - Total Orthonormal Sets And Sequences

Lecture 30 - Partially Ordered Set and Zorns Lemma
Lecture 31 - Hahn Banach Theorem for Real Vector Spaces
Lecture 32 - Hahn Banach Theorem for Complex V.S. & Normed Spaces
Lecture 33 - Baires Category & Uniform Boundedness Theorems
Lecture 34 - Open Mapping Theorem
Lecture 35 - Closed Graph Theorem
Lecture 36 - Adjoint Operator
Lecture 37 - Strong and Weak Convergence
Lecture 38 - Convergence of Sequence of Operators and Functionals
Lecture 39 - LP - Space
Lecture 40 - LP - Space (Continued.)

NPTEL Video Course - Mathematics - Numerical methods of Ordinary and Partial Differential Equations

Subject Co-ordinator - Dr. G.P. Raja Sekhar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Motivation with few Examples
Lecture 2 - Single - Step Methods for IVPs
Lecture 3 - Analysis of Single Step Methods
Lecture 4 - Runge - Kutta Methods for IVPs
Lecture 5 - Higher Order Methods/Equations
Lecture 6 - Error - Stability - Convergence of Single Step Methods
Lecture 7 - Tutorial - I
Lecture 8 - Tutorial - II
Lecture 9 - Multi-Step Methods (Explicit)
Lecture 10 - Multi-Step Methods (Implicit)
Lecture 11 - Convergence and Stability of multi step methods
Lecture 12 - General methods for absolute stability
Lecture 13 - Stability Analysis of Multi Step Methods
Lecture 14 - Predictor - Corrector Methods
Lecture 15 - Some Comments on Multi - Step Methods
Lecture 16 - Finite Difference Methods - Linear BVPs
Lecture 17 - Linear/Non - Linear Second Order BVPs
Lecture 18 - BVPS - Derivative Boundary Conditions
Lecture 19 - Higher Order BVPs
Lecture 20 - Shooting Method BVPs
Lecture 21 - Tutorial - III
Lecture 22 - Introduction to First Order PDE
Lecture 23 - Introduction to Second Order PDE
Lecture 24 - Finite Difference Approximations to Parabolic PDEs
Lecture 25 - Implicit Methods for Parabolic PDEs
Lecture 26 - Consistency, Stability and Convergence
Lecture 27 - Other Numerical Methods for Parabolic PDEs
Lecture 28 - Tutorial - IV
Lecture 29 - Matrix Stability Analysis of Finite Difference Scheme

Lecture 30 - Fourier Series Stability Analysis of Finite Difference Scheme
Lecture 31 - Finite Difference Approximations to Elliptic PDEs - I
Lecture 32 - Finite Difference Approximations to Elliptic PDEs - II
Lecture 33 - Finite Difference Approximations to Elliptic PDEs - III
Lecture 34 - Finite Difference Approximations to Elliptic PDEs - IV
Lecture 35 - Finite Difference Approximations to Hyperbolic PDEs - I
Lecture 36 - Finite Difference Approximations to Hyperbolic PDEs - II
Lecture 37 - Method of characteristics for Hyperbolic PDEs - I
Lecture 38 - Method of characterisitcs for Hyperbolic PDEs - II
Lecture 39 - Finite Difference Approximations to 1st order Hyperbolic PDEs
Lecture 40 - Summary, Appendices, Remarks

NPTEL Video Course - Mathematics - Optimization

Subject Co-ordinator - Prof. A. Goswami, Dr. Debjani Chakraborty

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Optimization - Introduction
Lecture 2 - Formulation of LPP
Lecture 3 - Geometry of LPP and Graphical Solution of LPP
Lecture 4 - Solution of LPP
Lecture 5 - Big - M Method
Lecture 6 - Two - Phase Method
Lecture 7 - Special Cases in Simple Applications
Lecture 8 - Introduction to Duality Theory
Lecture 9 - Dual Simplex Method
Lecture 10 - Post Optimaility Analysis
Lecture 11 - Integer Programming - I
Lecture 12 - Integer Programming - II
Lecture 13 - Introduction to Transportation Problems
Lecture 14 - Solving Various types of Transportation Problems
Lecture 15 - Assignment Problems
Lecture 16 - Project Management
Lecture 17 - Critical Path Analysis
Lecture 18 - PERT
Lecture 19 - Shortest Path Algorithm
Lecture 20 - Travelling Salesman Problem
Lecture 21 - Classical optimization techniques
Lecture 22 - Unconstarined multivariable optimization
Lecture 23 - Nonlinear programming with equality constraint
Lecture 24 - Nonlinear programming KKT conditions
Lecture 25 - Numerical optimization
Lecture 26 - Numerical optimization
Lecture 27 - Fibonacci Method
Lecture 28 - Golden Section Methods
Lecture 29 - Interpolation Methods

Lecture 30 - Unconstarined optimization techniques
Lecture 31 - Unconstarined optimization techniques
Lecture 32 - Nonlinear programming
Lecture 33 - Interior and Exterior penulty Function Method
Lecture 34 - Separable Programming Problem
Lecture 35 - Introduction to Geometric Programming
Lecture 36 - Constrained Geometric Programming Problem
Lecture 37 - Dynamic Programming Problem
Lecture 38 - Dynamic Programming Problem (Continued.)
Lecture 39 - Multi Objective Decision Making
Lecture 40 - Multi attribute decision making

NPTEL Video Course - Mathematics - Probability and Statistics

Subject Co-ordinator - Prof. Somesh Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Algebra of Sets - I
Lecture 2 - Algebra of Sets - II
Lecture 3 - Introduction to Probability
Lecture 4 - Laws of Probability - I
Lecture 5 - Laws of Probability - II
Lecture 6 - Problems in Probability
Lecture 7 - Random Variables
Lecture 8 - Probability Distributions
Lecture 9 - Characteristics of Distribution
Lecture 10 - Special Distributions - I
Lecture 11 - Special Distributions - II
Lecture 12 - Special Distributions - III
Lecture 13 - Special Distributions - IV
Lecture 14 - Special Distributions - V
Lecture 15 - Special Distributions - VI
Lecture 16 - Special Distributions - VII
Lecture 17 - Functions of a Random Variable
Lecture 18 - Joint Distributions - I
Lecture 19 - Joint Distributions - II
Lecture 20 - Joint Distributions - III
Lecture 21 - Joint Distributions - IV
Lecture 22 - Transformations of Random Vectors
Lecture 23 - Sampling Distributions - I
Lecture 24 - Sampling Distributions - II
Lecture 25 - Descriptive Statistics - I
Lecture 26 - Descriptive Statistics - II
Lecture 27 - Estimation - I
Lecture 28 - Estimation - II
Lecture 29 - Estimation - III

Lecture 30 - Estimation - IV
Lecture 31 - Estimation - V
Lecture 32 - Estimation - VI
Lecture 33 - Testing of Hypothesis - I
Lecture 34 - Testing of Hypothesis - II
Lecture 35 - Testing of Hypothesis - III
Lecture 36 - Testing of Hypothesis - IV
Lecture 37 - Testing of Hypothesis - V
Lecture 38 - Testing of Hypothesis - VI
Lecture 39 - Testing of Hypothesis - VII
Lecture 40 - Testing of Hypothesis - VIII

NPTEL Video Course - Mathematics - Regression Analysis

Subject Co-ordinator - Dr. Soumen Maity

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Simple Linear Regression
Lecture 2 - Simple Linear Regression (Continued...1)
Lecture 3 - Simple Linear Regression (Continued...2)
Lecture 4 - Simple Linear Regression (Continued...3)
Lecture 5 - Simple Linear Regression (Continued...4)
Lecture 6 - Multiple Linear Regression
Lecture 7 - Multiple Linear Regression (Continued...1)
Lecture 8 - Multiple Linear Regression (Continued...2)
Lecture 9 - Multiple Linear Regression (Continued...3)
Lecture 10 - Selecting the BEST Regression model
Lecture 11 - Selecting the BEST Regression model (Continued...1)
Lecture 12 - Selecting the BEST Regression model (Continued...2)
Lecture 13 - Selecting the BEST Regression model (Continued...3)
Lecture 14 - Multicollinearity
Lecture 15 - Multicollinearity (Continued...1)
Lecture 16 - Multicollinearity (Continued...2)
Lecture 17 - Model Adequacy Checking
Lecture 18 - Model Adequacy Checking (Continued...1)
Lecture 19 - Model Adequacy Checking (Continued...2)
Lecture 20 - Test for Influential Observations
Lecture 21 - Transformations and Weighting to correct model inadequacies
Lecture 22 - Transformations and Weighting to correct model inadequacies (Continued...1)
Lecture 23 - Transformations and Weighting to correct model inadequacies (Continued...2)
Lecture 24 - Dummy Variables
Lecture 25 - Dummy Variables (Continued...1)
Lecture 26 - Dummy Variables (Continued...2)
Lecture 27 - Polynomial Regression Models
Lecture 28 - Polynomial Regression Models (Continued...1)
Lecture 29 - Polynomial Regression Models (Continued...2)

Lecture 30 - Generalized Linear Models
Lecture 31 - Generalized Linear Models (Continued.)
Lecture 32 - Non-Linear Estimation
Lecture 33 - Regression Models with Autocorrelated Errors
Lecture 34 - Regression Models with Autocorrelated Errors (Continued.)
Lecture 35 - Measurement Errors & Calibration Problem
Lecture 36 - Tutorial - I
Lecture 37 - Tutorial - II
Lecture 38 - Tutorial - III
Lecture 39 - Tutorial - IV
Lecture 40 - Tutorial - V

NPTEL Video Course - Mathematics - Statistical Inference

Subject Co-ordinator - Prof. Somesh Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction and Motivation
Lecture 2 - Basic Concepts of Point Estimations - I
Lecture 3 - Basic Concepts of Point Estimations - II
Lecture 4 - Finding Estimators - I
Lecture 5 - Finding Estimators - II
Lecture 6 - Finding Estimators - III
Lecture 7 - Properties of MLEs
Lecture 8 - Lower Bounds for Variance - I
Lecture 9 - Lower Bounds for Variance - II
Lecture 10 - Lower Bounds for Variance - III
Lecture 11 - Lower Bounds for Variance - IV
Lecture 12 - Sufficiency
Lecture 13 - Sufficiency and Information
Lecture 14 - Minimal Sufficiency, Completeness
Lecture 15 - UMVU Estimation, Ancillarity
Lecture 16 - Invariance - I
Lecture 17 - Invariance - II
Lecture 18 - Bayes and Minimax Estimation - I
Lecture 19 - Bayes and Minimax Estimation - II
Lecture 20 - Bayes and Minimax Estimation - III
Lecture 21 - Testing of Hypotheses
Lecture 22 - Neyman Pearson Fundamental Lemma
Lecture 23 - Applications of NP lemma
Lecture 24 - UMP Tests
Lecture 25 - UMP Tests (Continued.)
Lecture 26 - UMP Unbiased Tests
Lecture 27 - UMP Unbiased Tests (Continued.)
Lecture 28 - UMP Unbiased Tests
Lecture 29 - Unbiased Tests for Normal Populations

Lecture 30 - Unbiased Tests for Normal Populations (Continued.)
Lecture 31 - Likelihood Ratio Tests - I
Lecture 32 - Likelihood Ratio Tests - II
Lecture 33 - Likelihood Ratio Tests - III
Lecture 34 - Likelihood Ratio Tests - IV
Lecture 35 - Invariant Tests
Lecture 36 - Test for Goodness of Fit
Lecture 37 - Sequential Procedure
Lecture 38 - Sequential Procedure (Continued.)
Lecture 39 - Confidence Intervals
Lecture 40 - Confidence Intervals (Continued.)

NPTEL Video Course - Mathematics - A Basic Course in Real Analysis

Subject Co-ordinator - Prof. P.D. Srivastava

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Rational Numbers and Rational Cuts
Lecture 2 - Irrational numbers, Dedekind's Theorem
Lecture 3 - Continuum and Exercises
Lecture 4 - Continuum and Exercises (Continued.)
Lecture 5 - Cantor's Theory of Irrational Numbers
Lecture 6 - Cantor's Theory of Irrational Numbers (Continued.)
Lecture 7 - Equivalence of Dedekind and Cantor's Theory
Lecture 8 - Finite, Infinite, Countable and Uncountable Sets of Real Numbers
Lecture 9 - Types of Sets with Examples, Metric Space
Lecture 10 - Various properties of open set, closure of a set
Lecture 11 - Ordered set, Least upper bound, greatest lower bound of a set
Lecture 12 - Compact Sets and its properties
Lecture 13 - Weiersstrass Theorem, Heine Borel Theorem, Connected set
Lecture 14 - Tutorial - II
Lecture 15 - Concept of limit of a sequence
Lecture 16 - Some Important limits, Ratio tests for sequences of Real Numbers
Lecture 17 - Cauchy theorems on limit of sequences with examples
Lecture 18 - Fundamental theorems on limits, Bolzano-Weiersstrass Theorem
Lecture 19 - Theorems on Convergent and divergent sequences
Lecture 20 - Cauchy sequence and its properties
Lecture 21 - Infinite series of real numbers
Lecture 22 - Comparison tests for series, Absolutely convergent and Conditional convergent series
Lecture 23 - Tests for absolutely convergent series
Lecture 24 - Raabe's test, limit of functions, Cluster point
Lecture 25 - Some results on limit of functions
Lecture 26 - Limit Theorems for functions
Lecture 27 - Extension of limit concept (one sided limits)
Lecture 28 - Continuity of Functions
Lecture 29 - Properties of Continuous Functions

Lecture 30 - Boundedness Theorem, Max-Min Theorem and Bolzano's theorem
Lecture 31 - Uniform Continuity and Absolute Continuity
Lecture 32 - Types of Discontinuities, Continuity and Compactness
Lecture 33 - Continuity and Compactness (Continued.), Connectedness
Lecture 34 - Differentiability of real valued function, Mean Value Theorem
Lecture 35 - Mean Value Theorem (Continued.)
Lecture 36 - Application of MVT , Darboux Theorem, L Hospital Rule
Lecture 37 - L'Hospital Rule and Taylor's Theorem
Lecture 38 - Tutorial - III
Lecture 39 - Riemann/Riemann Stieltjes Integral
Lecture 40 - Existence of Reimann Stieltjes Integral
Lecture 41 - Properties of Reimann Stieltjes Integral
Lecture 42 - Properties of Reimann Stieltjes Integral (Continued.)
Lecture 43 - Definite and Indefinite Integral
Lecture 44 - Fundamental Theorems of Integral Calculus
Lecture 45 - Improper Integrals
Lecture 46 - Convergence Test for Improper Integrals

NPTEL Video Course - Mathematics - Statistical Methods for Scientists and Engineers

Subject Co-ordinator - Prof. Somesh Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Foundations of Probability
Lecture 2 - Laws of Probability
Lecture 3 - Random Variables
Lecture 4 - Moments and Special Distributions
Lecture 5 - Moments and Special Distributions (Continued...)
Lecture 6 - Special Distributions (Continued...)
Lecture 7 - Special Distributions (Continued...)
Lecture 8 - Sampling Distributions
Lecture 9 - Parametric Methods - I
Lecture 10 - Parametric Methods - II
Lecture 11 - Parametric Methods - III
Lecture 12 - Parametric Methods - IV
Lecture 13 - Parametric Methods - V
Lecture 14 - Parametric Methods - VI
Lecture 15 - Parametric Methods - VII
Lecture 16 - Multivariate Analysis - I
Lecture 17 - Multivariate Analysis - II
Lecture 18 - Multivariate Analysis - III
Lecture 19 - Multivariate Analysis - IV
Lecture 20 - Multivariate Analysis - V
Lecture 21 - Multivariate Analysis - VI
Lecture 22 - Multivariate Analysis - VII
Lecture 23 - Multivariate Analysis - VIII
Lecture 24 - Multivariate Analysis - IX
Lecture 25 - Multivariate Analysis - X
Lecture 26 - Multivariate Analysis - XI
Lecture 27 - Multivariate Analysis - XII
Lecture 28 - Non parametric Methods - I
Lecture 29 - Non parametric Methods - II

Lecture 30 - Non parametric Methods - III
Lecture 31 - Non parametric Methods - IV
Lecture 32 - Nonparametric Methods - V
Lecture 33 - Nonparametric Methods - VI
Lecture 34 - Nonparametric Methods - VII
Lecture 35 - Nonparametric Methods - VIII
Lecture 36 - Nonparametric Methods - IX
Lecture 37 - Nonparametric Methods - X
Lecture 38 - Nonparametric Methods - XI
Lecture 39 - Nonparametric Methods - XII
Lecture 40 - Nonparametric Methods - XIII

NPTEL Video Course - Mathematics - NOC:Probability and Statistics

Subject Co-ordinator - Prof. Somesh Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Sets, Classes, Collection
Lecture 2 - Sequence of Sets
Lecture 3 - Ring, Field (Algebra)
Lecture 4 - Sigma-Ring, Sigma-Field, Monotone Class
Lecture 5 - Random Experiment, Events
Lecture 6 - Definitions of Probability
Lecture 7 - Properties of Probability Function - I
Lecture 8 - Properties of Probability Function - II
Lecture 9 - Conditional Probability
Lecture 10 - Independence of Events
Lecture 11 - Problems in Probability - I
Lecture 12 - Problems in Probability - II
Lecture 13 - Random Variables
Lecture 14 - Probability Distribution of a Random Variable - I
Lecture 15 - Probability Distribution of a Random Variable - II
Lecture 16 - Moments
Lecture 17 - Characteristics of Distributions - I
Lecture 18 - Characteristics of Distributions - II
Lecture 19 - Special Discrete Distributions - I
Lecture 20 - Special Discrete Distributions - II
Lecture 21 - Special Discrete Distributions - III
Lecture 22 - Poisson Process - I
Lecture 23 - Poisson Process - II
Lecture 24 - Special Continuous Distributions - I
Lecture 25 - Special Continuous Distributions - II
Lecture 26 - Special Continuous Distributions - III
Lecture 27 - Special Continuous Distributions - IV
Lecture 28 - Special Continuous Distributions - V
Lecture 29 - Normal Distribution

Lecture 30 - Problems on Normal Distribution
Lecture 31 - Problems on Special Distributions - I
Lecture 32 - Problems on Special Distributions - II
Lecture 33 - Function of a random variable - I
Lecture 34 - Function of a random variable - II
Lecture 35 - Joint Distributions - I
Lecture 36 - Joint Distributions - II
Lecture 37 - Independence, Product Moments
Lecture 38 - Linearity Property of Correlation and Examples
Lecture 39 - Bivariate Normal Distribution - I
Lecture 40 - Bivariate Normal Distribution - II
Lecture 41 - Additive Properties of Distributions - I
Lecture 42 - Additive Properties of Distributions - II
Lecture 43 - Transformation of Random Variables
Lecture 44 - Distribution of Order Statistics
Lecture 45 - Basic Concepts
Lecture 46 - Chi-Square Distribution
Lecture 47 - Chi-Square Distribution (Continued...), t-Distribution
Lecture 48 - F-Distribution
Lecture 49 - Descriptive Statistics - I
Lecture 50 - Descriptive Statistics - II
Lecture 51 - Descriptive Statistics - III
Lecture 52 - Descriptive Statistics - IV
Lecture 53 - Introduction to Estimation
Lecture 54 - Unbiased and Consistent Estimators
Lecture 55 - LSE, MME
Lecture 56 - Examples on MME, MLE
Lecture 57 - Examples on MLE - I
Lecture 58 - Examples on MLE - II, MSE
Lecture 59 - UMVUE, Sufficiency, Completeness
Lecture 60 - Rao - Blackwell Theorem and Its Applications
Lecture 61 - Confidence Intervals - I
Lecture 62 - Confidence Intervals - II
Lecture 63 - Confidence Intervals - III
Lecture 64 - Confidence Intervals - IV
Lecture 65 - Basic Definitions
Lecture 66 - Two Types of Errors
Lecture 67 - Neyman-Pearson Fundamental Lemma
Lecture 68 - Applications of N-P Lemma - I

Lecture 69 - Applications of N-P Lemma - II
Lecture 70 - Testing for Normal Mean
Lecture 71 - Testing for Normal Variance
Lecture 72 - Large Sample Test for Variance and Two Sample Problem
Lecture 73 - Paired t-Test
Lecture 74 - Examples
Lecture 75 - Testing Equality of Proportions
Lecture 76 - Chi-Square Test for Goodness Fit - I
Lecture 77 - Chi-Square Test for Goodness Fit - II
Lecture 78 - Testing for Independence in rxc Contingency Table - I
Lecture 79 - Testing for Independence in rxc Contingency Table - II

NPTEL Video Course - Mathematics - NOC:Applied Multivariate Statistical Modeling

Subject Co-ordinator - Dr J Maiti

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Multivariate Statistical Modeling
Lecture 2 - Introduction to Multivariate Statistical Modeling: Data types, models, and modeling
Lecture 3 - Statistical approaches to model building
Lecture 4 - Statistical approaches to model building (Continued...)
Lecture 5 - Univariate Descriptive Statistics
Lecture 6 - Univariate Descriptive Statistics (Continued...)
Lecture 7 - Normal Distribution and Chi-squared Distribution
Lecture 8 - t-distribution, F-distribution, and Central Limit Theorem
Lecture 9 - Univariate Inferential Statistics: Estimation
Lecture 10 - Univariate Inferential Statistics: Estimation (Continued...)
Lecture 11 - Univariate Inferential Statistics: Hypothesis Testing
Lecture 12 - Hypothesis Testing (Continued...): Decision Making Scenarios
Lecture 13 - Multivariate Descriptive Statistics: Mean Vector
Lecture 14 - Multivariate Descriptive Statistics: Covariance Matrix
Lecture 15 - Multivariate Descriptive Statistics: Correlation Matrix
Lecture 16 - Multivariate Descriptive Statistics: Relationship between correlation and covariance matrices
Lecture 17 - Multivariate Normal Distribution
Lecture 18 - Multivariate Normal Distribution (Continued...)
Lecture 19 - Multivariate Normal Distribution (Continued...): Geometrical Interpretation
Lecture 20 - Multivariate Normal Distribution (Continued...): Examining data for multivariate normal distribu
Lecture 21 - Multivariate Inferential Statistics: Basics and Hotelling T-square statistic
Lecture 22 - Multivariate Inferential Statistics: Confidence Region
Lecture 23 - Multivariate Inferential Statistics: Simultaneous confidence interval and Hypothesis testing
Lecture 24 - Multivariate Inferential Statistics: Hypothesis testing for equality of two population mean vect
Lecture 25 - Analysis of Variance (ANOVA)
Lecture 26 - Analysis of Variance (ANOVA): Decomposition of Total sum of squares
Lecture 27 - Analysis of Variance (ANOVA): Estimation of Parameters and Model Adequacy tests
Lecture 28 - Two-way and Three-way Analysis of Variance (ANOVA)
Lecture 29 - Tutorial ANOVA

Lecture 30 - Tutorial ANOVA (Continued...)
Lecture 31 - Multivariate Analysis of Variance (MANOVA): Conceptual Model
Lecture 32 - Multivariate Analysis of Variance (MANOVA): Assumptions and Decomposition of total sum square ar
Lecture 33 - Multivariate Analysis of Variance (MANOVA): Decomposition of total sum square and cross products
Lecture 34 - Multivariate Analysis of Variance (MANOVA): Estimation and Hypothesis testing
Lecture 35 - MANOVA Case Study
Lecture 36 - Multiple Linear Regression: Introduction
Lecture 37 - Multiple Linear Regression: Assumptions and Estimation of model parameters
Lecture 38 - Multiple Linear Regression: Sampling Distribution of parameter estimates
Lecture 39 - Multiple Linear Regression: Sampling Distribution of parameter estimates (Continued...)
Lecture 40 - Multiple Linear Regression: Model Adequacy Tests
Lecture 41 - Multiple Linear Regression: Model Adequacy Tests (Continued...)
Lecture 42 - Multiple Linear Regression: Test of Assumptions
Lecture 43 - MLR-Model diagnostics
Lecture 44 - MLR-case study
Lecture 45 - Multivariate Linear Regression: Conceptual model and assumptions
Lecture 46 - Multivariate Linear Regression: Estimation of parameters
Lecture 47 - Multivariate Linear Regression: Estimation of parameters (Continued...)
Lecture 48 - Multiple Linear Regression: Sampling Distribution of parameter estimates
Lecture 49 - Multivariate Linear Regression: Model Adequacy Tests
Lecture 50 - Multiple Linear Regression: Model Adequacy Tests (Continued...)
Lecture 51 - Regression modeling using SPSS
Lecture 52 - Principal Component Analysis (PCA): Conceptual Model
Lecture 53 - Principal Component Analysis (PCA): Extraction of Principal components (PCs)
Lecture 54 - Principal Component Analysis (PCA): Model Adequacy and Interpretation
Lecture 55 - Principal Component Analysis (PCA): Model Adequacy and Interpretation (Continued...)
Lecture 56 - Factor Analysis: Basics and Orthogonal factor models
Lecture 57 - Factor Analysis: Types of models and key questions
Lecture 58 - Factor Analysis: Parameter Estimation
Lecture 59 - Factor Analysis: Parameter Estimation (Continued...)
Lecture 60 - Factor Analysis: Model Adequacy tests and factor rotation
Lecture 61 - Factor Analysis: Factor scores and case study

NPTEL Video Course - Mathematics - NOC:Partial Differential Equations (PDE) for Engineers: Solution by Separa

Subject Co-ordinator - Prof. S. De

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to PDE
Lecture 2 - Classification of PDE
Lecture 3 - Principle of Linear Superposition
Lecture 4 - Standard Eigen Value Problem and Special ODEs
Lecture 5 - Adjoint Operator
Lecture 6 - Generalized Sturm - Louiville Problem
Lecture 7 - Properties of Adjoint Operator
Lecture 8 - Separation of Variables
Lecture 9 - Solution of 3 Dimensional Parabolic Problem
Lecture 10 - Solution of 4 Dimensional Parabolic problem
Lecture 11 - Solution of 4 Dimensional Parabolic Problem (Continued...)
Lecture 12 - Solution of Elliptical PDE
Lecture 13 - Solution of Hyperbolic PDE
Lecture 14 - Orthogonality of Bessel Function and 2 Dimensional Cylindrical Coordinate System
Lecture 15 - Cylindrical Co-ordinate System - 3 Dimensional Problem
Lecture 16 - Spherical Polar Coordinate System
Lecture 17 - Spherical Polar Coordinate System (Continued...)
Lecture 18 - Example of Generalized 3 Dimensional Problem
Lecture 19 - Example of Application Oriented Problems
Lecture 20 - Examples of Application Oriented Problems (Continued...)

NPTEL Video Course - Mathematics - NOC:Introductory Course in Real Analysis

Subject Co-ordinator - Prof. P.D. Srivastava

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Countable and Uncountable sets
Lecture 2 - Properties of Countable and Uncountable sets
Lecture 3 - Examples of Countable and Uncountable sets
Lecture 4 - Concepts of Metric Space
Lecture 5 - Open ball, Closed ball, Limit point of a set
Lecture 6 - Tutorial-I
Lecture 7 - Some theorems on Open and Closed sets
Lecture 8 - Ordered set, Least upper bound, Greatest lower bound of a set
Lecture 9 - Ordered set, Least upper bound, Greatest lower bound of a set (Continued...)
Lecture 10 - Compact Set
Lecture 11 - Properties of Compact sets
Lecture 12 - Tutorial-II
Lecture 13 - Heine Borel Theorem
Lecture 14 - Weierstrass Theorem
Lecture 15 - Cantor set and its properties
Lecture 16 - Derived set and Dense set
Lecture 17 - Limit of a sequence and monotone sequence
Lecture 18 - Tutorial-III
Lecture 19 - Some Important limits of sequences
Lecture 20 - Ratio Test CauchyÂ s theorems on limits of sequences of real numbers
Lecture 21 - Fundamental theorems on limits
Lecture 22 - Some results on limits and Bolzano-Weierstrass Theorem
Lecture 23 - Criteria for convergent sequence
Lecture 24 - Tutorial-IV
Lecture 25 - Criteria for Divergent Sequence
Lecture 26 - Cauchy Sequence
Lecture 27 - Cauchy Convergence Criteria for Sequences
Lecture 28 - Infinite Series of Real Numbers
Lecture 29 - Convergence Criteria for Series of Positive Real Numbers

Lecture 30 - Tutorial-V
Lecture 31 - Comparison Test for Series
Lecture 32 - Absolutely and Conditionally Convergent Series
Lecture 33 - Rearrangement Theorem and Test for Convergence of Series
Lecture 34 - Ratio and Integral Test for Convergence of Series
Lecture 35 - Raabe's Test for Convergence of Series
Lecture 36 - Tutorial-VI
Lecture 37 - Limit of Functions and Cluster Point
Lecture 38 - Limit of Functions (Continued...)
Lecture 39 - Divergence Criteria for Limit
Lecture 40 - Various Properties of Limit of Functions
Lecture 41 - Left and Right Hand Limits for Functions
Lecture 42 - Tutorial-VII
Lecture 43 - Limit of Functions at Infinity
Lecture 44 - Continuous Functions (Cauchy's Definition)
Lecture 45 - Continuous Functions (Heine's Definition)
Lecture 46 - Properties of Continuous Functions
Lecture 47 - Properties of Continuous Functions (Continued...)
Lecture 48 - Tutorial-VIII
Lecture 49 - Boundness Theorem and Max-Min Theorem
Lecture 50 - Location of Root and Bolzano's Theorem
Lecture 51 - Uniform Continuity and Related Theorems
Lecture 52 - Absolute Continuity and Related Theorems
Lecture 53 - Types of Discontinuities
Lecture 54 - Tutorial-IX
Lecture 55 - Types of Discontinuities (Continued...)
Lecture 56 - Relation between Continuity and Compact Sets
Lecture 57 - Differentiability of Real Valued Functions
Lecture 58 - Local Max. - Min. Cauchy's and Lagrange's Mean Value Theorem
Lecture 59 - Rolle's Mean Value Theorems and Its Applications
Lecture 60 - Tutorial-X
Lecture 61
Lecture 62
Lecture 63
Lecture 64
Lecture 65
Lecture 66
Lecture 67
Lecture 68

Lecture 69
Lecture 70
Lecture 71
Lecture 72
Lecture 73

NPTEL Video Course - Mathematics - NOC:Modeling Transport Phenomena of Microparticles

Subject Co-ordinator - Dr. G.P. Raja Sekhar, Prof. Somnath Bhattacharyya

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Preliminary concepts
Lecture 2 - CauchyÂ s equation of motion and Navier-Stokes equations
Lecture 3 - Reduced forms of Navier-Stokes equations and Boundary conditions
Lecture 4 - Exact solutions of Navier-Stokes equations in particular cases
Lecture 5 - Dimensional Analysis Â Non-dimensionalization of Navier-StokesÂ s equations
Lecture 6 - Stream function formulation of Navier-Stokes equations
Lecture 7 - Stokes flow past a cylinder
Lecture 8 - Stokes flow past a sphere
Lecture 9 - Elementary Lubrication Theory
Lecture 10 - Hydrodynamics of Squeeze flow
Lecture 11 - Solution of arbitrary Stokes flows
Lecture 12 - Mechanics of Swimming Microorganisms
Lecture 13 - Viscous flow past a spherical drop
Lecture 14 - Migration of a viscous drop under Marangoni effects
Lecture 15 - Singularities of Stokes flows
Lecture 16 - Introduction to porous media
Lecture 17 - Flow through porous media Â elementary geometries
Lecture 18 - Flow through composite porous channels
Lecture 19 - Modeling transport of particles inside capillaries
Lecture 20 - Modeling transport of microparticles Â some applications
Lecture 21 - Introduction to Elctrokietics
Lecture 22 - Basics on Electrostatics
Lecture 23 - Transport Equations for Electrokinetics, Part-I
Lecture 24 - Transport Equations for Electrokinetics, Part-II
Lecture 25 - Electric Double Layer
Lecture 26 - Electroosmotic flow (EOF) of ionized fluid
Lecture 27 - EOF in micro-channel
Lecture 28 - Non-linear EOF, Overlapping Debye Layer
Lecture 29 - Two-dimensional EOF

Lecture 30 - EOF near heterogeneous surface potential
Lecture 31 - Electroosmosis in hydrophobic surface
Lecture 32 - Numerical Methods for Boundary Value Problems (BVP)
Lecture 33 - Numerical Methods for nonlinear BVP
Lecture 34 - Numerical Methods for coupled set of BVP
Lecture 35 - Numerical Methods for PDEs
Lecture 36 - Numerical Methods for transport equations, Part-I
Lecture 37 - Numerical Methods for transport equations, Part-II
Lecture 38 - Electrophoresis of charged colloids, Part-I
Lecture 39 - Electrophoresis of charged colloids, Part-II
Lecture 40 - Gel Electrophoresis

NPTEL Video Course - Mathematics - NOC:Constrained and Unconstrained Optimization

Subject Co-ordinator - Dr. Debjani Chakraborty, Prof. A. Goswami

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Optimization
Lecture 2 - Assumptions and Mathematical Modeling of LPP
Lecture 3 - Geometrey of LPP
Lecture 4 - Graphical Solution of LPP - I
Lecture 5 - Graphical Solution of LPP - II
Lecture 6 - Solution of LPP
Lecture 7 - Simplex Method
Lecture 8 - Introduction to BIG-M Method
Lecture 9 - Algorithm of BIG-M Method
Lecture 10 - Problems on BIG-M Method
Lecture 11 - Two Phase Method
Lecture 12 - Two Phase Method
Lecture 13 - Special Cases of LPP
Lecture 14 - Degeneracy in LPP
Lecture 15 - Sensitivity Analysis - I
Lecture 16 - Sensitivity Analysis - II
Lecture 17 - Problems on Sensitivity Analysis
Lecture 18 - Introduction to Duality Theory - I
Lecture 19 - Introduction to Duality Theory - II
Lecture 20 - Dual Simplex Method
Lecture 21 - Examples on Dual Simplex Method
Lecture 22 - Interger Linear Programming
Lecture 23 - Interger Linear Programming
Lecture 24 - IPP
Lecture 25 - Mixed Integer Programming Problem
Lecture 26
Lecture 27
Lecture 28
Lecture 29

Lecture 30
Lecture 31 - Introduction to Nonlinear programming
Lecture 32 - Graphical Solution of NLP
Lecture 33 - Types of NLP
Lecture 34 - One dimentional unconstrained optimization
Lecture 35 - Unconstrained Optimization
Lecture 36 - Region Elimination Technique - 1
Lecture 37 - Region Elimination Technique - 2
Lecture 38 - Region Elimination Technique - 3
Lecture 39 - Unconstrained Optimization
Lecture 40 - Unconstrained Optimization
Lecture 41 - Multivariate Unconstrained Optimization - 1
Lecture 42 - Multivariate Unconstrained Optimization - 2
Lecture 43 - Unconstrained Optimization
Lecture 44 - NLP with Equality Constrained - 1
Lecture 45 - NLP with Equality Constrained - 2
Lecture 46 - Constrained NLP - 1
Lecture 47 - Constrained NLP - 2
Lecture 48 - Constrained Optimization
Lecture 49 - Constrained Optimization
Lecture 50 - KKT
Lecture 51 - Constrained Optimization
Lecture 52 - Constrained Optimization
Lecture 53 - Feasible Direction
Lecture 54 - Penalty and barrier method
Lecture 55 - Penalty method
Lecture 56 - Penalty and barrier method
Lecture 57 - Penalty and barrier method
Lecture 58 - Dynamic programming
Lecture 59 - Multi-Objective decision making
Lecture 60 - Multi-Attribute decision making

NPTEL Video Course - Mathematics - NOC:Matrix Solver

Subject Co-ordinator - Prof. Somnath Roy

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Matrix Algebra - I
Lecture 2 - Introduction to Matrix Algebra - II
Lecture 3 - System of Linear Equations
Lecture 4 - Determinant of a Matrix
Lecture 5 - Determinant of a Matrix (Continued...)
Lecture 6 - Gauss Elimination
Lecture 7 - Gauss Elimination (Continued...)
Lecture 8 - LU Decomposition
Lecture 9 - Gauss-Jordon Method
Lecture 10 - Representation of Physical Systems as Matrix Equations
Lecture 11 - Tridiagonal Matrix Algorithm
Lecture 12 - Equations with Singular Matrices
Lecture 13 - Introduction to Vector Space
Lecture 14 - Vector Subspace
Lecture 15 - Column Space and Nullspace of a Matrix
Lecture 16 - Finding Null Space of a Matrix
Lecture 17 - Solving Ax=b when A is Singular
Lecture 18 - Linear Independence and Spanning of a Subspace
Lecture 19 - Basis and Dimension of a Vector Space
Lecture 20 - Four Fundamental Subspaces of a Matrix
Lecture 21 - Left and right inverse of a matrix
Lecture 22 - Orthogonality between the subspaces
Lecture 23 - Best estimate
Lecture 24 - Projection operation and linear transformation
Lecture 25 - Creating orthogonal basis vectors
Lecture 26 - Gram-Schmidt and modified Gram-Schmidt algorithms
Lecture 27 - Comparing GS and modified GS
Lecture 28 - Introduction to eigenvalues and eigenvectors
Lecture 29 - Eigenvlues and eigenvectors for real symmetric matrix

Lecture 30 - Positive definiteness of a matrix
Lecture 31 - Positive definiteness of a matrix (Continued...)
Lecture 32 - Basic Iterative Methods
Lecture 33 - Basic Iterative Methods
Lecture 34 - Convergence Rate and Convergence Factor for Iterative Methods
Lecture 35 - Numerical Experiments on Convergence
Lecture 36 - Steepest Descent Method
Lecture 37 - Steepest Descent Method
Lecture 38 - Steepest Descent Method
Lecture 39 - Introduction to General Projection Methods
Lecture 40 - Residue Norm and Minimum Residual Algorithm
Lecture 41 - Developing computer programs for basic iterative methods
Lecture 42 - Developing computer programs for projection based methods
Lecture 43 - Introduction to Krylov subspace methods
Lecture 44 - Krylov subspace methods for linear systems
Lecture 45 - Iterative methods for solving linear systems using Krylov subspace methods
Lecture 46 - Conjugate gradient methods
Lecture 47 - Conjugate gradient methods (Continued...)
Lecture 48 - Conjugate gradient methods (Continued...) and Introduction to GMRES
Lecture 49 - GMRES (Continued...)
Lecture 50 - Lanczos Biorthogonalization and BCG Algorithm
Lecture 51 - Numerical issues in BICG and polynomial based formulation
Lecture 52 - Conjugate gradient squared and Biconjugate gradient stabilized
Lecture 53 - Line relaxation method
Lecture 54 - Block relaxation method
Lecture 55 - Domain Decomposition and Parallel Computing
Lecture 56 - Preconditioners
Lecture 57 - Preconditioned conjugate gradient
Lecture 58 - Preconditioned GMRES
Lecture 59 - Multigrid methods - I
Lecture 60 - Multigrid methods - II

NPTEL Video Course - Mathematics - NOC:Introduction to Abstract and Linear Algebra

Subject Co-ordinator - Prof.Sourav Mukhopadhyay

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Set Theory
Lecture 2 - Set Operations
Lecture 3 - Set Operations (Continued...)
Lecture 4 - Set of sets
Lecture 5 - Binary relation
Lecture 6 - Equivalence relation
Lecture 7 - Mapping
Lecture 8 - Permutation
Lecture 9 - Binary Composition
Lecture 10 - Groupoid
Lecture 11 - Group
Lecture 12 - Order of an element
Lecture 13 - Subgroup
Lecture 14 - Cyclic Group
Lecture 15 - Subgroup Operations
Lecture 16 - Left Cosets
Lecture 17 - Right Cosets
Lecture 18 - Normal Subgroup
Lecture 19 - Rings
Lecture 20 - Field
Lecture 21 - Vector Spaces
Lecture 22 - Sub-Spaces
Lecture 23 - Linear Span
Lecture 24 - Basis of a Vector Space
Lecture 25 - Dimension of a Vector space
Lecture 26 - Complement of subspace
Lecture 27 - Linear Transformation
Lecture 28 - Linear Transformation (Continued...)
Lecture 29 - More on linear mapping

Lecture 30 - Linear Space
Lecture 31 - Rank of a matrix
Lecture 32 - Rank of a matrix (Continued...)
Lecture 33 - System of linear equations
Lecture 34 - Row rank and Column rank
Lecture 35 - Eigen value of a matrix
Lecture 36 - Eigen Vector
Lecture 37 - Geometric multiplicity
Lecture 38 - More on eigen value
Lecture 39 - Similar matrices
Lecture 40 - Diagonalisable

NPTEL Video Course - Mathematics - NOC:Engineering Mathematics-I

Subject Co-ordinator - Prof. Jitendra Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - RolleÃ¢â ¬â ¢s Theorem
Lecture 2 - Mean Value Theorems
Lecture 3 - Indeterminate Forms - Part 1
Lecture 4 - Indeterminate Forms - Part 2
Lecture 5 - Taylor Polynomial and Taylor Series
Lecture 6 - Limit of Functions of Two Variables
Lecture 7 - Evaluation of Limit of Functions of Two Variables
Lecture 8 - Continuity of Functions of Two Variables
Lecture 9 - Partial Derivatives of Functions of Two Variables
Lecture 10 - Partial Derivatives of Higher Order
Lecture 11 - Derivative and Differentiability
Lecture 12 - Differentiability of Functions of Two Variables
Lecture 13 - Differentiability of Functions of Two Variables (Continued...)
Lecture 14 - Differentiability of Functions of Two Variables (Continued...)
Lecture 15 - Composite and Homogeneous Functions
Lecture 16 - TaylorÃ¢â ¬â ¢s Theorem for Functions of Two Variables
Lecture 17 - Maxima and Minima of Functions of Two Variables
Lecture 18 - Maxima and Minima of Functions of Two Variables (Continued...)
Lecture 19 - Maxima and Minima of Functions of Two Variables (Continued...)
Lecture 20 - Constrained Maxima and Minima
Lecture 21 - Improper Integrals
Lecture 22 - Improper Integrals (Continued...)
Lecture 23 - Improper Integrals (Continued...)
Lecture 24 - Improper Integrals (Continued...)
Lecture 25 - Beta and Gamma Function
Lecture 26 - Beta and Gamma Function (Continued...)
Lecture 27 - Differentiation Under Integral Sign
Lecture 28 - Double Integrals
Lecture 29 - Double Integrals (Continued...)

Lecture 30 - Double Integrals (Continued...)
Lecture 31 - Integral Calculus Double Integrals in Polar Form
Lecture 32 - Integral Calculus Double Integrals
Lecture 33 - Integral Calculus Double Integrals
Lecture 34 - Integral Calculus Triple Integrals
Lecture 35 - Integral Calculus Triple Integrals (Continued...)
Lecture 36 - System of Linear Equations
Lecture 37 - System of Linear Equations Gauss Elimination
Lecture 38 - System of Linear Equations Gauss Elimination (Continued...)
Lecture 39 - Linear Algebra - Vector Spaces
Lecture 40 - Linear Independence of Vectors
Lecture 41 - Vector Spaces Spanning Set
Lecture 42 - Vector Spaces Basis and Dimension
Lecture 43 - Rank of a Matrix
Lecture 44 - Linear Transformations
Lecture 45 - Linear Transformations (Continued....)
Lecture 46 - Eigenvalues and Eigenvectors
Lecture 47 - Eigenvalues and Eigenvectors (Continued...)
Lecture 48 - Eigenvalues and Eigenvectors (Continued...)
Lecture 49 - Eigenvalues and Eigenvectors (Continued...)
Lecture 50 - Eigenvalues and Eigenvectors
Lecture 51 - Differential Equations - Introduction
Lecture 52 - First Order Differential Equations
Lecture 53 - Exact Differential Equations
Lecture 54 - Exact Differential Equations (Continued...)
Lecture 55 - First Order Linear Differential Equations
Lecture 56 - Higher Order Linear Differential Equations
Lecture 57 - Solution of Higher Order Homogeneous Linear Equations
Lecture 58 - Solution of Higher Order Non-Homogeneous Linear Equations
Lecture 59 - Solution of Higher Order Non-Homogeneous Linear Equations (Continued...)
Lecture 60 - Cauchy-Euler Equations

NPTEL Video Course - Mathematics - NOC:Integral and Vector Calculus

Subject Co-ordinator - Prof. Hari Shankar Mahato

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Partition, Riemann intergrability and One example
Lecture 2 - Partition, Riemann intergrability and One example (Continued...)
Lecture 3 - Condition of integrability
Lecture 4 - Theorems on Riemann integrations
Lecture 5 - Examples
Lecture 6 - Examples (Continued...)
Lecture 7 - Reduction formula
Lecture 8 - Reduction formula (Continued...)
Lecture 9 - Improper Integral
Lecture 10 - Improper Integral (Continued...)
Lecture 11 - Improper Integral (Continued...)
Lecture 12 - Improper Integral (Continued...)
Lecture 13 - Introduction to Beta and Gamma Function
Lecture 14 - Beta and Gamma Function
Lecture 15 - Differentiation under Integral Sign
Lecture 16 - Differentiation under Integral Sign (Continued...)
Lecture 17 - Double Integral
Lecture 18 - Double Integral over a Region E
Lecture 19 - Examples of Integral over a Region E
Lecture 20 - Change of variables in a Double Integral
Lecture 21 - Change of order of Integration
Lecture 22 - Triple Integral
Lecture 23 - Triple Integral (Continued...)
Lecture 24 - Area of Plane Region
Lecture 25 - Area of Plane Region (Continued...)
Lecture 26 - Rectification
Lecture 27 - Rectification (Continued...)
Lecture 28 - Surface Integral
Lecture 29 - Surface Integral (Continued...)

Lecture 30 - Surface Integral (Continued...)
Lecture 31 - Volume Integral, Gauss Divergence Theorem
Lecture 32 - Vector Calculus
Lecture 33 - Limit, Continuity, Differentiability
Lecture 34 - Successive Differentiation
Lecture 35 - Integration of Vector Function
Lecture 36 - Gradient of a Function
Lecture 37 - Divergence and Curl
Lecture 38 - Divergence and Curl Examples
Lecture 39 - Divergence and Curl important Identities
Lecture 40 - Level Surface Relevant Theorems
Lecture 41 - Directional Derivative (Concept and Few Results)
Lecture 42 - Directional Derivative (Concept and Few Results) (Continued...)
Lecture 43 - Directional Derivatives, Level Surfaces
Lecture 44 - Application to Mechanics
Lecture 45 - Equation of Tangent, Unit Tangent Vector
Lecture 46 - Unit Normal, Unit binormal, Equation of Normal Plane
Lecture 47 - Introduction and Derivation of Serret-Frenet Formula, few results
Lecture 48 - Example on binormal, normal tangent, Serret-Frenet Formula
Lecture 49 - Osculating Plane, Rectifying plane, Normal plane
Lecture 50 - Application to Mechanics, Velocity, speed, acceleration
Lecture 51 - Angular Momentum, Newton's Law
Lecture 52 - Example on derivation of equation of motion of particle
Lecture 53 - Line Integral
Lecture 54 - Surface integral
Lecture 55 - Surface integral (Continued...)
Lecture 56 - Green's Theorem and Example
Lecture 57 - Volume integral, Gauss theorem
Lecture 58 - Gauss divergence theorem
Lecture 59 - Stoke's Theorem
Lecture 60 - Overview of Course

NPTEL Video Course - Mathematics - NOC:Transform Calculus and its applications in Differential Equations

Subject Co-ordinator - Prof. A. Goswami

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Integral Transform and Laplace Transform
Lecture 2 - Existence of Laplace Transform
Lecture 3 - Shifting Properties of Laplace Transform
Lecture 4 - Laplace Transform of Derivatives and Integration of a Function - I
Lecture 5 - Laplace Transform of Derivatives and Integration of a Function - II
Lecture 6 - Explanation of properties of Laplace Transform using Examples
Lecture 7 - Laplace Transform of Periodic Function
Lecture 8 - Laplace Transform of some special Functions
Lecture 9 - Error Function, Dirac Delta Function and their Laplace Transform
Lecture 10 - Bessel Function and its Laplace Transform
Lecture 11 - Introduction to Inverse Laplace Transform
Lecture 12 - Properties of Inverse Laplace Transform
Lecture 13 - Convolution and its Applications
Lecture 14 - Evaluation of Integrals using Laplace Transform
Lecture 15 - Solution of Ordinary Differential Equations with constant coefficients using Laplace Transform
Lecture 16 - Solution of Ordinary Differential Equations with variable coefficients using Laplace Transform
Lecture 17 - Solution of Simultaneous Ordinary Differential Equations using Laplace Transform
Lecture 18 - Introduction to Integral Equation and its Solution Process
Lecture 19 - Introduction to Fourier Series
Lecture 20 - Fourier Series for Even and Odd Functions
Lecture 21 - Fourier Series of Functions having arbitrary period - I
Lecture 22 - Fourier Series of Functions having arbitrary period - II
Lecture 23 - Half Range Fourier Series
Lecture 24 - Parseval's Theorem and its Applications
Lecture 25 - Complex form of Fourier Series
Lecture 26 - Fourier Integral Representation
Lecture 27 - Introduction to Fourier Transform
Lecture 28 - Derivation of Fourier Cosine Transform and Fourier Sine Transform of Functions
Lecture 29 - Evaluation of Fourier Transform of various functions

Lecture 30 - Linearity Property and Shifting Properties of Fourier Transform
Lecture 31 - Change of Scale and Modulation Properties of Fourier Transform
Lecture 32 - Fourier Transform of Derivative and Integral of a Function
Lecture 33 - Applications of Properties of Fourier Transform - I
Lecture 34 - Applications of Properties of Fourier Transform - II
Lecture 35 - Fourier Transform of Convolution of two functions
Lecture 36 - Parseval's Identity and its Application
Lecture 37 - Evaluation of Definite Integrals using Properties of Fourier Transform
Lecture 38 - Fourier Transform of Dirac Delta Function
Lecture 39 - Representation of a function as Fourier Integral
Lecture 40 - Applications of Fourier Transform to Ordinary Differential Equations - I
Lecture 41 - Applications of Fourier Transform to Ordinary Differential Equations - II
Lecture 42 - Solution of Integral Equations using Fourier Transform
Lecture 43 - Introduction to Partial Differential Equations
Lecture 44 - Solution of Partial Differential Equations using Laplace Transform
Lecture 45 - Solution of Heat Equation and Wave Equation using Laplace Transform
Lecture 46 - Criteria for choosing Fourier Transform, Fourier Sine Transform, Fourier Cosine Transform in sol
Lecture 47 - Solution of Partial Differential Equations using Fourier Cosine Transform and Fourier Sine Trans
Lecture 48 - Solution of Partial Differential Equations using Fourier Transform - I
Lecture 49 - Solution of Partial Differential Equations using Fourier Transform - II
Lecture 50 - Solving problems on Partial Differential Equations using Transform Techniques
Lecture 51 - Introduction to Finite Fourier Transform
Lecture 52 - Solution of Boundary Value Problems using Finite Fourier Transform - I
Lecture 53 - Solution of Boundary Value Problems using Finite Fourier Transform - II
Lecture 54 - Introduction to Mellin Transform
Lecture 55 - Properties of Mellin Transform
Lecture 56 - Examples of Mellin Transform - I
Lecture 57 - Examples of Mellin Transform - II
Lecture 58 - Introduction to Z-Transform
Lecture 59 - Properties of Z-Transform
Lecture 60 - Evaluation of Z-Transform of some functions

NPTEL Video Course - Mathematics - NOC:Statistical Inference (2019)

Subject Co-ordinator - Prof. Somesh Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction and Motivation - I
Lecture 2 - Introduction and Motivation - II
Lecture 3 - Basic Concepts of Point Estimations - I
Lecture 4 - Basic Concepts of Point Estimations - II
Lecture 5 - Basic Concepts of Point Estimations - III
Lecture 6 - Basic Concepts of Point Estimations - IV
Lecture 7 - Finding Estimators - I
Lecture 8 - Finding Estimators - II
Lecture 9 - Finding Estimators - III
Lecture 10 - Finding Estimators - IV
Lecture 11 - Finding Estimators - V
Lecture 12 - Finding Estimators - VI
Lecture 13 - Properties of MLEs - I
Lecture 14 - Properties of MLEs - II
Lecture 15 - Lower Bounds for Variance - I
Lecture 16 - Lower Bounds for Variance - II
Lecture 17 - Lower Bounds for Variance - III
Lecture 18 - Lower Bounds for Variance - IV
Lecture 19 - Lower Bounds for Variance - V
Lecture 20 - Lower Bounds for Variance - VI
Lecture 21 - Lower Bounds for Variance - VII
Lecture 22 - Lower Bounds for Variance - VIII
Lecture 23 - Sufficiency - I
Lecture 24 - Sufficiency - II
Lecture 25 - Sufficiency and Information - I
Lecture 26 - Sufficiency and Information - II
Lecture 27 - Minimal Sufficiency, Completeness - I
Lecture 28 - Minimal Sufficiency, Completeness - II
Lecture 29 - UMVU Estimation, Ancillarity - I

Lecture 30 - UMVU Estimation, Ancillarity - II
Lecture 31 - Testing of Hypotheses
Lecture 32 - Testing of Hypotheses
Lecture 33 - Neyman Pearson Fundamental Lemma - I
Lecture 34 - Neyman Pearson Fundamental Lemma - II
Lecture 35 - Application of NP-Lemma - I
Lecture 36 - Application of NP-Lemma - II
Lecture 37 - UMP Tests - I
Lecture 38 - UMP Tests - II
Lecture 39 - UMP Tests - III
Lecture 40 - UMP Tests - IV
Lecture 41 - UMP Unbiased Tests - I
Lecture 42 - UMP Unbiased Tests - II
Lecture 43 - UMP Unbiased Tests - III
Lecture 44 - UMP Unbiased Tests - IV
Lecture 45 - Applications of UMP Unbiased Tests - I
Lecture 46 - Applications of UMP Unbiased Tests - II
Lecture 47 - Unbiased Test for Normal Populations - I
Lecture 48 - Unbiased Test for Normal Populations - II
Lecture 49 - Unbiased Test for Normal Populations - III
Lecture 50 - Unbiased Test for Normal Populations - IV
Lecture 51 - Likelihood Ratio Tests - I
Lecture 52 - Likelihood Ratio Tests - II
Lecture 53 - Likelihood Ratio Tests - III
Lecture 54 - Likelihood Ratio Tests - IV
Lecture 55 - Likelihood Ratio Tests - V
Lecture 56 - Likelihood Ratio Tests - VI
Lecture 57 - Likelihood Ratio Tests - VII
Lecture 58 - Likelihood Ratio Tests - VIII
Lecture 59 - Test for Goodness of Fit - I
Lecture 60 - Test for Goodness of Fit - II
Lecture 61 - Interval Estimation - I
Lecture 62 - Interval Estimation - II
Lecture 63 - Interval Estimation - III
Lecture 64 - Interval Estimation - IV

NPTEL Video Course - Mathematics - NOC:Mathematical Methods for Boundary Value Problems

Subject Co-ordinator - Prof. Somnath Bhattacharyya

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Strum-Liouville Problems, Linear BVP
Lecture 2 - Strum-Liouville Problems, Linear BVP (Continued...)
Lecture 3 - Solution of BVPs by Eigen function expansion
Lecture 4 - Solution of BVPs by Eigen function expansion (Continued...)
Lecture 5 - Solutions of linear parabolic, hyperbolic and elliptic PDEs with finite domain by Eigen function
Lecture 6 - Solutions of linear parabolic, hyperbolic and elliptic PDEs with finite domain by Eigen function
Lecture 7 - Green's Function for BVP and Dirichlet Problem
Lecture 8 - Green's Function for BVP and Dirichlet Problem (Continued...)
Lecture 9 - Numerical Techniques for IVP; Shooting Method for BVP
Lecture 10 - Numerical Techniques for IVP; Shooting Method for BVP (Continued...)
Lecture 11 - Finite difference methods for linear BVP; Thomas Algorithm
Lecture 12 - Finite difference methods for linear BVP; Thomas Algorithm (Continued...)
Lecture 13 - Finite difference method for Higher-order BVP; Block tri-diagonal System
Lecture 14 - Finite difference method for Higher-order BVP; Block tri-diagonal System (Continued...)
Lecture 15 - Iterative methods for nonlinear BVP; Control volume formulation
Lecture 16 - Iterative methods for nonlinear BVP; Control volume formulation (Continued...)
Lecture 17 - Implicit scheme; Truncation error; Crank-Nicolson scheme
Lecture 18 - Implicit scheme; Truncation error; Crank-Nicolson scheme (Continued...)
Lecture 19 - Stability analysis of numerical schemes
Lecture 20 - Alternating-Direction-Implicit Scheme; Successive-Over-Relaxation technique for Poisson equation

NPTEL Video Course - Mathematics - NOC:Engineering Mathematics-II

Subject Co-ordinator - Prof. Jitendra Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Vector Functions
Lecture 2 - Vector and Scalar Fields
Lecture 3 - Divergence and Curl of a Vector Field
Lecture 4 - Line Integrals
Lecture 5 - Conservative Vector Field
Lecture 6 - Greenâ s Theorem
Lecture 7 - Surface Integral - I
Lecture 8 - Surface Integral - II
Lecture 9 - Stokesâ Theorem
Lecture 10 - Divergence Theorem
Lecture 11 - Complex Numbers and Functions
Lecture 12 - Differentiability of Complex Functions
Lecture 13 - Analytic Functions
Lecture 14 - Line Integral
Lecture 15 - Cauchy Integral Theorem
Lecture 16 - Cauchy Integral Formula
Lecture 17 - Taylorâ s Series
Lecture 18 - Laurentâ s Series
Lecture 19 - Singularities
Lecture 20 - Residue
Lecture 21 - Iterative Methods for Solving System of Linear Equations
Lecture 22 - Iterative Methods for Solving System of Linear Equations (Continued...)
Lecture 23 - Iterative Methods for Solving System of Linear Equations (Continued...)
Lecture 24 - Roots of Algebraic and Transcendental Equations
Lecture 25 - Roots of Algebraic and Transcendental Equations (Continued...)
Lecture 26 - Polynomial Interpolation
Lecture 27 - Polynomial Interpolation (Continued...)
Lecture 28 - Polynomial Interpolation (Continued...)
Lecture 29 - Polynomial Interpolation (Continued...)

Lecture 30 - Numerical Integration
Lecture 31 - Trigonometric Polynomials and Series
Lecture 32 - Derivation of Fourier Series
Lecture 33 - Fourier Series -Evaluation
Lecture 34 - Convergence of Fourier Series - I
Lecture 35 - Convergence of Fourier Series - II
Lecture 36 - Fourier Series for Even and Odd Functions
Lecture 37 - Half Range Fourier Expansions
Lecture 38 - Differentiation and Integration of Fourier Series
Lecture 39 - Besselâ s Inequality and Parsevalâ s Identity
Lecture 40 - Complex Form of Fourier Series
Lecture 41 - Fourier Integral Representation of a Function
Lecture 42 - Fourier Sine and Cosine Integrals
Lecture 43 - Fourier Cosine and Sine Transform
Lecture 44 - Fourier Transform
Lecture 45 - Properties of Fourier Transform
Lecture 46 - Evaluation of Fourier Transform - Part 1
Lecture 47 - Evaluation of Fourier Transform - Part 2
Lecture 48 - Introduction to Partial Differential Equations
Lecture 49 - Applications of Fourier Transform to PDEs - Part 1
Lecture 50 - Applications of Fourier Transform to PDEs - Part 2
Lecture 51 - Laplace Transform of Some Elementary Functions
Lecture 52 - Existence of Laplace Transform
Lecture 53 - Inverse Laplace Transform
Lecture 54 - Properties of Laplace Transform
Lecture 55 - Properties of Laplace Transform (Continued...)
Lecture 56 - Properties of Laplace Transform (Continued...)
Lecture 57 - Laplace Transform of Special Functions
Lecture 58 - Laplace Transform of Special Functions (Continued...)
Lecture 59 - Applications of Laplace Transform
Lecture 60 - Applications of Laplace Transform (Continued...)

NPTEL Video Course - Mathematics - NOC:Advanced Calculus For Engineers

Subject Co-ordinator - Prof. Somesh Kumar, Prof. Jitendra Kumar

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Rolle's Theorem
Lecture 2 - Mean Value Theorem
Lecture 3 - Taylor's Formula (Single Variable)
Lecture 4 - Indeterminate Forms - Part 1
Lecture 5 - Indeterminate Forms - Part 2
Lecture 6 - Introduction to Limit
Lecture 7 - Evaluation of Limit
Lecture 8 - Continuity
Lecture 9 - First Order Partial Derivatives
Lecture 10 - Higher Order Partial Derivatives
Lecture 11 - Differentiability - Part 1
Lecture 12 - Differentiability - Part 2
Lecture 13 - Differentiability - Part 3
Lecture 14 - Differentiability - Part 4
Lecture 15 - Composite and Homogeneous Functions
Lecture 16 - Taylor's Theorem (Multivariable)
Lecture 17 - Maxima and Minima - Part 1
Lecture 18 - Maxima and Minima - Part 2
Lecture 19 - Maxima and Minima - Part 3
Lecture 20 - Maxima and Minima - Part 4
Lecture 21 - Formation of Differential Equations
Lecture 22 - First Order and First Degree DE
Lecture 23 - Exact Differential Equations
Lecture 24 - Integrating Factor
Lecture 25 - Linear Differential Equations
Lecture 26 - Introduction to Higher Order DEs
Lecture 27 - Complementary Function
Lecture 28 - Particular Integral
Lecture 29 - Cauchy-Euler Equations

Lecture 30 - Method of Variation of Parameters
Lecture 31 - Improper Integral - Part 1
Lecture 32 - Improper Integral - Part 2
Lecture 33 - Improper Integral - Part 3
Lecture 34 - Improper Integral - Part 4
Lecture 35 - Beta and Gamma Function - Part 1
Lecture 36 - Beta and Gamma Function - Part 2
Lecture 37 - Differentiation under the Integral Sign
Lecture 38 - Double Integrals - Part 1
Lecture 39 - Double Integrals - Part 2
Lecture 40 - Double Integrals - Part 3
Lecture 41 - Double Integrals - Part 4
Lecture 42 - Double Integrals - Part 5
Lecture 43 - Double Integrals - Part 6
Lecture 44 - Triple Integrals - Part 1
Lecture 45 - Triple Integrals - Part 2
Lecture 46 - Vector Functions
Lecture 47 - Vector and Scalar Fields
Lecture 48 - Divergence and Curl of a Vector Field
Lecture 49 - Line Integrals
Lecture 50 - Conservative Vector Fields
Lecture 51 - Green's Theorem
Lecture 52 - Surface Integrals - Part 1
Lecture 53 - Surface Integrals - Part 2
Lecture 54 - Stokes' Theorem
Lecture 55 - Divergence Theorem
Lecture 56 - Application of Derivatives
Lecture 57 - Application of Derivatives (Continued...)
Lecture 58 - Properties of Gradient, Divergence and Curl
Lecture 59 - Properties of Gradient, Divergence and Curl (Continued...)
Lecture 60 - Curl and Integrals

NPTEL Video Course - Mathematics - NOC:Rings and Modules

Subject Co-ordinator - Prof. Ramakrishna Nanduri, Prof. Mousumi Mandal

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Rings
Lecture 2 - Rings, Subrings
Lecture 3 - Ring Homomorphism, Ideals
Lecture 4 - Properties of Ideals
Lecture 5 - Properties of Ideals (Continued...)
Lecture 6 - Quotient Ring, Isomorphism Theorem
Lecture 7 - Isomorphism Theorem, Homomorphism Theorem
Lecture 8 - Homomorphism Theorem
Lecture 9 - Integral Domain, Quotient Ring
Lecture 10 - Quotient Ring
Lecture 11 - Prime ideals, Maximal ideals
Lecture 12 - Maximal ideals
Lecture 13 - Hillbertâ s Nullstellensatz
Lecture 14 - Hillbertâ s Nullstellensatz (Continued...)
Lecture 15 - Application of Hillbertâ s Nullstellensatz
Lecture 16 - Unique Factorization domian
Lecture 17 - Properties of Unique Factorization domain
Lecture 18 - Principal ideal domain
Lecture 19 - Properties of PID and ED
Lecture 20 - Properties of PID and ED (Continued...)
Lecture 21 - Prime elements of Z[i]
Lecture 22 - Prime elements of Z[i] (Continued...)
Lecture 23 - Application in Z[i]
Lecture 24 - Polynomial Rings over UFD
Lecture 25 - Gauss's Lemma
Lecture 26 - Polynomial Ring over UFD and Irreducibility Criterion
Lecture 27 - Irreducibility Criterion
Lecture 28 - Chinese Remainder Theorem
Lecture 29 - Nilradical and Jacobson radical

Lecture 30 - Examples and Problems
Lecture 31 - Definition of Modules and Examples
Lecture 32 - Definition of Modules and Examples (Continued...)
Lecture 33 - Submodules,direct sum and direct product of modules
Lecture 34 - Direct sum and direct product of modules, free modules
Lecture 35 - Finitely generated modules, free modules vs Vector spaces
Lecture 36 - Free modules vs Vector spaces
Lecture 37 - Vector spaces vs free modules and Examples
Lecture 38 - Quotient modules and module homomorphisms
Lecture 39 - Module homomorphism, Epimorphism theorem
Lecture 40 - Epimorphism theorem
Lecture 41 - Maximal submodules, minimal submodules
Lecture 42 - Freeness of submodules of a free module over a PID
Lecture 43 - Torsion modules, freeness of torsion-free modules over a PID
Lecture 44 - Rank of a module, p-submodules over a PID
Lecture 45 - Structure of a torsion module over a PID
Lecture 46 - Structure theorem, chain conditions
Lecture 47 - Artinian modules, Artinian rings
Lecture 48 - Noetherian modules, Noetherian rings
Lecture 49 - Ascending chain condition, Noetherian modules
Lecture 50 - Examples of Noetherian and Artinian modules and rings
Lecture 51 - Composition series, Modules of finite length
Lecture 52 - Jordan-HolderÃ¢'s theorem
Lecture 53 - Artinian rings
Lecture 54 - Noetherian rings
Lecture 55 - Hilbert basis theorem
Lecture 56 - CohenÃ¢'s theorem on Noetherianness
Lecture 57 - Nakayama lemma
Lecture 58 - Nil and Jacobson radicals in Artinian rings
Lecture 59 - Structure theorem
Lecture 60 - Comparison between Artinian and Noetherian rings

NPTEL Video Course - Mathematics - NOC:Advanced Computational Techniques

Subject Co-ordinator - Prof. Somnath Bhattacharyya

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Polynomial Interpolation
Lecture 2 - Polynomial Interpolation
Lecture 3 - Polynomial Interpolation
Lecture 4 - Spline Interpolation
Lecture 5 - Spline Interpolation
Lecture 6 - Numerical Quadrature
Lecture 7 - Numerical Quadrature (Continued...)
Lecture 8 - Least Squares Approximation
Lecture 9 - Linear System of Equations
Lecture 10 - Linear System of Equations (Continued...)
Lecture 11 - Initial Value Problems (IVP)
Lecture 12 - Initial Value Problems (Continued...)
Lecture 13 - Initial Value Problems (Continued...)
Lecture 14 - Initial Value Problems (Continued...)
Lecture 15 - Linear Boundary Value Problem (BVP)
Lecture 16 - Linear Boundary Value Problem (BVP) (Continued...)
Lecture 17 - Non-linear BVP, Iterative Method
Lecture 18 - Linear Parabolic PDE
Lecture 19 - Hyperbolic PDE
Lecture 20 - Non-linear advection-diffusion equation

NPTEL Video Course - Mathematics - NOC:Applied Linear Algebra in AI and ML

Subject Co-ordinator - Prof. Swanand Khare

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Vector Spaces
Lecture 2 - Vector Subspaces
Lecture 3 - Linear Span and Linear Dependence
Lecture 4 - Linear Independence
Lecture 5 - Basis and Dimension
Lecture 6 - Linear Functionals
Lecture 7 - Norm of Vector - Part I
Lecture 8 - Norm of Vector - Part II
Lecture 9 - Linear Functions
Lecture 10 - Affine Functions and Examples
Lecture 11 - Examples of Linear and Affine Functions
Lecture 12 - Function Composition
Lecture 13 - System of Linear Equations
Lecture 14 - Left Invertibility
Lecture 15 - Invertibility of Matrices
Lecture 16 - Triangular Systems
Lecture 17 - LU Decomposition - Part I
Lecture 18 - LU Decomposition - Part II
Lecture 19 - QR Decomposition (Rotators) - Part I
Lecture 20 - QR Decomposition (Rotators) - Part II
Lecture 21 - QR Decomposition (Reflectors) - Part I
Lecture 22 - QR Decomposition (Reflectors) - Part II
Lecture 23 - Matrix Norms
Lecture 24 - Sensitivity Analysis
Lecture 25 - Condition Number of a Matrix
Lecture 26 - Sensitivity Analysis - II
Lecture 27 - Sensitivity Analysis - III
Lecture 28 - Least Squares - Part I
Lecture 29 - Least Squares - Part II

Lecture 30 - Least Squares - Part III
Lecture 31 - Least Squares Data Fitting
Lecture 32 - Examples of LS data fitting
Lecture 33 - Classification using Least Squares
Lecture 34 - Examples of LS classification
Lecture 35 - Constrained Least Squares
Lecture 36 - Multiobjective Least Squares
Lecture 37 - Eigenvalues and Eigenvectors - Part I
Lecture 38 - Eigenvalues and Eigenvectors - Part II
Lecture 39 - Spectral Decomposition Theorem
Lecture 40 - Positive Definite Matrices
Lecture 41 - Singular Value Decomposition (SVD)
Lecture 42 - Proof of SVD
Lecture 43 - Properties of SVD
Lecture 44 - Another Proof of SVD
Lecture 45 - Low Rank Approximations
Lecture 46 - Principal Component Analysis
Lecture 47 - SVD and Pseudo - Inverse
Lecture 48 - SVD and the Least Squares Problem
Lecture 49 - Sensitivity Analysis of the Least Squares Problem
Lecture 50 - Power Method
Lecture 51 - Directed Graphs and Properties
Lecture 52 - Page Ranking Algorithm
Lecture 53 - Inverse Eigen Value Problem
Lecture 54 - Fastest Mixing Markov Chains on Graphs - Part I
Lecture 55 - Fastest Mixing Markov Chains on Graphs - Part II
Lecture 56 - Sparse Solution and Underdetermined Systems
Lecture 57 - Structured Low Rank Approximations - Part I
Lecture 58 - Structured Low Rank Approximations - Part II
Lecture 59 - Structured Low Rank Approximations - Part III
Lecture 60 - Recap

NPTEL Video Course - Mathematics - NOC:Advanced Engineering Mathematics (2023)

Subject Co-ordinator - Prof. H S Mahato

Co-ordinating Institute - IIT - Kharagpur

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction on functions of a single variable
Lecture 2 - Basic definitions
Lecture 3 - Mean value Theorems
Lecture 4 - Extremum of function of single variable
Lecture 5 - Examples
Lecture 6 - Introduction on functions of two variable
Lecture 7 - Basic definitions
Lecture 8 - Partial differentiation
Lecture 9 - Extremum of function of two variable
Lecture 10 - Examples
Lecture 11 - Convergence and divergence test
Lecture 12 - Beta function, Gamma function
Lecture 13 - Differentiation under integral sign
Lecture 14 - Line integral, integration in R^2 (Double integral)
Lecture 15 - Examples
Lecture 16 - Double integral
Lecture 17 - Integration in R3
Lecture 18 - Triple integral
Lecture 19 - Examples
Lecture 20 - Introduction to Differential equation
Lecture 21 - Exact form
Lecture 22 - Second order differential equation
Lecture 23 - Iterative method (bisection and fixed point)
Lecture 24 - Newton-Raphson, Jacobi and Gauss-Seidel method
Lecture 25 - Finite difference method
Lecture 26 - Newton's forward and backward interpolation
Lecture 27 - Numerical integration
Lecture 28 - Vector space and Subspace
Lecture 29 - Basis and dimension

Lecture 30 - Rank of a matrix
Lecture 31 - Gauss-Elimination Method
Lecture 32 - Linear Transformation
Lecture 33 - Examples
Lecture 34 - Matrix Representation
Lecture 35 - Eigenvalues and Eigenvectors
Lecture 36 - Cayley-Hamilton Theorem
Lecture 37 - Diagonalisation of a Matrix
Lecture 38 - Examples and applications
Lecture 39 - Types of matrices
Lecture 40 - Equivalent Matrices and Elementary Matrices
Lecture 41 - Introduction to the vector function
Lecture 42 - Differentiation and integration of the vector function
Lecture 43 - Partial differentiation of vector function
Lecture 44 - Directional derivative of a vector function
Lecture 45 - Examples on directional derivative, tangent plane and normal
Lecture 46 - Divergence and curl of a vector function
Lecture 47 - Application to mechanics of vector calculus
Lecture 48 - Serret-Frenet formula and more applications to mechanics
Lecture 49 - Examples on finding unit vectors, curvature and torsion
Lecture 50 - Application of vector calculus to the particle dynamics
Lecture 51 - Line integral of vector function
Lecture 52 - Surface integral of vector function
Lecture 53 - Volume integral of vector function and Gauss Divergence Theorem
Lecture 54 - Green's theorem and Stoke's theorem
Lecture 55 - Verification and application of Divergencen theorem, Green's theorem and Stoke's theorem
Lecture 56 - Basic properties of a complex valued function
Lecture 57 - Analytic Complex valued function
Lecture 58 - Complex Integration and theorems
Lecture 59 - Application of Cauchy's integral formula
Lecture 60 - Regular and Singular point of a complex valued function

NPTEL Video Course - Mathematics - NOC:Essentials of Topology

Subject Co-ordinator - Prof. S. P. Tiwari

Co-ordinating Institute - IIT-ISM Dhanbad

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Sets and Functions - I
Lecture 3 - Sets and Functions - II
Lecture 4 - Sets and Functions - III
Lecture 5 - Sets and Functions - IV
Lecture 6 - Metric Spaces
Lecture 7 - Topological Spaces
Lecture 8 - Topological Spaces (Examples)
Lecture 9 - Typologies on R - I
Lecture 10 - Typologies on R - II
Lecture 11 - Comparison of topologies
Lecture 12 - Closed sets
Lecture 13 - Basis for a topology - I
Lecture 14 - Basis for a topology - II
Lecture 15 - A topology on R^2
Lecture 16 - Subbasis and Neighborhood
Lecture 17 - Limit points of sets
Lecture 18 - Closure of sets
Lecture 19 - Interior and boundary of sets
Lecture 20 - Subspaces
Lecture 21 - Product topology
Lecture 22 - Product and Box topologies
Lecture 23 - The Quotient topology
Lecture 24 - Krakowski closure/interior operator
Lecture 25 - Countability axioms - I
Lecture 26 - Countability axioms - II
Lecture 27 - Countability axioms - III
Lecture 28 - Continuous functions - I
Lecture 29 - Continuous functions - II

Lecture 30 - Continuous functions - III
Lecture 31 - Continuous functions - IV
Lecture 32 - Homeomorphisms - I
Lecture 33 - Homeomorphisms - II
Lecture 34 - Homeomorphisms - III
Lecture 35 - Connectedness - I
Lecture 36 - Connectedness - II
Lecture 37 - Connectedness - III
Lecture 38 - Connectedness - IV
Lecture 39 - Connectedness - V
Lecture 40 - Connectedness - VI
Lecture 41 - Connectedness - VII
Lecture 42 - Connectedness - VIII
Lecture 43 - Path connectedness - I
Lecture 44 - Path connectedness - II
Lecture 45 - Path connectedness - III
Lecture 46 - Path components and Local connectedness
Lecture 47 - Local connectedness
Lecture 48 - Local path connectedness
Lecture 49 - Compactness - I
Lecture 50 - Compactness - II
Lecture 51 - Compactness - III
Lecture 52 - Compactness - IV
Lecture 53 - Compactness - V
Lecture 54 - Compactness - VI
Lecture 55 - Compactness - VII
Lecture 56 - Compactness - VIII
Lecture 57 - Compactness - IX
Lecture 58 - Compactness - X
Lecture 59 - One-point compactifications - I
Lecture 60 - One-point compactifications - II
Lecture 61 - Separation axioms - I
Lecture 62 - Separation axioms - II
Lecture 63 - Separation axioms - III
Lecture 64 - Separation axioms - IV
Lecture 65 - Separation axioms - V
Lecture 66 - Separation axioms - VI
Lecture 67 - Separation axioms - VII
Lecture 68 - Separation axioms - VIII

Lecture 69 - Tychonoff theorem - I
Lecture 70 - Tychonoff theorem - II
Lecture 71 - Stone-Cech compactification - I
Lecture 72 - Stone-Cech compactification - II

NPTEL Video Course - Mathematics - An Introduction to Riemann Surfaces and Algebraic Curves: Complex 1-Tori and Elliptic Curves

Subject Co-ordinator - Dr. T.E. Venkata Balaji

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - The Idea of a Riemann Surface
Lecture 2 - Simple Examples of Riemann Surfaces
Lecture 3 - Maximal Atlases and Holomorphic Maps of Riemann Surfaces
Lecture 4 - A Riemann Surface Structure on a Cylinder
Lecture 5 - A Riemann Surface Structure on a Torus
Lecture 6 - Riemann Surface Structures on Cylinders and Tori via Covering Spaces
Lecture 7 - Moebius Transformations Make up Fundamental Groups of Riemann Surfaces
Lecture 8 - Homotopy and the First Fundamental Group
Lecture 9 - A First Classification of Riemann Surfaces
Lecture 10 - The Importance of the Path-lifting Property
Lecture 11 - Fundamental groups as Fibres of the Universal covering Space
Lecture 12 - The Monodromy Action
Lecture 13 - The Universal covering as a Hausdorff Topological Space
Lecture 14 - The Construction of the Universal Covering Map
Lecture 15 - Completion of the Construction of the Universal Covering
Lecture 16 - Completion of the Construction of the Universal Covering
Lecture 17 - The Riemann Surface Structure on the Topological Covering of a Riemann Surface
Lecture 18 - Riemann Surfaces with Universal Covering the Plane or the Sphere
Lecture 19 - Classifying Complex Cylinders
Lecture 20 - Characterizing Moebius Transformations with a Single Fixed Point
Lecture 21 - Characterizing Moebius Transformations with Two Fixed Points
Lecture 22 - Torsion-freeness of the Fundamental Group of a Riemann Surface
Lecture 23 - Characterizing Riemann Surface Structures on Quotients of the Upper Half-Plane with Abelian Fundamental Groups
Lecture 24 - Classifying Annuli up to Holomorphic Isomorphism
Lecture 25 - Orbits of the Integral Unimodular Group in the Upper Half-Plane
Lecture 26 - Galois Coverings are precisely Quotients by Properly Discontinuous Free Actions
Lecture 27 - Local Actions at the Region of Discontinuity of a Kleinian Subgroup of Moebius Transformations

Lecture 28 - Quotients by Kleinian Subgroups give rise to Riemann Surfaces
Lecture 29 - The Unimodular Group is Kleinian
Lecture 30 - The Necessity of Elliptic Functions for the Classification of Complex Tori
Lecture 31 - The Uniqueness Property of the Weierstrass Phe-function associated to a Lattice in the Plane
Lecture 32 - The First Order Degree Two Cubic Ordinary Differential Equation satisfied by the Weierstrass Phe-function
Lecture 33 - The Values of the Weierstrass Phe-function at the Zeros of its Derivative are nonvanishing Analytic Functions on the Upper Half-Plane
Lecture 34 - The Construction of a Modular Form of Weight Two on the Upper Half-Plane
Lecture 35 - The Fundamental Functional Equations satisfied by the Modular Form of Weight Two on the Upper Half-Plane
Lecture 36 - The Weight Two Modular Form assumes Real Values on the Imaginary Axis in the Upper Half-plane
Lecture 37 - The Weight Two Modular Form Vanishes at Infinity
Lecture 38 - The Weight Two Modular Form Decays Exponentially in a Neighbourhood of Infinity
Lecture 39 - A Suitable Restriction of the Weight Two Modular Form is a Holomorphic Conformal Isomorphism onto the Upper Half-Plane
Lecture 40 - The J-Invariant of a Complex Torus (or) of an Algebraic Elliptic Curve
Lecture 41 - A Fundamental Region in the Upper Half-Plane for the Elliptic Modular J-Invariant
Lecture 42 - The Fundamental Region in the Upper Half-Plane for the Unimodular Group
Lecture 43 - A Region in the Upper Half-Plane Meeting Each Unimodular Orbit Exactly Once
Lecture 44 - Moduli of Elliptic Curves
Lecture 45 - Punctured Complex Tori are Elliptic Algebraic Affine Plane Cubic Curves in Complex 2-Space
Lecture 46 - The Natural Riemann Surface Structure on an Algebraic Affine Nonsingular Plane Curve
Lecture 47 - Complex Projective 2-Space as a Compact Complex Manifold of Dimension Two
Lecture 48 - Complex Tori are the same as Elliptic Algebraic Projective Curves

NPTEL Video Course - Mathematics - Linear Algebra

Subject Co-ordinator - Dr. K.C. Sivakumar

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to the Course Contents
Lecture 2 - Linear Equations
Lecture 3a - Equivalent Systems of Linear Equations I
Lecture 3b - Equivalent Systems of Linear Equations II
Lecture 4 - Row-reduced Echelon Matrices
Lecture 5 - Row-reduced Echelon Matrices and Non-homogeneous Equations
Lecture 6 - Elementary Matrices, Homogeneous Equations and Non-homogeneous Equations
Lecture 7 - Invertible matrices, Homogeneous Equations Non-homogeneous Equations
Lecture 8 - Vector spaces
Lecture 9 - Elementary Properties in Vector Spaces. Subspaces
Lecture 10 - Subspaces (Continued...), Spanning Sets, Linear Independence, Dependence
Lecture 11 - Basis for a vector space
Lecture 12 - Dimension of a vector space
Lecture 13 - Dimensions of Sums of Subspaces
Lecture 14 - Linear Transformations
Lecture 15 - The Null Space and the Range Space of a Linear Transformation
Lecture 16 - The Rank-Nullity-Dimension Theorem. Isomorphisms Between Vector Spaces
Lecture 17 - Isomorphic Vector Spaces, Equality of the Row-rank and the Column-rank - I
Lecture 18 - Equality of the Row-rank and the Column-rank - II
Lecture 19 - The Matrix of a Linear Transformation
Lecture 20 - Matrix for the Composition and the Inverse. Similarity Transformation
Lecture 21 - Linear Functionals. The Dual Space. Dual Basis - I
Lecture 22 - Dual Basis II. Subspace Annihilators - I
Lecture 23 - Subspace Annihilators - II
Lecture 24 - The Double Dual. The Double Annihilator
Lecture 25 - The Transpose of a Linear Transformation. Matrices of a Linear Transformation and its Transpose
Lecture 26 - Eigenvalues and Eigenvectors of Linear Operators
Lecture 27 - Diagonalization of Linear Operators. A Characterization
Lecture 28 - The Minimal Polynomial

Lecture 29 - The Cayley-Hamilton Theorem
Lecture 30 - Invariant Subspaces
Lecture 31 - Triangulability, Diagonalization in Terms of the Minimal Polynomial
Lecture 32 - Independent Subspaces and Projection Operators
Lecture 33 - Direct Sum Decompositions and Projection Operators - I
Lecture 34 - Direct Sum Decompositions and Projection Operators - II
Lecture 35 - The Primary Decomposition Theorem and Jordan Decomposition
Lecture 36 - Cyclic Subspaces and Annihilators
Lecture 37 - The Cyclic Decomposition Theorem - I
Lecture 38 - The Cyclic Decomposition Theorem - II. The Rational Form
Lecture 39 - Inner Product Spaces
Lecture 40 - Norms on Vector spaces. The Gram-Schmidt Procedure I
Lecture 41 - The Gram-Schmidt Procedure II. The QR Decomposition
Lecture 42 - Bessel's Inequality, Parseval's Indentity, Best Approximation
Lecture 43 - Best Approximation
Lecture 44 - Orthogonal Complementary Subspaces, Orthogonal Projections
Lecture 45 - Projection Theorem. Linear Functionals
Lecture 46 - The Adjoint Operator
Lecture 47 - Properties of the Adjoint Operation. Inner Product Space Isomorphism
Lecture 48 - Unitary Operators
Lecture 49 - Unitary operators - II. Self-Adjoint Operators - I.
Lecture 50 - Self-Adjoint Operators - II - Spectral Theorem
Lecture 51 - Normal Operators - Spectral Theorem

NPTEL Video Course - Mathematics - Mathematical Logic

Subject Co-ordinator - Prof. Arindama Singh

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Sets and Strings
Lecture 2 - Syntax of Propositional Logic
Lecture 3 - Unique Parsing
Lecture 4 - Semantics of PL
Lecture 5 - Consequences and Equivalences
Lecture 6 - Five results about PL
Lecture 7 - Calculations and Informal Proofs
Lecture 8 - More Informal Proofs
Lecture 9 - Normal forms
Lecture 10 - SAT and 3SAT
Lecture 11 - Horn-SAT and Resolution
Lecture 12 - Resolution
Lecture 13 - Adequacy of Resolution
Lecture 14 - Adequacy and Resolution Strategies
Lecture 15 - Propositional Calculus (PC)
Lecture 16 - Some Results about PC
Lecture 17 - Arguing with Proofs
Lecture 18 - Adequacy of PC
Lecture 19 - Compactness & Analytic Tableau
Lecture 20 - Examples of Tableau Proofs
Lecture 21 - Adequacy of Tableaux
Lecture 22 - Syntax of First order Logic (FL)
Lecture 23 - Symbolization & Scope of Quantifiers
Lecture 24 - Hurdles in giving Meaning
Lecture 25 - Semantics of FL
Lecture 26 - Relevance Lemma
Lecture 27 - Validity, Satisfiability & Equivalence
Lecture 28 - Six Results about FL
Lecture 29 - Laws, Calculation & Informal Proof

Lecture 30 - Quantifier Laws and Consequences
Lecture 31 - More Proofs and Prenex Form
Lecture 32 - Prenex Form Conversion
Lecture 33 - Skolem Form
Lecture 34 - Syntatic Interpretation
Lecture 35 - Herbrand's Theorem
Lecture 36 - Most General Unifiers
Lecture 37 - Resolution Rules
Lecture 38 - Resolution Examples
Lecture 39 - Ariomatic System FC
Lecture 40 - FC and Semidecidability of FL
Lecture 41 - Analytic Tableau for FL
Lecture 42 - Godels Incompleteness Theorems

NPTEL Video Course - Mathematics - Real Analysis

Subject Co-ordinator - Prof. S.H. Kulkarni

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Functions and Relations
Lecture 3 - Finite and Infinite Sets
Lecture 4 - Countable Sets
Lecture 5 - Uncountable Sets, Cardinal Number
Lecture 6 - Real Number System
Lecture 7 - LUB Axiom
Lecture 8 - Sequences of Real Numbers
Lecture 9 - Sequences of Real Numbers - (Continued.)
Lecture 10 - Sequences of Real Numbers - (Continued.)
Lecture 11 - Infinite Series of Real Numbers
Lecture 12 - Series of nonnegative Real Numbers
Lecture 13 - Conditional Convergence
Lecture 14 - Metric Spaces
Lecture 15 - Metric Spaces
Lecture 16 - Balls and Spheres
Lecture 17 - Open Sets
Lecture 18 - Closure Points, Limit Points and isolated Points
Lecture 19 - Closed sets
Lecture 20 - Sequences in Metric Spaces
Lecture 21 - Completeness
Lecture 22 - Baire Category Theorem
Lecture 23 - Limit and Continuity of a Function defined on a Metric space
Lecture 24 - Continuous Functions on a Metric Space
Lecture 25 - Uniform Continuity
Lecture 26 - Connectedness
Lecture 27 - Connected Sets
Lecture 28 - Compactness
Lecture 29 - Compactness (Continued.)

Lecture 30 - Characterizations of Compact Sets
Lecture 31 - Continuous Functions on Compact Sets
Lecture 32 - Types of Discontinuity
Lecture 33 - Differentiation
Lecture 34 - Mean Value Theorems
Lecture 35 - Mean Value Theorems (Continued.)
Lecture 36 - Taylor's Theorem
Lecture 37 - Differentiation of Vector Valued Functions
Lecture 38 - Integration
Lecture 39 - Integrability
Lecture 40 - Integrable Functions
Lecture 41 - Integrable Functions (Continued.)
Lecture 42 - Integration as a Limit of Sum
Lecture 43 - Integration and Differentiation
Lecture 44 - Integration of Vector Valued Functions
Lecture 45 - More Theorems on Integrals
Lecture 46 - Sequences and Series of Functions
Lecture 47 - Uniform Convergence
Lecture 48 - Uniform Convergence and Integration
Lecture 49 - Uniform Convergence and Differentiation
Lecture 50 - Construction of Everywhere Continuous Nowhere Differentiable Function
Lecture 51 - Approximation of a Continuous Function by Polynomials
Lecture 52 - Equicontinuous family of Functions

NPTEL Video Course - Mathematics - Dynamic Data Assimilation: An Introduction

Subject Co-ordinator - Prof. S. Lakshmivarahan

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - An Overview
Lecture 2 - Data Mining, Data assimilation and prediction
Lecture 3 - A classification of forecast errors
Lecture 4 - Finite Dimensional Vector Space
Lecture 5 - Matrices
Lecture 6 - Matrices (Continued...)
Lecture 7 - Multi-variate Calculus
Lecture 8 - Optimization in Finite Dimensional Vector spaces
Lecture 9 - Deterministic, Static, linear Inverse (well-posed) Problems
Lecture 10 - Deterministic, Static, Linear Inverse (Ill-posed) Problems
Lecture 11 - A Geometric View Â Projections
Lecture 12 - Deterministic, Static, nonlinear Inverse Problems
Lecture 13 - On-line Least Squares
Lecture 14 - Examples of static inverse problems
Lecture 15 - Interlude and a Way Forward
Lecture 16 - Matrix Decomposition Algorithms
Lecture 17 - Matrix Decomposition Algorithms (Continued...)
Lecture 18 - Minimization algorithms
Lecture 19 - Minimization algorithms (Continued...)
Lecture 20 - Inverse problems in deterministic
Lecture 21 - Inverse problems in deterministic (Continued...)
Lecture 22 - Forward sensitivity method
Lecture 23 - Relation between FSM and 4DVAR
Lecture 24 - Statistical Estimation
Lecture 25 - Statistical Least Squares
Lecture 26 - Maximum Likelihood Method
Lecture 27 - Bayesian Estimation
Lecture 28 - From Gauss to Kalman-Linear Minimum Variance Estimation
Lecture 29 - Initialization Classical Method

Lecture 30 - Optimal interpolations
Lecture 31 - A Bayesian Formation-3D-VAR methods
Lecture 32 - Linear Stochastic Dynamics - Kalman Filter
Lecture 33 - Linear Stochastic Dynamics - Kalman Filter (Continued...)
Lecture 34 - Linear Stochastic Dynamics - Kalman Filter (Continued...)
Lecture 35 - Covariance Square Root Filter
Lecture 36 - Nonlinear Filtering
Lecture 37 - Ensemble Reduced Rank Filter
Lecture 38 - Basic nudging methods
Lecture 39 - Deterministic predictability
Lecture 40 - Predictability A stochastic view and Summary

NPTEL Video Course - Mathematics - NOC:An Invitation to Mathematics

Subject Co-ordinator - Prof. Sankaran Vishwanath

Co-ordinating Institute - Institute of Mathematical Sciences

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Long division
Lecture 3 - Applications of Long division
Lecture 4 - Lagrange interpolation
Lecture 5 - The 0-1 idea in other contexts - dot and cross product
Lecture 6 - Taylors formula
Lecture 7 - The Chebyshev polynomials
Lecture 8 - Counting number of monomials - several variables
Lecture 9 - Permutations, combinations and the binomial theorem
Lecture 10 - Combinations with repetition, and counting monomials
Lecture 11 - Combinations with restrictions, recurrence relations
Lecture 12 - Fibonacci numbers; an identity and a bijective proof
Lecture 13 - Permutations and cycle type
Lecture 14 - The sign of a permutation, composition of permutations
Lecture 15 - Rules for drawing tangle diagrams
Lecture 16 - Signs and cycle decompositions
Lecture 17 - Sorting lists of numbers, and crossings in tangle diagrams
Lecture 18 - Real and integer valued polynomials
Lecture 19 - Integer valued polynomials revisited
Lecture 20 - Functions on the real line, continuity
Lecture 21 - The intermediate value property
Lecture 22 - Visualizing functions
Lecture 23 - Functions on the plane, Rigid motions
Lecture 24 - More examples of functions on the plane, dilations
Lecture 25 - Composition of functions
Lecture 26 - Affine and Linear transformations
Lecture 27 - Length and Area dilation, the derivative
Lecture 28 - Examples-I
Lecture 29 - Examples-II

Lecture 30 - Linear equations, Lagrange interpolation revisited
Lecture 31 - Completed Matrices in combinatorics
Lecture 32 - Polynomials acting on matrices
Lecture 33 - Divisibility, prime numbers
Lecture 34 - Congruences, Modular arithmetic
Lecture 35 - The Chinese remainder theorem
Lecture 36 - The Euclidean algorithm, the 0-1 idea and the Chinese remainder theorem

NPTEL Video Course - Mathematics - Advanced Complex Analysis

Subject Co-ordinator - Dr. T.E. Venkata Balaji

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Fundamental Theorems Connected with Zeros of Analytic Functions
Lecture 2 - The Argument (Counting) Principle, Rouche's Theorem and The Fundamental Theorem of Algebra
Lecture 3 - Morera's Theorem and Normal Limits of Analytic Functions
Lecture 4 - Hurwitz's Theorem and Normal Limits of Univalent Functions
Lecture 5 - Local Constancy of Multiplicities of Assumed Values
Lecture 6 - The Open Mapping Theorem
Lecture 7 - Introduction to the Inverse Function Theorem
Lecture 8 - Completion of the Proof of the Inverse Function Theorem
Lecture 9 - Univalent Analytic Functions have never-zero Derivatives and are Analytic Isomorphisms
Lecture 10 - Introduction to the Implicit Function Theorem
Lecture 11 - Proof of the Implicit Function Theorem
Lecture 12 - Proof of the Implicit Function Theorem
Lecture 13 - Doing Complex Analysis on a Real Surface
Lecture 14 - F(z,w)=0 is naturally a Riemann Surface
Lecture 15 - Constructing the Riemann Surface for the Complex Logarithm
Lecture 16 - Constructing the Riemann Surface for the m-th root function
Lecture 17 - The Riemann Surface for the functional inverse of an analytic mapping at a critical point
Lecture 18 - The Algebraic nature of the functional inverses of an analytic mapping at a critical point
Lecture 19 - The Idea of a Direct Analytic Continuation or an Analytic Extension
Lecture 20 - General or Indirect Analytic Continuation and the Lipschitz Nature of the Radius of Convergence
Lecture 21 - Analytic Continuation Along Paths via Power Series Part A
Lecture 22 - Analytic Continuation Along Paths via Power Series Part B
Lecture 23 - Continuity of Coefficients occurring in Families of Power Series defining Analytic Continuations
Lecture 24 - Analytic Continuability along Paths
Lecture 25 - Maximal Domains of Direct and Indirect Analytic Continuation
Lecture 26 - Deducing the Second (Simply Connected) Version of the Monodromy Theorem from the First (Homotopy
Lecture 27 - Existence and Uniqueness of Analytic Continuations on Nearby Paths
Lecture 28 - Proof of the First (Homotopy) Version of the Monodromy Theorem
Lecture 29 - Proof of the Algebraic Nature of Analytic Branches of the Functional Inverse of an Analytic Func

Lecture 30 - The Mean-Value Property, Harmonic Functions and the Maximum Principle
Lecture 31 - Proofs of Maximum Principles and Introduction to Schwarz Lemma
Lecture 32 - Proof of Schwarz Lemma and Uniqueness of Riemann Mappings
Lecture 33 - Reducing Existence of Riemann Mappings to Hyperbolic Geometry of Sub-domains of the Unit Disc
Lecture 34 - Differential or Infinitesimal Schwarzs Lemma, Picks Lemma, Hyperbolic Arclengths, Metric and Geo
Lecture 35 - Differential or Infinitesimal Schwarzs Lemma, Picks Lemma, Hyperbolic Arclengths, Metric and Geo
Lecture 36 - Hyperbolic Geodesics for the Hyperbolic Metric on the Unit Disc
Lecture 37 - Schwarz-Pick Lemma for the Hyperbolic Metric on the Unit Disc
Lecture 38 - Arzela-Ascoli Theorem
Lecture 39 - Completion of the Proof of the Arzela-Ascoli Theorem and Introduction to Montels Theorem
Lecture 40 - The Proof of Montels Theorem
Lecture 41 - The Candidate for a Riemann Mapping
Lecture 42 - Completion of Proof of The Riemann Mapping Theorem
Lecture 43 - Completion of Proof of The Riemann Mapping Theorem

NPTEL Video Course - Mathematics - NOC:Discrete Mathematics

Subject Co-ordinator - Prof. Sourav Chakraborty

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Course Introduction
Lecture 2 - Sets, Relations and Functions
Lecture 3 - Propositional Logic and Predicate Logic
Lecture 4 - Propositional Logic and Predicate Logic (Part 2)
Lecture 5 - Elementary Number Theory
Lecture 6 - Formal Proofs
Lecture 7 - Direct Proofs
Lecture 8 - Case Study
Lecture 9 - Case Study (Part 2)
Lecture 10 - Sets, Relations, Function and Logic
Lecture 11 - Proof by Contradiction (Part 1)
Lecture 12 - Proof by Contradiction (Part 2)
Lecture 13 - Proof by Contraposition
Lecture 14 - Proof by Counter Example
Lecture 15 - Mathematical Induction (Part 1)
Lecture 16 - Mathematical Induction (Part 2)
Lecture 17 - Mathematical Induction (Part 3)
Lecture 18 - Mathematical Induction (Part 4)
Lecture 19 - Mathematical Induction (Part 5)
Lecture 20 - Mathematical Induction (Part 6)
Lecture 21 - Mathematical Induction (Part 7)
Lecture 22 - Mathematical Induction (Part 8)
Lecture 23 - Introduction to Graph Theory
Lecture 24 - Handshake Problem
Lecture 25 - Tournament Problem
Lecture 26 - Tournament Problem (Part 2)
Lecture 27 - Ramsey Problem
Lecture 28 - Ramsey Problem (Part 2)
Lecture 29 - Properties of Graphs

Lecture 30 - Problem 1
Lecture 31 - Problem 2
Lecture 32 - Problem 3 & 4
Lecture 33 - Counting for Selection
Lecture 34 - Counting for Distribution
Lecture 35 - Counting for Distribution (Part 2)
Lecture 36 - Some Counting Problems
Lecture 37 - Counting using Recurrence Relations
Lecture 38 - Counting using Recurrence Relations (Part 2)
Lecture 39 - Solving Recurrence Relations (Part 1)
Lecture 40 - Solving Recurrence Relations (Part 2)
Lecture 41 - Asymptotic Relations (Part 1)
Lecture 42 - Asymptotic Relations (Part 2)
Lecture 43 - Asymptotic Relations (Part 3)
Lecture 44 - Asymptotic Relations (Part 4)
Lecture 45 - Generating Functions (Part 1)
Lecture 46 - Generating Functions (Part 2)
Lecture 47 - Generating Functions (Part 3)
Lecture 48 - Generating Functions (Part 4)
Lecture 49 - Proof Techniques
Lecture 50 - Modeling
Lecture 51 - Combinatorics

NPTEL Video Course - Mathematics - Advanced Complex Analysis - Part 2

Subject Co-ordinator - Dr. T.E. Venkata Balaji

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Properties of the Image of an Analytic Function - Introduction to the Picard Theorems
Lecture 2 - Recalling Singularities of Analytic Functions - Non-isolated and Isolated Removable, Pole and Es
Lecture 3 - Recalling Riemann's Theorem on Removable Singularities
Lecture 4 - Casorati-Weierstrass Theorem; Dealing with the Point at Infinity -- Riemann Sphere and Riemann S
Lecture 5 - Neighborhood of Infinity, Limit at Infinity and Infinity as an Isolated Singularity
Lecture 6 - Studying Infinity - Formulating Epsilon-Delta Definitions for Infinite Limits and Limits at Inf
Lecture 7 - When is a function analytic at infinity ?
Lecture 8 - Laurent Expansion at Infinity and Riemann\'s Removable Singularities Theorem for the Point at Inf
Lecture 9 - The Generalized Liouville Theorem - Little Brother of Little Picard and Analogue of Casorati-Weie
Lecture 10 - Morera\'s Theorem at Infinity, Infinity as a Pole and Behaviour at Infinity of Rational and Mero
Lecture 11 - Residue at Infinity and Introduction to the Residue Theorem for the Extended Complex Plane - Res
Lecture 12 - Proofs of Two Avatars of the Residue Theorem for the Extended Complex Plane and Applications of
Lecture 13 - Infinity as an Essential Singularity and Transcendental Entire Functions
Lecture 14 - Meromorphic Functions on the Extended Complex Plane are Precisely Quotients of Polynomials
Lecture 15 - The Ubiquity of Meromorphic Functions - The Nerves of the Geometric Network Bridging Algebra, A
Lecture 16 - Continuity of Meromorphic Functions at Poles and Topologies of Spaces of Functions
Lecture 17 - Why Normal Convergence, but Not Globally Uniform Convergence, is the Inevitable in Complex Analy
Lecture 18 - Measuring Distances to Infinity, the Function Infinity and Normal Convergence of Holomorphic Fun
Lecture 19 - The Invariance Under Inversion of the Spherical Metric on the Extended Complex Plane
Lecture 20 - Introduction to Hurwitz\'s Theorem for Normal Convergence of Holomorphic Functions in the Spheri
Lecture 21 - Completion of Proof of Hurwitz\'s Theorem for Normal Limits of Analytic Functions in the Spheric
Lecture 22 - Hurwitz\'s Theorem for Normal Limits of Meromorphic Functions in the Spherical Metric
Lecture 23 - What could the Derivative of a Meromorphic Function Relative to the Spherical Metric Possibly Be
Lecture 24 - Defining the Spherical Derivative of a Meromorphic Function
Lecture 25 - Well-definedness of the Spherical Derivative of a Meromorphic Function at a Pole and Inversion-i
Lecture 26 - Topological Preliminaries - Translating Compactness into Boundedness
Lecture 27 - Introduction to the Arzela-Ascoli Theorem - Passing from abstract Compactness to verifiable Equi
Lecture 28 - Proof of the Arzela-Ascoli Theorem for Functions - Abstract Compactness Implies Equicontinuity
Lecture 29 - Proof of the Arzela-Ascoli Theorem for Functions - Equicontinuity Implies Compactness

Lecture 30 - Introduction to the Montel Theorem - the Holomorphic Avatar of the Arzela-Ascoli Theorem & Why
Lecture 31 - Completion of Proof of the Montel Theorem - the Holomorphic Avatar of the Arzela-Ascoli Theorem
Lecture 32 - Introduction to Marty\'s Theorem - the Meromorphic Avatar of the Montel & Arzela-Ascoli Theorems
Lecture 33 - Proof of one direction of Marty\'s Theorem - the Meromorphic Avatar of the Montel & Arzela-Ascol
Lecture 34 - Proof of the other direction of Marty\'s Theorem - the Meromorphic Avatar of the Montel & Arzela
Lecture 35 - Normal Convergence at Infinity and Hurwitz\'s Theorems for Normal Limits of Analytic and Meromo
Lecture 36 - Normal Sequential Compactness, Normal Uniform Boundedness and Montel\'s & Marty\'s Theorems at I
Lecture 37 - Local Analysis of Normality and the Zooming Process - Motivation for Zalcman\'s Lemma
Lecture 38 - Characterizing Normality at a Point by the Zooming Process and the Motivation for Zalcman\'s Lem
Lecture 39 - Local Analysis of Normality and the Zooming Process - Motivation for Zalcman\'s Lemma
Lecture 40 - Montel\'s Deep Theorem - The Fundamental Criterion for Normality or Fundamental Normality Test b
Lecture 41 - Proofs of the Great and Little Picard Theorems
Lecture 42 - Royden\'s Theorem on Normality Based On Growth Of Derivatives
Lecture 43 - Schottky\'s Theorem - Uniform Boundedness from a Point to a Neighbourhood & Problem Solving Sess

NPTEL Video Course - Mathematics - Basic Algebraic Geometry : Varieties, Morphisms, Local Rings, Function Fie

Subject Co-ordinator - Dr. T.E. Venkata Balaji

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - What is Algebraic Geometry?
Lecture 2 - The Zariski Topology and Affine Space
Lecture 3 - Going back and forth between subsets and ideals
Lecture 4 - Irreducibility in the Zariski Topology
Lecture 5 - Irreducible Closed Subsets Correspond to Ideals Whose Radicals are Prime
Lecture 6 - Understanding the Zariski Topology on the Affine Line; The Noetherian property in Topology and in
Lecture 7 - Basic Algebraic Geometry
Lecture 8 - Topological Dimension, Krull Dimension and Heights of Prime Ideals
Lecture 9 - The Ring of Polynomial Functions on an Affine Variety
Lecture 10 - Geometric Hypersurfaces are Precisely Algebraic Hypersurfaces
Lecture 11 - Why Should We Study Affine Coordinate Rings of Functions on Affine Varieties ?
Lecture 12 - Capturing an Affine Variety Topologically From the Maximal Spectrum of its Ring of Functions
Lecture 13 - Analyzing Open Sets and Basic Open Sets for the Zariski Topology
Lecture 14 - The Ring of Functions on a Basic Open Set in the Zariski Topology
Lecture 15 - Quasi-Compactness in the Zariski Topology; Regularity of a Function at a point of an Affine Vari
Lecture 16 - What is a Global Regular Function on a Quasi-Affine Variety?
Lecture 17 - Characterizing Affine Varieties; Defining Morphisms between Affine or Quasi-Affine Varieties
Lecture 18 - Translating Morphisms into Affines as k-Algebra maps and the Grand Hilbert Nullstellensatz
Lecture 19 - Morphisms into an Affine Correspond to k-Algebra Homomorphisms from its Coordinate Ring of Funct
Lecture 20 - The Coordinate Ring of an Affine Variety Determines the Affine Variety and is Intrinsic to it
Lecture 21 - Automorphisms of Affine Spaces and of Polynomial Rings - The Jacobian Conjecture; The Punctured
Lecture 22 - The Various Avatars of Projective n-space
Lecture 23 - Gluing (n+1) copies of Affine n-Space to Produce Projective n-space in Topology, Manifold Theor
Lecture 24 - Translating Projective Geometry into Graded Rings and Homogeneous Ideals
Lecture 25 - Expanding the Category of Varieties to Include Projective and Quasi-Projective Varieties
Lecture 26 - Translating Homogeneous Localisation into Geometry and Back
Lecture 27 - Adding a Variable is Undone by Homogenous Localization - What is the Geometric Significance of t
Lecture 28 - Doing Calculus Without Limits in Geometry ?
Lecture 29 - The Birth of Local Rings in Geometry and in Algebra

Lecture 30 - The Formula for the Local Ring at a Point of a Projective Variety Or Playing with Localisations
Lecture 31 - The Field of Rational Functions or Function Field of a Variety - The Local Ring at the Generic P
Lecture 32 - Fields of Rational Functions or Function Fields of Affine and Projective Varieties and their Rel
Lecture 33 - Global Regular Functions on Projective Varieties are Simply the Constants
Lecture 34 - The d-Uple Embedding and the Non-Intrinsic Nature of the Homogeneous Coordinate Ring of a Projec
Lecture 35 - The Importance of Local Rings - A Morphism is an Isomorphism if it is a Homeomorphism and Induce
Lecture 36 - The Importance of Local Rings - A Rational Function in Every Local Ring is Globally Regular
Lecture 37 - Geometric Meaning of Isomorphism of Local Rings - Local Rings are Almost Global
Lecture 38 - Local Ring Isomorphism,Equals Function Field Isomorphism, Equals Birationality
Lecture 39 - Why Local Rings Provide Calculus Without Limits for Algebraic Geometry Pun Intended!
Lecture 40 - How Local Rings Detect Smoothness or Nonsingularity in Algebraic Geometry
Lecture 41 - Any Variety is a Smooth Manifold with or without Non-Smooth Boundary
Lecture 42 - Any Variety is a Smooth Hypersurface On an Open Dense Subset

NPTEL Video Course - Mathematics - NOC:Introduction to Commutative Algebra

Subject Co-ordinator - Prof. A.V.Jayanthan

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Review of Ring Theory
Lecture 2 - Review of Ring Theory (Continued...)
Lecture 3 - Ideals in commutative rings
Lecture 4 - Operations on ideals
Lecture 5 - Properties of prime ideals
Lecture 6 - Colon and Radical of ideals
Lecture 7 - Radicals, extension and contraction of ideals
Lecture 8 - Modules and homomorphisms
Lecture 9 - Isomorphism theorems and Operations on modules
Lecture 10 - Operations on modules (Continued...)
Lecture 11 - Module homomorphism and determinant trick
Lecture 12 - NakayamaÂ s lemma and exact sequences
Lecture 13 - Exact sequences (Continued...)
Lecture 14 - Homomorphisms and Tensor products
Lecture 15 - Properties of tensor products
Lecture 16 - Properties of tensor products (Continued...)
Lecture 17 - Tensor product of Algebras
Lecture 18 - Localization
Lecture 19 - Localization (Continued...)
Lecture 20 - Local properties
Lecture 21 - Further properties of localization
Lecture 22 - Intergral dependence
Lecture 23 - Integral extensions
Lecture 24 - Lying over and Going-up theorems
Lecture 25 - Going-down theorem
Lecture 26 - Going-down theorem (Continued...)
Lecture 27 - Chain conditions
Lecture 28 - Noetherian and Artinian modules
Lecture 29 - Properties of Noetherian and Artinian modules, Composition Series

Lecture 30 - Further properties of Noetherian and Artinian modules and rings
Lecture 31 - Hilbert basis theorem and Primary decomposition
Lecture 32 - Primary decomposition (Continued...)
Lecture 33 - Uniqueness of primary decomposition
Lecture 34 - 2nd Uniqueness theorem, Artinian rings
Lecture 35 - Properties of Artinian rings
Lecture 36 - Structure Theorem of Artinian rings
Lecture 37 - Noether Normalization
Lecture 38 - Hilberts Nullstellensatz

NPTEL Video Course - Mathematics - NOC:Differential Equations

Subject Co-ordinator - Prof. Srinivasa Manam

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Ordinary Differential Equations (ODE)
Lecture 2 - Methods for First Order ODE's - Homogeneous Equations
Lecture 3 - Methods for First order ODE's - Exact Equations
Lecture 4 - Methods for First Order ODE's - Exact Equations (Continued...)
Lecture 5 - Methods for First order ODE's - Reducible to Exact Equations
Lecture 6 - Methods for First order ODE's - Reducible to Exact Equations (Continued...)
Lecture 7 - Non-Exact Equations - Finding Integrating Factors
Lecture 8 - Linear First Order ODE and Bernoulli's Equation
Lecture 9 - Introduction to Second order ODE's
Lecture 10 - Properties of solutions of second order homogeneous ODE's
Lecture 11 - Abel's formula to find the other solution
Lecture 12 - Abel's formula - Demonstration
Lecture 13 - Second Order ODE's with constant coefficients
Lecture 14 - Euler - Cauchy equation
Lecture 15 - Non homogeneous ODEs Variation of Parameters
Lecture 16 - Method of undetermined coefficients
Lecture 17 - Demonstration of Method of undetermined coefficients
Lecture 18 - Power Series and its properties
Lecture 19 - Power Series Solutions to Second Order ODE's
Lecture 20 - Power Series Solutions (Continued...)
Lecture 21 - Legendre Differential Equation
Lecture 22 - Legendre Polynomials
Lecture 23 - Properties of Legendre Polynomials
Lecture 24 - Power series solutions around a regular singular point
Lecture 25 - Frobenius method of solutions
Lecture 26 - Frobenius method of solutions (Continued...)
Lecture 27 - Examples on Frobenius method
Lecture 28 - Bessel differential equation
Lecture 29 - Frobenius solutions for Bessel Equation

Lecture 30 - Properties of Bessel functions
Lecture 31 - Properties of Bessel functions (Continued...)
Lecture 32 - Introduction to Sturm-Liouville theory
Lecture 33 - Sturm-Liouville Problems
Lecture 34 - Regular Sturm-Liouville problem
Lecture 35 - Periodic and singular Sturm-Liouville Problems
Lecture 36 - Generalized Fourier series
Lecture 37 - Examples of Sturm-Liouville systems
Lecture 38 - Examples of Sturm-Liouville systems (Continued...)
Lecture 39 - Examples of regular Sturm-Liouville systems
Lecture 40 - Second order linear PDEs
Lecture 41 - Classification of second order linear PDEs
Lecture 42 - Reduction to canonical form for equations with constant coefficients
Lecture 43 - Reduction to canonical form for equations with variable coefficients
Lecture 44 - Reduction to Normal form-More examples
Lecture 45 - D'Alembert solution for wave equation
Lecture 46 - Uniqueness of solutions for wave equation
Lecture 47 - Vibration of a semi-infinite string
Lecture 48 - Vibration of a finite string
Lecture 49 - Finite length string vibrations
Lecture 50 - Finite length string vibrations (Continued...)
Lecture 51 - Non-homogeneous wave equation
Lecture 52 - Vibration of a circular drum
Lecture 53 - Solutions of heat equation-Properties
Lecture 54 - Temperature in an infinite rod
Lecture 55 - Temperature in a semi-infinite rod
Lecture 56 - Non-homogeneous heat equation
Lecture 57 - Temperature in a finite rod
Lecture 58 - Temperature in a finite rod with insulated ends
Lecture 59 - Laplace equation over a rectangle
Lecture 60 - Laplace equation over a rectangle with flux boundary conditions
Lecture 61 - Laplace equation over circular domains
Lecture 62 - Laplace equation over circular Sectors
Lecture 63 - Uniqueness of the boundary value problems for Laplace equation
Lecture 64 - Conclusions

NPTEL Video Course - Mathematics - NOC:Numerical Analysis

Subject Co-ordinator - Prof. R. Usha

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Lesson 1 - Introduction, Motivation
Lecture 2 - Lesson 2 - Part 1 - Mathematical Preliminaries, Polynomial Interpolation - 1
Lecture 3 - Lesson 2 - Part 2 - Mathematical Preliminaries, Polynomial Interpolation - 1
Lecture 4 - Lesson 3 - Part 1 - Polynomial Interpolation - 2
Lecture 5 - Lesson 3 - Part 2 - Polynomial Interpolation - 2
Lecture 6 - Lesson 4 - Polynomial Interpolation - 3
Lecture 7 - Lagrange Interpolation Polynomial, Error In Interpolation - 1
Lecture 8 - Lagrange Interpolation Polynomial, Error In Interpolation - 1
Lecture 9 - Error In Interpolation - 2
Lecture 10 - Error In Interpolation - 2
Lecture 11 - Divide Difference Interpolation Polynomial
Lecture 12 - Properties Of Divided Difference, Introduction To Inverse Interpolation
Lecture 13 - Properties Of Divided Difference, Introduction To Inverse Interpolation
Lecture 14 - Inverse Interpolation, Remarks on Polynomial Interpolation
Lecture 15 - Numerical Differentiation - 1 Taylor Series Method
Lecture 16 - Numerical Differentiation - 2 Method Of Undetermined Coefficients
Lecture 17 - Numerical Differentiation - 2 Polynomial Interpolation Method
Lecture 18 - Numerical Differentiation - 3 Operator Method Numerical Integration - 1
Lecture 19 - Numerical Integration - 2 Error in Trapezoidal Rule Simpson's Rule
Lecture 20 - Numerical Integration - 3 Error in Simpson's Rule Composite in Trapezoidal Rule, Error
Lecture 21 - Numerical Integration - 4 Composite Simpsons Rule , Error Method of Undetermined Coefficients
Lecture 22 - Numerical Integration - 5 Gaussian Quadrature (Two-Point Method)
Lecture 23 - Numerical Integrature - 5 Gaussian Quadrature (Three-Point Method) Adaptive Quadrature
Lecture 24 - Numerical Solution of Ordinary Differential Equation (ODE) - 1
Lecture 25 - Numerical Solution Of ODE-2 Stability , Single-Step Methods - 1 Taylor Series Method
Lecture 26 - Numerical Solution Of ODE-3 Examples of Taylor Series Method Euler's Method
Lecture 27 - Numerical Solution Of ODE-4 Runge-Kutta Methods
Lecture 28 - Numerical Solution Of ODE-5 Example For RK-Method Of Order 2 Modified Euler's Method
Lecture 29 - Numerical Solution Of Ordinary Differential Equations - 6 Predictor-Corrector Methods (Adam-Moul

Lecture 30 - Numerical Solution Of Ordinary Differential Equations - 7
Lecture 31 - Numerical Solution Of Ordinary Differential Equations - 8
Lecture 32 - Numerical Solution of Ordinary Differential Equations - 9
Lecture 33 - Numerical Solution of Ordinary Differential Equations - 10
Lecture 34 - Numerical Solution of Ordinary Differential Equations - 11
Lecture 35 - Root Finding Methods - 1 The Bisection Method - 1
Lecture 36 - Root Finding Methods - 2 The Bisection Method - 2
Lecture 37 - Root Finding Methods - 3 Newton-Raphson Method - 1
Lecture 38 - Root Finding Methods - 4 Newton-Raphson Method - 2
Lecture 39 - Root Finding Methods - 5 Secant Method, Method Of false Position
Lecture 40 - Root Finding Methods - 6 Fixed Point Methods - 1
Lecture 41 - Root Finding Methods - 7 Fixed Point Methods - 2
Lecture 42 - Root Finding Methods - 8 Fixed Point Iteration Methods - 3
Lecture 43 - Root Finding Methods - 9 Practice Problems
Lecture 44 - Solution Of Linear Systems Of Equations - 1
Lecture 45 - Solution Of Linear Systems Of Equations - 2
Lecture 46 - Solution Of Linear Systems Of Equations - 3
Lecture 47 - Solution Of Linear Systems Of Equations - 4
Lecture 48 - Solution Of Linear Systems Of Equations - 5
Lecture 49 - Solution Of Linear Systems Of Equations - 6
Lecture 50 - Solution Of Linear Systems Of Equations - 7
Lecture 51 - Solution Of Linear Systems Of Equations - 8 Iterative Method - 1
Lecture 52 - Solution Of Linear Systems Of Equations - 8 Iterative Method - 2
Lecture 53 - Matrix Eigenvalue Problems - 2 Power Method - 2
Lecture 54 - Practice Problems

NPTEL Video Course - Mathematics - NOC:Graph Theory

Subject Co-ordinator - Dr. Soumen Maity

Co-ordinating Institute - IISER - Pune

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Basic Concepts
Lecture 2 - Basic Concepts - 1
Lecture 3 - Eulerian and Hamiltonian Graph
Lecture 4 - Eulerian and Hamiltonian Graph - 1
Lecture 5 - Bipartite Graph
Lecture 6 - Bipartite Graph
Lecture 7 - Diameter of a graph; Isomorphic graphs
Lecture 8 - Diameter of a graph; Isomorphic graphs
Lecture 9 - Minimum Spanning Tree
Lecture 10 - Minimum Spanning Trees (Continued...)
Lecture 11 - Minimum Spanning Trees (Continued...)
Lecture 12 - Minimum Spanning Trees (Continued...)
Lecture 13 - Maximum Matching in Bipartite Graph
Lecture 14 - Maximum Matching in Bipartite Graph - 1
Lecture 15 - Hall's Theorem and Konig's Theorem
Lecture 16 - Hall's Theorem and Konig's Theorem - 1
Lecture 17 - Independent Set and Edge Cover
Lecture 18 - Independent Set and Edge Cover - 1
Lecture 19 - Matching in General Graphs
Lecture 20 - Proof of Halls Theorem
Lecture 21 - Stable Matching
Lecture 22 - Gale-Shapley Algorithm
Lecture 23 - Graph Connectivity
Lecture 24 - Graph Connectivity - 1
Lecture 25 - 2-Connected Graphs
Lecture 26 - 2-Connected Graphs - 1
Lecture 27 - Subdivision of an edge; 2-edge-connected graphs
Lecture 28 - Problems Related to Graphs Connectivity
Lecture 29 - Flow Network

Lecture 30 - Residual Network and Augmenting Path
Lecture 31 - Augmenting Path Algorithm
Lecture 32 - Max-Flow and Min-Cut
Lecture 33 - Max-Flow and Min-Cut Theorem
Lecture 34 - Vertex Colouring
Lecture 35 - Chromatic Number and Max. Degree
Lecture 36 - Edge Colouring
Lecture 37 - Planar Graphs and Euler's Formula
Lecture 38 - Characterization Of Planar Graphs
Lecture 39 - Colouring of Planar Graphs

NPTEL Video Course - Mathematics - NOC:Transform Techniques for Engineers

Subject Co-ordinator - Prof. Srinivasa Manam

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Fourier series
Lecture 2 - Fourier seriesÂ - ExamplesÂ
Lecture 3 - Complex Fourier seriesÂ
Lecture 4 - Conditions for the Convergence of Fourier SeriesÂ
Lecture 5 - Conditions for the Convergence of Fourier Series (Continued...)
Lecture 6 - Use of Delta function in the Fourier series convergence
Lecture 7 - More Examples on Fourier Series of a Periodic Signal
Lecture 8 - Gibb's Phenomenon in the Computation of Fourier Series
Lecture 9 - Properties of Fourier Transform of a Periodic Signal
Lecture 10 - Properties of Fourier transform (Continued...)
Lecture 11 - Parseval's Identity and Recap of Fourier series
Lecture 12 - Fourier integral theorem-an informal proof
Lecture 13 - Definition of Fourier transforms
Lecture 14 - Fourier transform of a Heavyside function
Lecture 15 - Use of Fourier transforms to evaluate some integrals
Lecture 16 - Evaluation of an integral- Recall of complex function theory
Lecture 17 - Properties of Fourier transforms of non-periodic signals
Lecture 18 - More properties of Fourier transforms
Lecture 19 - Fourier integral theorem - proof
Lecture 20 - Application of Fourier transform to ODE's
Lecture 21 - Application of Fourier transforms to differential and integral equations
Lecture 22 - Evaluation of integrals by Fourier transforms
Lecture 23 - D'Alembert's solution by Fourier transform
Lecture 24 - Solution of Heat equation by Fourier transform
Lecture 25 - Solution of Heat and Laplace equations by Fourier transform
Lecture 26 - Introduction to Laplace transform
Lecture 27 - Laplace transform of elementary functions
Lecture 28 - Properties of Laplace transforms
Lecture 29 - Properties of Laplace transforms (Continued...)

Lecture 30 - Methods of finding inverse Laplace transform
Lecture 31 - Heavyside expansion theorem
Lecture 32 - Review of complex function theory
Lecture 33 - Inverse Laplace transform by contour integration
Lecture 34 - Application of Laplace transforms - ODEs'
Lecture 35 - Solutions of initial or boundary value problems for ODEs'
Lecture 36 - Solving first order PDE's by Laplace transform
Lecture 37 - Solution of wave equation by Laplace transform
Lecture 38 - Solving hyperbolic equations by Laplace transform
Lecture 39 - Solving heat equation by Laplace transform
Lecture 40 - Initial boundary value problems for heat equations
Lecture 41 - Solution of Integral Equations by Laplace Transform
Lecture 42 - Evaluation of Integrals by Laplace Transform
Lecture 43 - Introduction to Z-Transforms
Lecture 44 - Properties of Z-Transforms
Lecture 45 - Inverse Z-transforms
Lecture 46 - Solution of difference equations by Z-transforms
Lecture 47 - Evaluation of infinite sums by Z-transforms
Lecture 48 - conclusions

NPTEL Video Course - Mathematics - NOC:Introduction to Probability and Statistics

Subject Co-ordinator - Prof. G. Srinivasan

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to probability and Statistics
Lecture 2 - Types of data
Lecture 3 - Categorical data
Lecture 4 - Describing Categorical data
Lecture 5 - Describing Categorical data (Continued...)
Lecture 6 - Describing numerical data
Lecture 7 - Describing numerical data (Continued...)
Lecture 8 - Exercises, Association between categorical variables
Lecture 9 - Association between categorical variables (Continued...)
Lecture 10 - Association between numerical variables
Lecture 11 - Association between numerical variables (Continued...)
Lecture 12 - Probability
Lecture 13 - Rules of Probability
Lecture 14 - Rules of Probability (Continued...)
Lecture 15 - Conditional Probability
Lecture 16 - Random variables
Lecture 17 - Random variables - concepts and exercises
Lecture 18 - Association between Random variables
Lecture 19 - Binomial Distribution
Lecture 20 - Normal distribution
Lecture 21 - Additional Examples

NPTEL Video Course - Mathematics - NOC:Introduction to Abstract Group Theory

Subject Co-ordinator - Prof. Krishna Hanumanthu

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Motivational examples of groups
Lecture 2 - Definition of a group and examples
Lecture 3 - More examples of groups
Lecture 4 - Basic properties of groups and multiplication tables
Lecture 5 - Problems - 1
Lecture 6 - Problems - 2
Lecture 7 - Problems - 3
Lecture 8 - Subgroups
Lecture 9 - Types of groups
Lecture 10 - Group homomorphisms and examples
Lecture 11 - Properties of homomorphisms
Lecture 12 - Group isomorphisms
Lecture 13 - Normal subgroups
Lecture 14 - Equivalence relations
Lecture 15 - Problems - 4
Lecture 16 - Cosets and Lagrange's theorem
Lecture 17 - S_3 revisited
Lecture 18 - Problems - 5
Lecture 19 - Quotient groups
Lecture 20 - Examples of quotient groups
Lecture 21 - First isomorphism theorem
Lecture 22 - Examples and Second isomorphism theorem
Lecture 23 - Third isomorphism theorem
Lecture 24 - Cauchy's theorem
Lecture 25 - Problems - 6
Lecture 26 - Symmetric groups - I
Lecture 27 - Symmetric Groups - II
Lecture 28 - Symmetric groups - III
Lecture 29 - Symmetric groups - IV

Lecture 30 - Odd and even permutations - I
Lecture 31 - Odd and even permutations - II
Lecture 32 - Alternating groups
Lecture 33 - Group actions
Lecture 34 - Examples of group actions
Lecture 35 - Orbits and stabilizers
Lecture 36 - Counting formula
Lecture 37 - Cayley's theorem
Lecture 38 - Problems - 7
Lecture 39 - Problems - 8 and Class equation
Lecture 40 - Group actions on subsets
Lecture 41 - Sylow Theorem - I
Lecture 42 - Sylow Theorem - II
Lecture 43 - Sylow Theorem - III
Lecture 44 - Problems - 9
Lecture 45 - Problems - 10

NPTEL Video Course - Mathematics - NOC:Groups: Motion, Symmetry and Puzzles

Subject Co-ordinator - Prof. Amit Kulshrestha

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Permutation, symmetry and groups
Lecture 2 - Groups acting on a set/an object
Lecture 3 - More on group actions
Lecture 4 - Groups and parity
Lecture 5 - Parity and puzzles
Lecture 6 - Generators and relations
Lecture 7 - Cosets, quotients and homomorphisms
Lecture 8 - Cayley graphs of groups
Lecture 9 - Platonic solids
Lecture 10 - Symmetries of plane and wallpapers
Lecture 11 - Introduction to GAP
Lecture 12 - GAP through Rubik's cube
Lecture 13 - Representing abstract groups
Lecture 14 - A quick introduction to group representations
Lecture 15 - Rotations and quaternions
Lecture 16 - Rotational symmetries of platonic solids
Lecture 17 - Finite subgroups of SO(3)

NPTEL Video Course - Mathematics - NOC:Introduction to Rings and Fields

Subject Co-ordinator - Prof. Krishna Hanumanthu

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction, main definitions
Lecture 2 - Examples of rings
Lecture 3 - More examples
Lecture 4 - Polynomial Rings - 1
Lecture 5 - Polynomial Rings - 2
Lecture 6 - Homomorphisms
Lecture 7 - Kernels, ideals
Lecture 8 - Problems - 1
Lecture 9 - Problems - 2
Lecture 10 - Problems - 3
Lecture 11 - Quotient Rings
Lecture 12 - First isomorphism and correspondence theorems
Lecture 13 - Examples of correspondence theorem
Lecture 14 - Prime ideals
Lecture 15 - Maximal ideals, integral domains
Lecture 16 - Existence of maximal ideals
Lecture 17 - Problems - 4
Lecture 18 - Problems - 5
Lecture 19 - Problems - 6
Lecture 20 - Field of fractions, Noetherian rings - 1
Lecture 21 - Noetherian rings - 2
Lecture 22 - Hilbert Basis Theorem
Lecture 23 - Irreducible, prime elements
Lecture 24 - Irreducible, prime elements, GCD
Lecture 25 - Principal Ideal Domains
Lecture 26 - Unique Factorization Domains - 1
Lecture 27 - Unique Factorization Domains - 2
Lecture 28 - Gauss Lemma
Lecture 29 - Z[X] is a UFD

Lecture 30 - Eisenstein criterion and Problems - 7
Lecture 31 - Problems - 8
Lecture 32 - Problems - 9
Lecture 33 - Field extensions - 1
Lecture 34 - Field extensions - 2
Lecture 35 - Degree of a field extension - 1
Lecture 36 - Degree of a field extension - 2
Lecture 37 - Algebraic elements form a field
Lecture 38 - Field homomorphisms
Lecture 39 - Splitting fields
Lecture 40 - Finite fields - 1
Lecture 41 - Finite fields - 2
Lecture 42 - Finite fields - 3
Lecture 43 - Problems - 10
Lecture 44 - Problems - 11

NPTEL Video Course - Mathematics - NOC:Probabilistic Methods in PDE

Subject Co-ordinator - Prof. Anindya Goswami

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Prerequisite Measure Theory - Part 1
Lecture 2 - Prerequisite Measure Theory - Part 2
Lecture 3 - Prerequisite Measure Theory - Part 3
Lecture 4 - Random variable
Lecture 5 - Stochastic Process
Lecture 6 - Conditional Expectation
Lecture 7 - Preliminary for Stochastic Integration - Part 1
Lecture 8 - Preliminary for Stochastic Integration - Part 2
Lecture 9 - Definition and properties of Stochastic Integration - Part 1
Lecture 10 - Definition and properties of Stochastic Integration - Part 2
Lecture 11 - Further properties of Stochastic Integration
Lecture 12 - Extension of stochastic integral
Lecture 13 - change of variable formula and proof - Part 1
Lecture 14 - change of variable formula and proof - Part 2
Lecture 15 - Brownian motion as the building block
Lecture 16 - Brownian motion and its martingale property - Part 1
Lecture 17 - Brownian motion and its martingale property - Part 2
Lecture 18 - Application of Itoâ s rule on Ito process
Lecture 19 - Harmonic function and its properties
Lecture 20 - Maximum principle of harmonic function
Lecture 21 - Dirichlet Problem and bounded solution
Lecture 22 - Example of a Dirichlet problem
Lecture 23 - Regular points at the boundary
Lecture 24 - Zarembas cone condition for regularity
Lecture 25 - Summary of the Zaremba's cone condition
Lecture 26 - Continuity of candidate solution at regular points - Part 1
Lecture 27 - Continuity of candidate solution at regular points - Part 2
Lecture 28 - Summary of bounded solution to the Dirichlet Problem
Lecture 29 - Stochastic representation of bounded solution to a heat equation - Part 1

Lecture 30 - Stochastic representation of bounded solution to a heat equation - Part 2
Lecture 31 - Uniqueness of solution to the heat equationÂ
Lecture 32 - Remark on Tychonoff's Theorem
Lecture 33 - Widderâ s result and its extension on heat equation
Lecture 34 - Solution to the mixed initial boundary value problemÂ
Lecture 35 - The Feynman-Kac formulaÂ
Lecture 36 - Kacâ s theorem on the stochastic representation of solution to a second-order linear ODE - Part
Lecture 37 - Kacâ s theorem on the stochastic representation of solution to a second-order linear ODE - Part
Lecture 38 - Geometric Brownian motion
Lecture 39 - A system of stochastic differential equations in application
Lecture 40 - Brownian bridge
Lecture 41 - Simulation of stochastic differential equations
Lecture 42 - Stochastic differential equations
Lecture 43 - Stochastic differential equations
Lecture 44 - Stochastic differential equations
Lecture 45 - Stochastic differential equations
Lecture 46 - Stochastic differential equations
Lecture 47 - Functional Stochastic Differential Equations
Lecture 48 - Statement of Dirichlet and Cauchy problems with variable coefficients elliptic operators
Lecture 49 - Cauchy Problem with variable coefficients
Lecture 50 - Cauchy Problem with variable coefficients
Lecture 51 - Semigroup of bounded linear operators on Banach space - Part 1
Lecture 52 - Semigroup of bounded linear operators on Banach space - Part 2
Lecture 53 - Growth property of C0 semigroup
Lecture 54 - Unique semigroup generated by a bounded linear operator
Lecture 55 - Homogeneous initial value problem
Lecture 56 - Mild solution to homogeneous initial value problem
Lecture 57 - Mild solution to inhomogeneous initial value problem
Lecture 58 - Sufficient condition for existence of classical solution of IVP
Lecture 59 - Tutorial on Resolvant operator
Lecture 60 - Feynman-Kac formula and the formula of variations of constants
Lecture 61 - Non-autonomous evolution problem and mild/generalized solution
Lecture 62 - Sufficient condition for existence of an evolution system
Lecture 63 - Y-valued solution
Lecture 64 - mild/generalized solution to Semi-linear Evolution Problem
Lecture 65 - Existence of classical solution - Part 1
Lecture 66 - Existence of classical solution - Part 2
Lecture 67 - Conclusion video

NPTEL Video Course - Mathematics - NOC:Linear Algebra (Prof. Pranav Haridas)

Subject Co-ordinator - Prof. Pranav Haridas

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Vector Spaces
Lecture 2 - Examples of Vector Spaces
Lecture 3 - Vector Subspaces
Lecture 4 - Linear Combinations and Span
Lecture 5 - Linear Independence
Lecture 6 - Basis
Lecture 7 - Dimension
Lecture 8 - Replacement theorem consequences
Lecture 9 - Rank Nullity
Lecture 10 - Linear Transformations
Lecture 11 - Linear Transformation Basis
Lecture 12 - Linear Transformation and Matrices
Lecture 13 - Problem session
Lecture 14 - Linear Transformation and Matrices (Continued...)
Lecture 15 - Invertible Linear Transformations
Lecture 16 - Invertible Linear Transformations and Matrices
Lecture 17 - Change of Basis
Lecture 18 - Product of Vector Spaces
Lecture 19 - Quotient Spaces
Lecture 20 - Dual Spaces
Lecture 21 - Row operations
Lecture 22 - Rank of a Matrix
Lecture 23 - Inverting matrices
Lecture 24 - Determinants
Lecture 25 - Problem Session
Lecture 26 - Diagonal Matrices
Lecture 27 - Eigenvectors and eigenvalues
Lecture 28 - Computing eigenvalues
Lecture 29 - Characteristic ploynomia

Lecture 30 - Diagonalizibility
Lecture 31 - Multiplicity of eigenvalues
Lecture 32 - Invariant subspaces
Lecture 33 - Complex Vector Spaces
Lecture 34 - Inner Product Spaces
Lecture 35 - Inner Product and Length
Lecture 36 - Orthogonality
Lecture 37 - Problem Session
Lecture 38 - Problem Session
Lecture 39 - Orthonormal Basis
Lecture 40 - Gram Schmidt Orthogonalization
Lecture 41 - Orthogonal Complements
Lecture 42 - Problem Session
Lecture 43 - Riesz Representation Theorem
Lecture 44 - Adjoint of a linear transformation
Lecture 45 - Problem Session
Lecture 46 - Normal Operators
Lecture 47 - Self Adjoint Operators
Lecture 48 - Spectral Theorem

NPTEL Video Course - Mathematics - NOC:Algebra - I

Subject Co-ordinator - Prof. Amritanshu Prasad, Prof. S. Viswanath

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Permutations
Lecture 2 - Group Axioms
Lecture 3 - Order and Conjugacy
Lecture 4 - Subgroups
Lecture 5 - Problem solving
Lecture 6 - Group Actions
Lecture 7 - Cosets
Lecture 8 - Group Homomorphisms
Lecture 9 - Normal subgroups
Lecture 10 - Qutient Groups
Lecture 11 - Product and Chinese Remainder Theorem
Lecture 12 - Dihedral Groups
Lecture 13 - Semidirect products
Lecture 14 - Problem solving
Lecture 15 - The Orbit Counting Theorem
Lecture 16 - Fixed points of group actions
Lecture 17 - Second application
Lecture 18 - Sylow Theorem - a preliminary proposition
Lecture 19 - Sylow Theorem - I
Lecture 20 - Problem solving - I
Lecture 21 - Problem solving - II
Lecture 22 - Sylow Theorem - II
Lecture 23 - Sylow Theorem - III
Lecture 24 - Problem solving - I
Lecture 25 - Problem solving - II
Lecture 26 - Free Groups - I
Lecture 27 - Free Groups - IIa
Lecture 28 - Free Groups - IIb
Lecture 29 - Free Groups - III

Lecture 30 - Free Groups - IV
Lecture 31 - Problem Solving/Examples
Lecture 32 - Generators and relations for symmetric groups â   I
Lecture 33 - Generators and relations for symmetric groups â   II
Lecture 34 - Definition of a Ring
Lecture 35 - Euclidean Domains
Lecture 36 - Gaussian Integers
Lecture 37 - The Fundamental Theorem of Arithmetic
Lecture 38 - Divisibility and Ideals
Lecture 39 - Factorization and the Noetherian Condition
Lecture 40 - Examples of Ideals in Commutative Rings
Lecture 41 - Problem Solving/Examples
Lecture 42 - The Ring of Formal Power Series
Lecture 43 - Fraction Fields
Lecture 44 - Path Algebra of a Quiver
Lecture 45 - Ideals In Non-Commutative Rings
Lecture 46 - Product of Rings
Lecture 47 - Ring Homomorphisms
Lecture 48 - Quotient Rings
Lecture 49 - Problem solving
Lecture 50 - Tensor and Exterior Algebras
Lecture 51 - Modules
Lecture 52 - Modules over polynomial rings $K[x]$
Lecture 53 - Modules
Lecture 54 - Modules
Lecture 55 - Submodules
Lecture 56 - General constructions of submodules
Lecture 57 - Problem Solving
Lecture 58 - Quotient modules
Lecture 59 - Homomorphisms
Lecture 60 - More examples of homomorphisms
Lecture 61 - First isomorphism theorem
Lecture 62 - Direct sums of modules
Lecture 63 - Complementary submodules
Lecture 64 - Change of ring
Lecture 65 - Problem solving
Lecture 66 - Free Modules (finitely generated)
Lecture 67 - Determinants
Lecture 68 - Primary Decomposition

Lecture 69 - Problem solving
Lecture 70 - Finitely generated modules and the Noetherian condition
Lecture 71 - Counterexamples to the Noetherian condition
Lecture 72 - Generators and relations for Finitely Generated Modules
Lecture 73 - General Linear Group over a Commutative Ring
Lecture 74 - Equivalence of Matrices
Lecture 75 - Smith Canonical Form for a Euclidean domain
Lecture 76 - solved_problems1
Lecture 77 - Smith Canonical Form for PID
Lecture 78 - Structure of finitely generated modules over a PID
Lecture 79 - Structure of a finitely generated abelian group
Lecture 80 - Similarity of Matrices
Lecture 81 - Deciding Similarity
Lecture 82 - Rational Canonical Form
Lecture 83 - Jordan Canonical Form

NPTEL Video Course - Mathematics - NOC:Computational Commutative Algebra

Subject Co-ordinator - Prof. Manoj Kummini

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Definitions
Lecture 2 - Homomorphisms
Lecture 3 - Quotient rings
Lecture 4 - Noetherian rings
Lecture 5 - Monomials
Lecture 6 - Initial ideals
Lecture 7 - Division algorithm
Lecture 8 - Grobner basis
Lecture 9 - Solving Polynomial Equations
Lecture 10 - Nullstellensatz - Part 1
Lecture 11 - Nullstellensatz - Part 2
Lecture 12 - Buchberger criterion
Lecture 13 - Monomial basis
Lecture 14 - Elimination
Lecture 15 - Modules - Part 1
Lecture 16 - Modules - Part 2
Lecture 17 - Localisation
Lecture 18 - Nakayama Lemma
Lecture 19 - Spectrum - Part 1
Lecture 20 - Spectrum - Part 2
Lecture 21 - Associated primes
Lecture 22 - Primary Decomposition
Lecture 23 - Support of a module
Lecture 24 - Associated primes
Lecture 25 - Prime avoidance
Lecture 26 - Saturation - Part 1
Lecture 27 - Saturation - Part 2
Lecture 28 - Saturation - Part 3
Lecture 29 - Morphisms - Part 1

Lecture 30 - Morphisms - Part 2
Lecture 31 - Integral extensions
Lecture 32 - Noether normalisation lemma
Lecture 33 - Noether normalisation lemma
Lecture 34 - Polynomial rings
Lecture 35 - Going up theorem
Lecture 36 - Artinian rings
Lecture 37 - Graded modules
Lecture 38 - Hilbert polynomial
Lecture 39 - Hilbert-Samuel polynomial
Lecture 40 - Artin Rees Lemma
Lecture 41 - Degree of Hilbert-Samuel polynomial
Lecture 42 - Dimension of noetherian local rings - Part 1
Lecture 43 - Dimension of noetherian local rings - Part 2
Lecture 44 - Dimension of polynomial rings
Lecture 45 - Algebras over a field
Lecture 46 - Graded rings - Part 1
Lecture 47 - Graded rings - Part 2
Lecture 48 - Polynomial rings over fields
Lecture 49 - Hilbert series - Part 1
Lecture 50 - Hilbert series - Part 2
Lecture 51 - Proj of a graded ring
Lecture 52 - Homogenization - Part 1
Lecture 53 - Homogenization - Part 2
Lecture 54 - More on graded rings
Lecture 55 - Free resolutions
Lecture 56 - Computing syzygies
Lecture 57 - Koszul complex
Lecture 58 - More on Koszul complexes
Lecture 59 - Castelnuovo Mumford regularity
Lecture 60 - Castelnuovo Mumford regularity

NPTEL Video Course - Mathematics - NOC:Laplace Transform

Subject Co-ordinator - Prof. Indrava Roy

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction and Motivation for Laplace transforms - Part 1
Lecture 2 - Introduction and Motivation for Laplace transforms - Part 2
Lecture 3 - Improper Riemann integrals
Lecture 4 - Improper Riemann integrals
Lecture 5 - Existence of Laplace transforms and Examples
Lecture 6 - Properties of Laplace transforms-I - Part 1
Lecture 7 - Properties of Laplace transforms-I - Part 2
Lecture 8 - Existence of Laplace transforms for functions with vertical asymptote at the Y-axis - Part 1
Lecture 9 - Existence of Laplace transforms for functions with vertical asymptote at the Y-axis - Part 2
Lecture 10 - Properties of Laplace transforms-II - Part 1
Lecture 11 - Properties of Laplace transforms-II - Part 2
Lecture 12 - Laplace transform of Derivatives - Part 1
Lecture 13 - Laplace transform of Derivatives - Part 2
Lecture 14 - Laplace transform of Periodic functions and Integrals - I
Lecture 15 - Laplace transform of Integrals-II - Part 1
Lecture 16 - Laplace transform of Integrals-II - Part 2
Lecture 17 - Inverse Laplace transform and asymptotic behaviour - Part 1
Lecture 18 - Inverse Laplace transform and asymptotic behaviour - Part 2
Lecture 19 - Methods of finding Inverse Laplace transform-I- Partial Fractions
Lecture 20 - Methods of finding Inverse Laplace transform-II- Convolution theorem
Lecture 21 - Convolution theorem for Laplace transforms
Lecture 22 - Applications of Laplace transforms
Lecture 23 - Applications of Laplace Transform to physical systems
Lecture 24 - Solving Linear ODE's with polynomial coefficients
Lecture 25 - Integral and Integro-differential equation
Lecture 26 - Further application of Laplace transforms - Part 1
Lecture 27 - Further application of Laplace transforms - Part 2

NPTEL Video Course - Mathematics - NOC:Measure Theory (Prof. Indrava Roy)

Subject Co-ordinator - Prof. Indrava Roy

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Finite Sets and Cardinality
Lecture 2 - Infinite Sets and the Banach-Tarski Paradox - Part 1
Lecture 3 - Infinite Sets and the Banach-Tarski Paradox - Part 2
Lecture 4 - Elementary Sets and Elementary measure - Part 1
Lecture 5 - Elementary Sets and Elementary measure - Part 2
Lecture 6 - Properties of elementary measure - Part 1
Lecture 7 - Properties of elementary measure - Part 2
Lecture 8 - Uniqueness of elementary measure and Jordan measurability - Part 1
Lecture 9 - Uniqueness of elementary measure and Jordan measurability - Part 2
Lecture 10 - Characterization of Jordan measurable sets and basic properties of Jordan measure - Part 1
Lecture 11 - Characterization of Jordan measurable sets and basic properties of Jordan measure - Part 2
Lecture 12 - Examples of Jordan measurable sets-I
Lecture 13 - Examples of Jordan measurable sets-II - Part 1
Lecture 14 - Examples of Jordan measurable sets-II - Part 2
Lecture 15 - Jordan measure under Linear transformations - Part 1
Lecture 16 - Jordan measure under Linear transformations - Part 2
Lecture 17 - Connecting the Jordan measure with the Riemann integral - Part 1
Lecture 18 - Connecting the Jordan measure with the Riemann integral - Part 2
Lecture 19 - Outer measure - Motivation and Axioms of outer measure
Lecture 20 - Comparing Inner Jordan measure, Lebesgue outer measure and Jordan Outer measure
Lecture 21 - Finite additivity of outer measure on Separated sets, Outer regularity - Part 1
Lecture 22 - Finite additivity of outer measure on Separated sets, Outer regularity - Part 2
Lecture 23 - Lebesgue measurable class of sets and their Properties - Part 1
Lecture 24 - Lebesgue measurable class of sets and their Properties - Part 2
Lecture 25 - Equivalent criteria for lebesgue measurability of a subset - Part 1
Lecture 26 - Equivalent criteria for lebesgue measurability of a subset - Part 2
Lecture 27 - The measure axioms and the Borel-Cantelli Lemma
Lecture 28 - Properties of the Lebesgue measure
Lecture 29 - Properties of the Lebesgue measure

Lecture 30 - Lebesgue measurability under Linear transformation, Construction of Vitali Set - Part 1
Lecture 31 - Lebesgue measurability under Linear transformation, Construction of Vitali Set - Part 2
Lecture 32 - Abstract measure spaces
Lecture 33 - Abstract measure and Caratheodory Measurability - Part 1
Lecture 34 - Abstract measure and Caratheodory Measurability - Part 2
Lecture 35 - Abstrsct measure and Hahn-Kolmogorov Extension
Lecture 36 - Lebesgue measurable class vs Caratheodory extension of usual outer measure on R^d
Lecture 37 - Examples of Measures defined on R^d via Hahn Kolmogorov extension - Part 1
Lecture 38 - Examples of Measures defined on R^d via Hahn Kolmogorov extension - Part 2
Lecture 39 - Measurable functions
Lecture 40 - Measurable functions
Lecture 41 - Egorov's theorem
Lecture 42 - Lebesgue integral of unsigned simple measurable functions
Lecture 43 - Lebesgue integral of unsigned measurable functions
Lecture 44 - Fundamental convergence theorems in Lebesgue integration
Lecture 45 - Lebesgue integral for complex and real measurable functions
Lecture 46 - Basic properties of L^1-functions and Lebesgue's Dominated convergence theorem
Lecture 47 - L^1 functions on R^d
Lecture 48 - L^1 functions on R^d
Lecture 49 - L^1 functions on R^d
Lecture 50 - L^1 functions on R^d
Lecture 51 - Various modes of convergence of measurable functions
Lecture 52 - Easy implications from one mode of convergence to another
Lecture 53 - Implication map for modes of convergence with various examples
Lecture 54 - Uniqueness of limits across various modes of convergence
Lecture 55 - Some criteria for reverse implications for modes of convergence
Lecture 56 - Riesz Representation theorem- Motivation
Lecture 57 - Basics on Locally compact Hausdorff spaces
Lecture 58 - Borel and Radon measures on LCH spaces
Lecture 59 - Properties of Radon measures and Lusin's theorem on LCH spaces
Lecture 60 - Riesz Representation theorem - Complete statement and proof - Part 1
Lecture 61 - Riesz Representation theorem - Complete statement and proof - Part 2
Lecture 62 - Examples of measures constructed using RRT
Lecture 63 - Theorems of Tonelli and Fubini- interchanging the order of integration for repeated integrals
Lecture 64 - Product measures
Lecture 65 - Tonelli's theorem for sets - Part 1
Lecture 66 - Tonelli's theorem for sets - Part 2
Lecture 67 - Fubini-Tonelli theorem
Lecture 68 - Lebesgue's differentiation theorem

Lecture 69 - Lebesgue's differentiation theorem
Lecture 70 - Lebesgue's differentiation theorem
Lecture 71 - DIfferentiation theorems
Lecture 72 - DIfferentiation theorems
Lecture 73 - Riesz's Rising Sun Lemma
Lecture 74 - Differentiation theorem for monone continuous functions
Lecture 75 - Differentation theorem for general monotone functions and Second fundamental theorem of calculus

NPTEL Video Course - Mathematics - NOC:Complex Analysis

Subject Co-ordinator - Prof. Pranav Haridas

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Field of Complex Numbers
Lecture 2 - Conjugation and Absolute value
Lecture 3 - Topology on Complex plane
Lecture 4 - Topology on Complex Plane (Continued...)
Lecture 5 - Problem Session
Lecture 6 - Isometries on the Complex Plane
Lecture 7 - Functions on the Complex Plane
Lecture 8 - Complex differentiability
Lecture 9 - Power Series
Lecture 10 - Differentiation of power series
Lecture 11 - Problem Session
Lecture 12 - Cauchy-Riemann equations
Lecture 13 - Harmonic functions
Lecture 14 - MÃ¶bius transformations
Lecture 15 - Problem session
Lecture 16 - Curves in the complex plane
Lecture 17 - Complex Integration over curves
Lecture 18 - First Fundamental theorem of Calculus
Lecture 19 - Second Fundamental theorem of Calculus
Lecture 20 - Problem session
Lecture 21 - Homotopy of curves
Lecture 22 - Cauchy-Goursat theorem
Lecture 23 - Cauchy's theorem
Lecture 24 - Problem Session
Lecture 25 - Cauchy Integral Formula
Lecture 26 - Principle of analytic continuation and Cauchy estimates
Lecture 27 - Further consequences of Cauchy Integral Formula
Lecture 28 - Problem session
Lecture 29 - Winding number

Lecture 30 - Open mapping theorem
Lecture 31 - Schwarz reflection principle
Lecture 32 - Problem session
Lecture 33 - Singularities of a holomorphic function
Lecture 34 - Pole of a function
Lecture 35 - Laurent Series
Lecture 36 - Casorati Weierstrass theorem
Lecture 37 - Problem Session
Lecture 38 - Residue theorem
Lecture 39 - Argument principle
Lecture 40 - Problem Session
Lecture 41 - Branch of the Complex logarithm
Lecture 42 - Automorphisms of the Unit disk
Lecture 43 - Phragmen Lindelof method
Lecture 44 - Problem Session
Lecture 45 - Lifting of maps
Lecture 46 - Covering spaces
Lecture 47 - Bloch's theorem
Lecture 48 - Little Picard's theorem

NPTEL Video Course - Mathematics - NOC:Real Analysis - I

Subject Co-ordinator - Prof. Jaikrishnan J

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - WEEK 1 - INTRODUCTION
Lecture 2 - Why study Real Analysis
Lecture 3 - Square root of 2
Lecture 4 - Wason's selection task
Lecture 5 - Zeno's Paradox
Lecture 6 - Basic set theory
Lecture 7 - Basic logic
Lecture 8 - Quantifiers
Lecture 9 - Proofs
Lecture 10 - Functions and relations
Lecture 11 - Axioms of Set Theory
Lecture 12 - Equivalence relations
Lecture 13 - What are the rationals
Lecture 14 - Cardinality
Lecture 15 - WEEK 2 - INTRODUCTION
Lecture 16 - Field axioms
Lecture 17 - Order axioms
Lecture 18 - Absolute value
Lecture 19 - The completeness axiom
Lecture 20 - Nested intervals property
Lecture 21 - NIP+APâ   Completeness
Lecture 22 - Existence of square roots
Lecture 23 - Uncountability of the real numbers
Lecture 24 - Density of rationals and irrationals
Lecture 25 - WEEK 3 - INTRODUCTION
Lecture 26 - Motivation for infinite sums
Lecture 27 - Definition of sequence and examples
Lecture 28 - Definition of convergence
Lecture 29 - Uniqueness of limits

Lecture 30 - Achilles and the tortoise
Lecture 31 - Deep dive into the definition of convergence
Lecture 32 - A descriptive language for convergence
Lecture 33 - Limit laws
Lecture 34 - Subsequences
Lecture 35 - Examples of convergent and divergent sequences
Lecture 36 - Some special sequences-CORRECT
Lecture 37 - Monotone sequences
Lecture 38 - Bolzano-Weierstrass theorem
Lecture 39 - The Cauchy Criterion
Lecture 40 - MCT implies completeness
Lecture 41 - Definition and examples of infinite series
Lecture 42 - Cauchy tests-Corrected
Lecture 43 - Tests for convergence
Lecture 44 - Erdos_s proof on divergence of reciprocals of primes
Lecture 45 - Resolving Zeno_s paradox
Lecture 46 - Absolute and conditional convergence
Lecture 47 - Absolute convergence continued
Lecture 48 - The number e
Lecture 49 - Grouping terms of an infinite series
Lecture 50 - The Cauchy product
Lecture 51 - WEEK 5 - INTRODUCTION
Lecture 52 - The role of topology in real analysis
Lecture 53 - Open and closed sets
Lecture 54 - Basic properties of adherent and limit points
Lecture 55 - Basic properties of open and closed sets
Lecture 56 - Definition of continuity
Lecture 57 - Deep dive into epsilon-delta
Lecture 58 - Negating continuity
Lecture 59 - The functions x and x2
Lecture 60 - Limit laws
Lecture 61 - Limit of sin x_x
Lecture 62 - Relationship between limits and continuity
Lecture 63 - Global continuity and open sets
Lecture 64 - Continuity of square root
Lecture 65 - Operations on continuous functions
Lecture 66 - Language for limits
Lecture 67 - Infinite limits
Lecture 68 - One sided limits

Lecture 69 - Limits of polynomials
Lecture 70 - Compactness
Lecture 71 - The Heine-Borel theorem
Lecture 72 - Open covers and compactness
Lecture 73 - Equivalent notions of compactness
Lecture 74 - The extreme value theorem
Lecture 75 - Uniform continuity
Lecture 76 - Connectedness
Lecture 77 - Intermediate Value Theorem
Lecture 78 - Darboux continuity and monotone functions
Lecture 79 - Perfect sets and the Cantor set
Lecture 80 - The structure of open sets
Lecture 81 - The Baire Category theorem
Lecture 82 - Discontinuities
Lecture 83 - Classification of discontinuities and monotone functions
Lecture 84 - Structure of set of discontinuities
Lecture 85 - WEEK 8 and 9 - INTRODUCTION
Lecture 86 - Definition and interpretation of the derivative
Lecture 87 - Basic properties of the derivative
Lecture 88 - Examples of differentiation
Lecture 89 - Darboux_s theorem
Lecture 90 - The mean value theorem
Lecture 91 - Applications of the mean value theorem
Lecture 92 - Taylor's theorem NEW
Lecture 93 - The ratio mean value theorem and L_Hospital_s rule
Lecture 94 - Axiomatic characterisation of area and the Riemann integral
Lecture 95 - Proof of axiomatic characterization
Lecture 96 - The definition of the Riemann integral
Lecture 97 - Criteria for Riemann integrability
Lecture 98 - Linearity of integral
Lecture 99 - Sets of measure zero
Lecture 100 - The Riemann-Lebesgue theorem
Lecture 101 - Consequences of the Riemann-Lebesgue theorem
Lecture 102 - WEEK 10 and 11 - INTRODUCTION
Lecture 103 - The fundamental theorem of calculus
Lecture 104 - Taylor's theorem-Integral form of remainder
Lecture 105 - Notation for Taylor polynomials
Lecture 106 - Smooth functions and Taylor series
Lecture 107 - Power series

Lecture 108 - Definition of uniform convergence
Lecture 109 - The exponential function
Lecture 110 - The inverse function theorem
Lecture 111 - The Logarithm
Lecture 112 - Trigonometric functions
Lecture 113 - The number Pi
Lecture 114 - The graphs of sin and cos
Lecture 115 - The Basel problem
Lecture 116 - Improper integrals
Lecture 117 - The Integral test
Lecture 118 - Weierstrass approximation theorem
Lecture 119 - Bernstein Polynomials
Lecture 120 - Properties of Bernstein polynomials
Lecture 121 - Proof of Weierstrass approximation theorem

NPTEL Video Course - Mathematics - NOC:Variational Calculus and its applications in Control Theory and Nanome

Subject Co-ordinator - Prof. Sarthok Sircar

Co-ordinating Institute - IIIT - Delhi

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction / Euler Lagrange Equations - Part 1
Lecture 2 - Introduction / Euler Lagrange Equations - Part 2
Lecture 3 - Introduction / Euler Lagrange Equations - Part 3
Lecture 4 - Introduction / Euler Lagrange Equations - Part 4
Lecture 5 - Introduction / Euler Lagrange Equations - Part 5
Lecture 6 - Introduction / Euler Lagrange Equations - Part 6
Lecture 7 - Special cases / Invariance, Existence and Uniqueness of solutions - Part 1
Lecture 8 - Special cases / Invariance, Existence and Uniqueness of solutions - Part 2
Lecture 9 - Special cases / Invariance, Existence and Uniqueness of solutions - Part 3
Lecture 10 - Special cases / Invariance, Existence and Uniqueness of solutions - Part 4
Lecture 11 - Special cases / Invariance, Existence and Uniqueness of solutions - Part 5
Lecture 12 - Special cases / Invariance, Existence and Uniqueness of solutions - Part 6
Lecture 13 - Generalization / Numerical solution of Euler Lagrange Equations - Part 1
Lecture 14 - Generalization / Numerical solution of Euler Lagrange Equations - Part 2
Lecture 15 - Generalization / Numerical solution of Euler Lagrange Equations - Part 3
Lecture 16 - Generalization / Numerical solution of Euler Lagrange Equations - Part 4
Lecture 17 - Generalization / Numerical solution of Euler Lagrange Equations - Part 5
Lecture 18 - Generalization / Numerical solution of Euler Lagrange Equations - Part 6
Lecture 19 - Isoperimetric Problems - Part 1
Lecture 20 - Isoperimetric Problems - Part 2
Lecture 21 - Isoperimetric Problems - Part 3
Lecture 22 - Isoperimetric Problems - Part 4
Lecture 23 - Isoperimetric Problems - Part 5
Lecture 24 - Isoperimetric Problems - Part 6
Lecture 25 - Problems with Holononomic and non- Holononomic Constraints, Variable Endpts - Part 1
Lecture 26 - Problems with Holononomic and non- Holononomic Constraints, Variable Endpts - Part 2
Lecture 27 - Problems with Holononomic and non- Holononomic Constraints, Variable Endpts - Part 3
Lecture 28 - Problems with Holononomic and non- Holononomic Constraints, Variable Endpts - Part 4
Lecture 29 - Problems with Holononomic and non- Holononomic Constraints, Variable Endpts - Part 5

Lecture 30 - Problems with Holononomic and non- Holononomic Constraints, Variable Endpts - Part 6
Lecture 31 - Broken extremals / Hamiltonian Formulation - Part 1
Lecture 32 - Broken extremals / Hamiltonian Formulation - Part 2
Lecture 33 - Broken extremals / Hamiltonian Formulation - Part 3
Lecture 34 - Broken extremals / Hamiltonian Formulation - Part 4
Lecture 35 - Broken extremals / Hamiltonian Formulation - Part 5
Lecture 36 - Broken extremals / Hamiltonian Formulation - Part 6
Lecture 37 - Hamilton-Jacobi Equations - Part 1
Lecture 38 - Hamilton-Jacobi Equations - Part 2
Lecture 39 - Hamilton-Jacobi Equations - Part 3
Lecture 40 - Hamilton-Jacobi Equations - Part 4
Lecture 41 - Hamilton-Jacobi Equations - Part 5
Lecture 42 - Hamilton-Jacobi Equations - Part 6
Lecture 43 - Noether's Theorem / Introduction to Second Variation - Part 1
Lecture 44 - Noether's Theorem / Introduction to Second Variation - Part 2
Lecture 45 - Noether's Theorem / Introduction to Second Variation - Part 3
Lecture 46 - Noether's Theorem / Introduction to Second Variation - Part 4
Lecture 47 - Noether's Theorem / Introduction to Second Variation - Part 5
Lecture 48 - Noether's Theorem / Introduction to Second Variation - Part 6
Lecture 49 - Conjugate points / Jacobi Accessory Equations / Introduction to Optimal Control Theory - Part 1
Lecture 50 - Conjugate points / Jacobi Accessory Equations / Introduction to Optimal Control Theory - Part 2
Lecture 51 - Conjugate points / Jacobi Accessory Equations / Introduction to Optimal Control Theory - Part 3
Lecture 52 - Conjugate points / Jacobi Accessory Equations / Introduction to Optimal Control Theory - Part 4
Lecture 53 - Conjugate points / Jacobi Accessory Equations / Introduction to Optimal Control Theory - Part 5
Lecture 54 - Conjugate points / Jacobi Accessory Equations / Introduction to Optimal Control Theory - Part 6
Lecture 55 - Constrained Optimization in Optimal Control Theory - Part 1
Lecture 56 - Constrained Optimization in Optimal Control Theory - Part 2
Lecture 57 - Constrained Optimization in Optimal Control Theory - Part 3
Lecture 58 - Constrained Optimization in Optimal Control Theory - Part 4
Lecture 59 - Constrained Optimization in Optimal Control Theory - Part 5
Lecture 60 - Constrained Optimization in Optimal Control Theory - Part 6
Lecture 61 - Introduction to Nanomechanics - Part 1
Lecture 62 - Introduction to Nanomechanics - Part 2
Lecture 63 - Introduction to Nanomechanics - Part 3
Lecture 64 - Introduction to Nanomechanics - Part 4
Lecture 65 - Introduction to Nanomechanics - Part 5
Lecture 66 - Introduction to Nanomechanics - Part 6

NPTEL Video Course - Mathematics - NOC:Introduction to Galois Theory

Subject Co-ordinator - Prof. Krishna Hanumanthu

Co-ordinating Institute - Chennai Mathematical Institute

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Motivation and overview of the course
Lecture 2 - Review of group theory
Lecture 3 - Review of ring theory - I
Lecture 4 - Review of ring theory - II
Lecture 5 - Review of field theory - I
Lecture 6 - Review of field theory - II
Lecture 7 - Review of field theory - III
Lecture 8 - Problem Session - Part 1
Lecture 9 - Problem Session - Part 2
Lecture 10 - Beginning of Galois theory
Lecture 11 - Fixed fields
Lecture 12 - Theorem I on fixed fields
Lecture 13 - Theorem II on fixed fields
Lecture 14 - Galois extensions, Galois groups
Lecture 15 - Normal extensions
Lecture 16 - Problem Session - Part 3
Lecture 17 - Problem Session - Part 4
Lecture 18 - Separable extension - Part 1
Lecture 19 - Separable extension - Part 2
Lecture 20 - Characterization of Galois extensions - Part 1
Lecture 21 - Characterization of Galois extensions - Part 2
Lecture 22 - Examples of Galois extensions
Lecture 23 - Motivating the main theorem of Galois theory
Lecture 24 - Main theorem of Galois theory - Part 1
Lecture 25 - Main theorem of Galois theory - Part 2
Lecture 26 - Fundamental theorem of algebra
Lecture 27 - Problem Session - Part 5
Lecture 28 - Problem Session - Part 6
Lecture 29 - Problem Session - Part 7

Lecture 30 - Problem Session - Part 8
Lecture 31 - Problem Session - Part 9
Lecture 32 - Kummer extensions - Part 1
Lecture 33 - Kummer extensions - Part 2
Lecture 34 - Kummer extensions - Part 3
Lecture 35 - Cyclotomic extensions - Part 1
Lecture 36 - Cyclotomic extensions - Part 2
Lecture 37 - Solvability by radicals
Lecture 38 - Characterizations of solvability - Part 1
Lecture 39 - Characterizations of solvability - Part 2
Lecture 40 - Discriminants, Galois groups of polynomials
Lecture 41 - Quartics are solvable
Lecture 42 - Solvable groups - Part 1
Lecture 43 - Solvable groups - Part 2
Lecture 44 - Solvable groups - Part 3
Lecture 45 - Insolvability of quintics
Lecture 46 - Problem Session - Part 10
Lecture 47 - Problem Session - Part 11
Lecture 48 - Problem Session - Part 12
Lecture 49 - Problem Session - Part 13

NPTEL Video Course - Mathematics - NOC:Basic Calculus 1

Subject Co-ordinator - Prof. Arindama Singh

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - The Real line - Part 1
Lecture 2 - The Real line - Part 2
Lecture 3 - Absolute value - Part 1
Lecture 4 - Absolute value - Part 2
Lecture 5 - Functions - Part 1
Lecture 6 - Functions - Part 2
Lecture 7 - Transcendental and trigonometric Functions - Part 1
Lecture 8 - Transcendental and trigonometric Functions - Part 2
Lecture 9 - Limits of functions - Part 1
Lecture 10 - Limits of functions - Part 2
Lecture 11 - Algebra of limits - Part 1
Lecture 12 - Algebra of limits - Part 2
Lecture 13 - One-sided limits - Part 1
Lecture 14 - One-sided limits - Part 2
Lecture 15 - Limits at infinity - Part 1
Lecture 16 - Limits at infinity - Part 2
Lecture 17 - Infinite limits - Part 1
Lecture 18 - Infinite limits - Part 2
Lecture 19 - Continuity - Part 1
Lecture 20 - Continuity - Part 2
Lecture 21 - Algebra of continuous functions - Part 1
Lecture 22 - Algebra of continuous functions - Part 2
Lecture 23 - Results on continuity - Part 1
Lecture 24 - Results on continuity - Part 2
Lecture 25 - Differentiability - Part 1
Lecture 26 - Differentiability - Part 2
Lecture 27 - Derivative and tangent - Part 1
Lecture 28 - Derivative and tangent - Part 2
Lecture 29 - Rules of differentiation - Part 1

Lecture 30 - Rules of differentiation - Part 2
Lecture 31 - Differentiation exercises - Part 1
Lecture 32 - Differentiation exercises - Part 2
Lecture 33 - Maxima and minima - Part 1
Lecture 34 - Maxima and minima - Part 2
Lecture 35 - Rolleâ s theorem and mean value theorem - Part 1
Lecture 36 - Rolleâ s theorem and mean value theorem - Part 2
Lecture 37 - Using Rolleâ s theorem and Mean value theorem - Part 1
Lecture 38 - Using Rolleâ s theorem and Mean value theorem - Part 2
Lecture 39 - First derivative test - Part 1
Lecture 40 - First derivative test - Part 2
Lecture 41 - Second derivative test - Part 1
Lecture 42 - Second derivative test - Part 2
Lecture 43 - Concavity - Part 1
Lecture 44 - Concavity - Part 2
Lecture 45 - Linearization and differential - Part 1
Lecture 46 - Linearization and differential - Part 2
Lecture 47 - Lâ Hospitalâ s rules - Part 1
Lecture 48 - Lâ Hospitalâ s rules - Part 2
Lecture 49 - Definite integral - Part 1
Lecture 50 - Definite integral - Part 2
Lecture 51 - Properties of integral - Part 1
Lecture 52 - Properties of integral - Part 2
Lecture 53 - Fundamental theorem of calculus - Part 1
Lecture 54 - Fundamental theorem of calculus - Part 2
Lecture 55 - Applications of Funda - mental theorem of calculus - Part 1
Lecture 56 - Applications of Funda - mental theorem of calculus - Part 2
Lecture 57 - Rule of substitution - Part 1
Lecture 58 - Rule of substitution - Part 2
Lecture 59 - Area between curves - Part 1
Lecture 60 - Area between curves - Part 2
Lecture 61 - Volumes by slicing - Part 1
Lecture 62 - Volumes by slicing - Part 2
Lecture 63 - The disk method - Part 1
Lecture 64 - The disk method - Part 2
Lecture 65 - The washer method - Part 1
Lecture 66 - The washer method - Part 2
Lecture 67 - Volumes by cylindrical shells - Part 1
Lecture 68 - Volumes by cylindrical shells - Part 2

Lecture 69 - Lengths oc curves - Part 1
Lecture 70 - Lengths oc curves - Part 2
Lecture 71 - Areas of surface of revolution - Part 1
Lecture 72 - Areas of surface of revolution - Part 2

NPTEL Video Course - Mathematics - NOC:Functional Analysis

Subject Co-ordinator - Prof. Kesavan

Co-ordinating Institute - Institute of Mathematical Sciences

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Normed Linear Spaces
Lecture 2 - Examples of Normed Linear Spaces
Lecture 3 - Examples (Continued...)
Lecture 4 - Continuous linear maps - Part 1
Lecture 5 - Continuous linear maps - Part 2
Lecture 6 - Isomorphisms
Lecture 7 - Exercises
Lecture 8 - Exercises (Continued...)
Lecture 9 - Hahn-Banach Theorems
Lecture 10 - Reflexivity
Lecture 11 - Geometric version
Lecture 12 - Geometric version (Continued...)
Lecture 13 - Vector valued integration
Lecture 14 - Exercises - Part 1
Lecture 15 - Exercises - Part 2
Lecture 16 - Baire's Theorem and Applications
Lecture 17 - Application to Fourier series
Lecture 18 - Open mapping and closed graph theorems
Lecture 19 - Annihilators
Lecture 20 - Complemented subspaces
Lecture 21 - Unbounded Operators, Adjoints - Part 1
Lecture 22 - Unbounded Operators, Adjoints - Part 2
Lecture 23 - Orthogonality relations
Lecture 24 - Exercises
Lecture 25 - Exercises (Continued...)
Lecture 26 - Weak topology - Part 1
Lecture 27 - Weak topology - Part 2
Lecture 28 - Weak topology - Part 3
Lecture 29 - Weak* topology - Part 1

Lecture 30 - Weak* topology - Part 2
Lecture 31 - Reflexive Spaces
Lecture 32 - Separable Spaces - Part 1
Lecture 33 - Separable Spaces - Part 2
Lecture 34 - Uniformly Convex Spaces
Lecture 35 - Applications
Lecture 36 - Exercises
Lecture 37 - L-p Spaces - Part 1
Lecture 38 - L-p Spaces - Part 2
Lecture 39 - Completeness
Lecture 40 - Duality
Lecture 41 - L-p Spaces in Euclidean spaces - Part 1
Lecture 42 - L-p Spaces in Euclidean spaces - Part 2
Lecture 43 - Dual of L-1
Lecture 44 - The space L-1 (Continued...)
Lecture 45 - Exercises - Part 1
Lecture 46 - Exercises - Part 2
Lecture 47 - Exercises - Part 3
Lecture 48 - Exercises - Part 4
Lecture 49 - Hilbert spaces - Part 1
Lecture 50 - Hilbert spaces - Part 2
Lecture 51 - Duality
Lecture 52 - Adjoints
Lecture 53 - Applications
Lecture 54 - Orthonormal sets
Lecture 55 - Orthonormal bases - Part 1
Lecture 56 - Orthonormal bases - Part 2
Lecture 57 - Fourier series
Lecture 58 - Spectrum of an operator - Part 1
Lecture 59 - Spectrum of an operator - Part 2
Lecture 60 - Exercises - Part 1
Lecture 61 - Exercises - Part 2
Lecture 62 - Exercises - Part 3
Lecture 63 - Compact operators - Part 1
Lecture 64 - Compact operators - Part 2
Lecture 65 - Riesz-Fredholm theory - Part 1
Lecture 66 - Riesz-Fredholm theory - Part 2
Lecture 67 - Riesz-Fredholm theory
Lecture 68 - Spectrum of a compact operator

Lecture 69 - Spectrum of a compact self-adjoint operator
Lecture 70 - Eigenvalues of a compact self-adjoint operator
Lecture 71 - Exercises - Part 1
Lecture 72 - Exercises - Part 2
Lecture 73 - Exercises - Part 3
Lecture 74 - Exercises - Part 4

NPTEL Video Course - Mathematics - NOC:Mathematical Methods in Physics 1

Subject Co-ordinator - Prof. Auditya Sharma

Co-ordinating Institute - IISER - Bhopal

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Vectors
Lecture 2 - Linear vector spaces
Lecture 3 - Linear vector spaces: immediate consequences
Lecture 4 - Dot product of Euclidean vectors
Lecture 5 - Inner product on a Linear vector space
Lecture 6 - Cauchy-Schwartz inequality for Euclidean vectors
Lecture 7 - Cauchy-Schwartz inequality for vectors from LVS
Lecture 8 - Applications of the Cauchy-Schwartz inequality
Lecture 9 - Triangle inequality
Lecture 10 - Linear dependence and independence of vectors
Lecture 11 - Row reduction of matrices
Lecture 12 - Rank of a matrix
Lecture 13 - Rank of a matrix: consequences
Lecture 14 - Determinants and their properties
Lecture 15 - The rank of a matrix using determinants
Lecture 16 - Cramer's rule
Lecture 17 - Square system of equations
Lecture 18 - Homogeneous equations
Lecture 19 - The rank of a matrix and linear dependence
Lecture 20 - Span, basis, and dimension of a LVS
Lecture 21 - Gram-Schmidt orthogonalization
Lecture 22 - Vector subspaces
Lecture 23 - Linear operators
Lecture 24 - Inverse of an operator
Lecture 25 - Adjoint of an operator
Lecture 26 - Projection operators
Lecture 27 - Eigenvalues and Eigenvectors
Lecture 28 - Hermitian operators
Lecture 29 - Unitary operators

Lecture 30 - Normal operators
Lecture 31 - Similarity and Unitary transformations
Lecture 32 - Matrix representations
Lecture 33 - Eigenvalues and Eigenvectors of matrices
Lecture 34 - Defective matrices
Lecture 35 - Eigenvalues and eigenvectors: useful results
Lecture 36 - Transformation of Basis
Lecture 37 - A class of invertible matrices
Lecture 38 - Diagonalization of matrices
Lecture 39 - Diagonalizability of matrices
Lecture 40 - Functions of matrices
Lecture 41 - SHM and waves
Lecture 42 - Periodic functions
Lecture 43 - Average value of a function
Lecture 44 - Piecewise continuous functions
Lecture 45 - Orthogonal basis: Fourier series
Lecture 46 - Fourier coefficients
Lecture 47 - Dirichlet Conditions
Lecture 48 - Complex Form of Fourier Series
Lecture 49 - Other intervals: arbitrary period
Lecture 50 - Even and Odd Functions
Lecture 51 - Differentiating Fourier series
Lecture 52 - Parseval's theorem
Lecture 53 - Fourier series to Fourier transforms
Lecture 54 - Fourier Sine and Cosine transforms
Lecture 55 - Parseval's theorem for Fourier series
Lecture 56 - Ordinary Differential equations
Lecture 57 - First order ODEs
Lecture 58 - Linear first order ODEs
Lecture 59 - Orthogonal Trajectories
Lecture 60 - Exact differential equations
Lecture 61 - Special first order ODEs
Lecture 62 - Solutions of linear first-order ODEs
Lecture 63 - Revisit linear first-order ODEs
Lecture 64 - ODEs in disguise
Lecture 65 - 2nd order Homogeneous linear equations with constant coefficients
Lecture 66 - The use of a known solution to find another
Lecture 67 - An alternate approach to auxiliary equation
Lecture 68 - Inhomogeneous second order equations

Lecture 69 - Methods to find a Particular solution
Lecture 70 - Successive Integration of two first order equations
Lecture 71 - Illustrative examples
Lecture 72 - Variation of Parameters
Lecture 73 - Vibrations in mechanical systems
Lecture 74 - Forced Vibrations
Lecture 75 - Resonance
Lecture 76 - Linear Superposition
Lecture 77 - Laplace Transform (LT)
Lecture 78 - Basic Properties of Laplace Transforms
Lecture 79 - Step functions, Translations, and Periodic functions
Lecture 80 - The Inverse Laplace Transform
Lecture 81 - Convolution of functions
Lecture 82 - Solving ODEs using Laplace transforms
Lecture 83 - The Dirac Delta function
Lecture 84 - Properties of the Dirac Delta function
Lecture 85 - Green's function method
Lecture 86 - Green's function method: Boundary value problem
Lecture 87 - Power series method
Lecture 88 - Power series solutions about an ordinary point
Lecture 89 - Initial value problem: power series solution
Lecture 90 - Frobenius method for regular singular points

NPTEL Video Course - Mathematics - NOC:Computational Mathematics with SageMath

Subject Co-ordinator - Prof. Ajit Kumar

Co-ordinating Institute - Institute of Chemical Technology - Mumbai

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Installation of Python
Lecture 2 - Getting Started with Python
Lecture 3 - Python as an advanced calculator
Lecture 4 - Lists in Python
Lecture 5 - Tuple, Sets and Dictionaries in Python
Lecture 6 - Functions and Branching
Lecture 7 - For loop in Python
Lecture 8 - While loop in Python
Lecture 9 - Creating Modules and Introduction to NumPy
Lecture 10 - Use of NumPy module
Lecture 11 - Python Graphics using MatplotLib
Lecture 12 - Use of SciPy and SymPy in Python
Lecture 13 - Classes in Python - Part 1
Lecture 14 - Classes in Python - Part 2
Lecture 15 - Introduction and Installation of SageMath
Lecture 16 - Exploring integers in SageMath
Lecture 17 - Solving Equations in SageMath
Lecture 18 - 2d Plotting with SageMath
Lecture 19 - 3d Plotting with SageMath
Lecture 20 - Calculus of one variable with SageMath - Part 1
Lecture 21 - Calculus of one variable with SageMath - Part 2
Lecture 22 - Applications of derivatives
Lecture 23 - Integration with SageMath
Lecture 24 - Improper Integral using SageMath
Lecture 25 - Application of integration using SageMath
Lecture 26 - Limit and Continuity of real valued functions
Lecture 27 - Partial Derivative with SageMath
Lecture 28 - Local Maximum and Minimum
Lecture 29 - Application of local maximum and local minimum

Lecture 30 - Constrained optimization using Lagrange multipliers
Lecture 31 - Working with vectors in SageMath
Lecture 32 - Solving system of linear Equations in SageMath
Lecture 33 - Vector Spaces in SageMath
Lecture 34 - Basis and dimensions of vector spaces in SageMath
Lecture 35 - Matrix Spaces with SageMath
Lecture 36 - Linear Transformations - Part 1 with SageMath
Lecture 37 - Linear Transformations - Part 2 with SageMath
Lecture 38 - Eigenvalues and Eigenvectors - Part 1 with SageMath
Lecture 39 - Eigenvalues and Eigenvectors - Part 2 with SageMath
Lecture 40 - Inner Product - Part 1 with SageMath
Lecture 41 - Inner Product - Part 2 with SageMath
Lecture 42 - Orthogonal Decomposition with SageMath
Lecture 43 - Least Square Solution with SageMath
Lecture 44 - Singular Value Decomposition (SVD) with SageMath
Lecture 45 - Application of SVD to image processing
Lecture 46 - Solving System of linear ODE using Eigenvalues and Eigenvectors
Lecture 47 - Google Page Rank Algorithm using SageMath
Lecture 48 - Finding Roots of algebraic and transcendental equations in SageMath
Lecture 49 - Numerical Solutions of System of linear equations in SageMath
Lecture 50 - Interpolations in SageMath
Lecture 51 - Numerical Integration in SageMath
Lecture 52 - Numerical Eigenvalues
Lecture 53 - Solving 1st and 2nd order ODE with SageMath
Lecture 54 - Euler's Method to solve 1st order ODE with SageMath
Lecture 55 - Fourth Order Runge-Kutta Method
Lecture 56 - RK4 method for System of ODE and Applications
Lecture 57 - Solving ODE using Laplace Transforms in SageMath
Lecture 58 - Introduction to Linear Programming Problems (LPP)
Lecture 59 - Solving Linear Programming Problmes using Graphical Methods
Lecture 60 - Basics Definitions and Results in LPP
Lecture 61 - Theory of Simplex Method
Lecture 62 - Simplex Methods in SageMath - Part 1
Lecture 63 - Simplex Methods in SageMath - Part 2
Lecture 64 - Simplex Methods in Matrix Form
Lecture 65 - Revised Simplex Method in SageMath
Lecture 66 - Two Phase Simplex Method in SageMath
Lecture 67 - Big-M Method in SageMath
Lecture 68 - Duality of Linear Program

Lecture 69 - Dual Simplex Method in SageMath
Lecture 70 - Review and What next in SageMath?

NPTEL Video Course - Mathematics - NOC:Introduction to Probability (with examples using R)

Subject Co-ordinator - Prof. Siva Athreya

Co-ordinating Institute - ISI - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Sample Space, Events and Probability
Lecture 2 - Properties of Probability
Lecture 3 - Equally likely Outcomes
Lecture 4 - Conditional Probability
Lecture 5 - Bayes Theorem
Lecture 6 - Independence - Part 1
Lecture 7 - Independence - Part 2
Lecture 8 - Sampling and Repeated Trials
Lecture 9 - Sampling and Repeated Trials - Part 1
Lecture 10 - Sampling and Repeated Trials - Part 2
Lecture 11 - Sampling with and Without Replacement
Lecture 12 - Sampling without Replacement
Lecture 13 - Hypergeometric Distribution and Discrete Random Variables
Lecture 14 - Discrete Random Variables - Part 1
Lecture 15 - Discrete Random Variables - Part 2
Lecture 16 - Conditional, Joint and Marginal Distributions
Lecture 17 - Memoryless property of Geometric Distribution
Lecture 18 - Functions of Random Variables
Lecture 19 - Sums of Independent Random Variables
Lecture 20 - Functions and Independence
Lecture 21 - Expectation of Random Variables
Lecture 22 - Properties of Expectation
Lecture 23 - Expectation: Independence and Functions
Lecture 24 - Variance of Discrete Random Variables
Lecture 25 - Markov and Chebyshev Inequalities
Lecture 26 - Conditional Expectation and Covariance
Lecture 27 - Continuous Random Variables - Part 1
Lecture 28 - Continuous Random Variables - Part 2
Lecture 29 - Distribution Function

Lecture 30 - Exponential and Normal Random Variable
Lecture 31 - Normal Random Variable
Lecture 32 - Change of Variable
Lecture 33 - Joint Distribution of Continuous Random Variables
Lecture 34 - Marginal Density and Independence
Lecture 35 - Conditional Density
Lecture 36 - Sums of Independent Random Variables
Lecture 37 - Quotient of Independent Random Variables
Lecture 38 - Expectation and Variance of Continuous Random Variables
Lecture 39 - Sampling Distribution and Sample Mean
Lecture 40 - Weak Law of Large Numbers
Lecture 41 - Revisit of Variance and Expectation
Lecture 42 - Revisit of Properties of Variance
Lecture 43 - Revisit Weak Law of Large Numbers
Lecture 44 - Demoivre-Laplace Central Limit Theorem and Normal Random Variables
Lecture 45 - Revisit Normal Random Variables
Lecture 46 - Normal Tables, Mean and Variance

NPTEL Video Course - Mathematics - NOC:Algebra-II

Subject Co-ordinator - Prof. Amritanshu Prasad, Prof. S. Viswanath

Co-ordinating Institute - Institute of Mathematical Sciences

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Algebraic and Transcendental Numbers
Lecture 2 - Extensions Generated by Elements
Lecture 3 - Isomorphic Extensions
Lecture 4 - Degree of an Extension
Lecture 5 - Constructible Numbers
Lecture 6 - The Field of Constructible Numbers
Lecture 7 - Characterization of Constructible Numbers
Lecture 8 - Solved Problems (Week 1)
Lecture 9 - Some Things can't be Constructed
Lecture 10 - Symbolic Adjunction
Lecture 11 - Repeated Roots
Lecture 12 - Gauss Lemma
Lecture 13 - Eisensteinâ s criterion
Lecture 14 - Existence Theorem for Finite Fields
Lecture 15 - Subfields of a Finite Field
Lecture 16 - Multiplicative Group of a Finite Field
Lecture 17 - Uniqueness Theorem for Finite Fields
Lecture 18 - Solved Problems (Week 2)
Lecture 19 - Algebraic Extensions and Algebraic Closures
Lecture 20 - Existence of Algebraic Closures
Lecture 21 - Uniqueness of Algebraic Closure
Lecture 22 - Solved Problems - Part 1 (Week 3)
Lecture 23 - Existence of splitting fields, bound on degree
Lecture 24 - Uniqueness of splitting fields
Lecture 25 - Solved problems - Part 2 (Week 3)
Lecture 26 - Normal Extensions
Lecture 27 - Separable polynomials
Lecture 28 - Perfect fields, separable extensions
Lecture 29 - Definition and examples, fixed fields

Lecture 30 - Characterization of Galois extensions
Lecture 31 - Linear Independence of Characters
Lecture 32 - Solved problems (Week 4)
Lecture 33 - Artinâ s Theorem - Part 1
Lecture 34 - Artinâ s Theorem - Part 2
Lecture 35 - Finite Galois Extensions
Lecture 36 - The fundamental theorem of Galois Theory - 1
Lecture 37 - The fundamental theorem of Galois Theory - 2
Lecture 38 - Solved problems (Week 5)
Lecture 39 - Cyclotomic extensions
Lecture 40 - Irreducibility of the cyclotomic polynomial
Lecture 41 - Application: Constructibility of regular n-gons.
Lecture 42 - Insolvability of the general quintic - Part 1
Lecture 43 - Insolvability of the general quintic - Part 2
Lecture 44 - Insolvability of the general quintic - Part 3
Lecture 45 - What is category theory (and why is it important)?
Lecture 46 - Definition of a category
Lecture 47 - Monomorphisms, epimorphisms, and isomorphisms
Lecture 48 - Categories: First Problem Session
Lecture 49 - Initial and Terminal Objects
Lecture 50 - Products and Coproducts
Lecture 51 - Categories: Second Problem Session
Lecture 52 - Functors
Lecture 53 - The Category of Categories
Lecture 54 - Natural Transformations
Lecture 55 - Functor Categories
Lecture 56 - Categories: Third Problem Session
Lecture 57 - Adjunction
Lecture 58 - Categories: Fourth Problem Session
Lecture 59 - Tensor products of Z-modules
Lecture 60 - Free abelian groups and quotient groups
Lecture 61 - Construction of the tensor product
Lecture 62 - Problem session
Lecture 63 - Tensor product of R-modules
Lecture 64 - Functoriality of the tensor product
Lecture 65 - Bimodules
Lecture 66 - Tensor products of bimodules
Lecture 67 - Tensor products of modules over commutative rings
Lecture 68 - Extension of scalars

Lecture 69 - Problem session - tensor products of vector spaces
Lecture 70 - Some Properties of the tensor product
Lecture 71 - F-algebras
Lecture 72 - Composition Series
Lecture 73 - Schreierâ s Theorem
Lecture 74 - Ascending and Descending Chain Conditions
Lecture 75 - Existence of Jordan-Holder Series
Lecture 76 - The Jordan-Holder Theorem
Lecture 77 - Examples related to the Jordan-Holder Theorem
Lecture 78 - The Jordan-Holder Theorem for Groups
Lecture 79 - Indecomposable Modules
Lecture 80 - Direct Sum Decompositions
Lecture 81 - Decomposition as a sum of Indecomposables
Lecture 82 - The Endomorphism Ring of an Indecomposable Module
Lecture 83 - Krull-Schmidt Theorem
Lecture 84 - Krull-Schmidt Examples

NPTEL Video Course - Mathematics - NOC:Mathematical Methods in Physics 2

Subject Co-ordinator - Prof. Auditya Sharma

Co-ordinating Institute - IISER - Bhopal

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to complex numbers
Lecture 2 - The triangle inequality
Lecture 3 - The de Moivre formula
Lecture 4 - Roots of unity
Lecture 5 - Functions of a complex variable and the notion of continuity
Lecture 6 - Derivative of a complex function
Lecture 7 - Differentiation rules for a complex function
Lecture 8 - Cauchy-Riemann Equations
Lecture 9 - Sufficient conditions for differentiability
Lecture 10 - Cauchy-Riemann conditions in polar coordinates
Lecture 11 - More persepective on differentiability
Lecture 12 - The value of the derivative
Lecture 13 - Analytic functions
Lecture 14 - Harmonic functions
Lecture 15 - The exponential function
Lecture 16 - Complex logarithm
Lecture 17 - Complex exponents
Lecture 18 - Trigonometric functions of complex variables
Lecture 19 - Hyperbolic functions of complex variables
Lecture 20 - Inverse Trigonometric and Hyperbolic functions
Lecture 21 - Branch of a multivalued function
Lecture 22 - Contour Integrals
Lecture 23 - Green's Theorem
Lecture 24 - Path dependence of the contour intergal
Lecture 25 - Antiderivatives
Lecture 26 - The Cauchy theorem
Lecture 27 - Crossing contours and multiply connected domains
Lecture 28 - Cauchy Integral formula
Lecture 29 - Derivatives of an analytic function

Lecture 30 - Liouville's theorem and the Fundamental theorem of algebra
Lecture 31 - Taylor Series
Lecture 32 - Laurent Series
Lecture 33 - Convergence
Lecture 34 - Differentiation and integration of power series
Lecture 35 - Isolated Singularities
Lecture 36 - Residues
Lecture 37 - Residue Theorem
Lecture 38 - Evaluation of integrals - I
Lecture 39 - Evaluation of integrals - II
Lecture 40 - Analytic Continuation
Lecture 41 - Introduction of orthogonal polynomials
Lecture 42 - How to construct orthogonal polynomials
Lecture 43 - The weight function
Lecture 44 - Recursion relations
Lecture 45 - Differential equation satisfied by the orthogonal polynomials
Lecture 46 - Hermite polynomials
Lecture 47 - Properties of Hemite polynomials
Lecture 48 - Legendre polynomials
Lecture 49 - Legendre polynomials: recurrence relation
Lecture 50 - Differential equation corresponding to Legendre polynomials
Lecture 51 - The generating function corresponding to Legendre polynomials
Lecture 52 - Laguerre Polynomials
Lecture 53 - Laguerre Polynomials: recurrence relation
Lecture 54 - Laguerre polynomials: differential equation
Lecture 55 - Laguerre polynomials: generating function
Lecture 56 - Bessel functions: series defination
Lecture 57 - Bessel functions: recurrence relations
Lecture 58 - Bessel functions: differential equation
Lecture 59 - Bessel functions of integral order: generating function
Lecture 60 - Bessel functions: orthogonality
Lecture 61 - Classification of Second Order PDEs
Lecture 62 - Canonical Forms for Hyperbolic PDEs
Lecture 63 - Canonical Forms for Parabolic PDEs
Lecture 64 - Canonical Forms for Elliptic PDEs
Lecture 65 - Tha Laplace Equation
Lecture 66 - The Laplace Equation: Separation of Variables
Lecture 67 - The Laplace Equation: Dirichlet and Neumann boundary conditions
Lecture 68 - The Laplace Equation in Cartesian coordinates

Lecture 69 - The Laplace Equation for a 3-D rectangular box
Lecture 70 - The Laplace Equation in spherical coordinates
Lecture 71 - The Laplace Equation in Spherical Coordinates: Solution
Lecture 72 - The Laplace Equation in Spherical Coordinates: illustrative examples
Lecture 73 - The Poisson's Equation: Green's function solution
Lecture 74 - The heat equation: a heuristic discussion
Lecture 75 - From the random walk to the diffusion equation
Lecture 76 - Solution of the Diffusion equation
Lecture 77 - The Diffusion equation with Dirichlet and Neumann boundary conditions
Lecture 78 - The Heat equation: illustrative examples
Lecture 79 - The Wave equation: Method of characteristics
Lecture 80 - The Wave equation: Separation of variables

NPTEL Video Course - Mathematics - NOC:Real Analysis - II

Subject Co-ordinator - Prof. Jaikrishnan J

Co-ordinating Institute - IIT - Palakkad

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Metric Spaces
Lecture 2 - Examples of metric spaces
Lecture 3 - Loads of definitions
Lecture 4 - Normed vector spaces
Lecture 5 - Examples of normed vector spaces
Lecture 6 - Basic properties open closed sets metric
Lecture 7 - Continuity in metric spaces
Lecture 8 - Equivalent metrics and product spaces
Lecture 9 - Completeness
Lecture 10 - Completeness (Continued...)
Lecture 11 - Completeness of B(x,y)
Lecture 12 - Completion
Lecture 13 - Compactness
Lecture 14 - The Bolzano-Weierstrass Property
Lecture 15 - Open covers and Compactness
Lecture 16 - The Heine-Borel Theorem for Metric Spaces
Lecture 17 - Connectedness
Lecture 18 - Path-Connectedness
Lecture 19 - Connected Components
Lecture 20 - The Arzela-Ascolli theorem
Lecture 21 - Upper and lower limits
Lecture 22 - The Stone-Weierstrass theorem
Lecture 23 - All norms are equivalent
Lecture 24 - Vector-valued functions
Lecture 25 - Scalar-valued functions of a vector variable
Lecture 26 - Directional derivatives and the gradient
Lecture 27 - Interpretation and properties of the gradient
Lecture 28 - Higher-order partial derivatives
Lecture 29 - The derivative as a linear map

Lecture 30 - Examples of differentiation
Lecture 31 - Properties of the derivative map
Lecture 32 - The mean-value theorem
Lecture 33 - Differentiating under the integral sign
Lecture 34 - Higher-order derivatives
Lecture 35 - Symmetry of the second derivative
Lecture 36 - Taylor's theorem
Lecture 37 - Taylor's theorem with remainder
Lecture 38 - The Banach fixed point theorem
Lecture 39 - Newton's method
Lecture 40 - The inverse function theorem
Lecture 41 - Diffeomorphismsm and local diffeomorphisms
Lecture 42 - The implicit function theorem
Lecture 43 - Tangent space to a hypersurface
Lecture 44 - The definition of a manifold
Lecture 45 - Examples and non examples of manifolds
Lecture 46 - The tangent space to a manifold
Lecture 47 - Maxima and minima in several variables
Lecture 48 - The Hessian and extrema
Lecture 49 - Completing the squares
Lecture 50 - Constrained extrema and lagrange multipliers
Lecture 51 - Curves
Lecture 52 - Rectifiability and arc-length
Lecture 53 - The Riemann integral revisited
Lecture 54 - Monotone sequences of functions
Lecture 55 - Upper functions and their integrals
Lecture 56 - Riemann integrable functions as upper functions
Lecture 57 - Lebesgue integrable functions
Lecture 58 - Approximation of Lebesgure integrable functions
Lecture 59 - Levi monotone convergence theorem for step functions
Lecture 60 - Monotone convergence theorem for upper functions
Lecture 61 - Monotone convergence theorem for Lebesgue integrable functions
Lecture 62 - The Lebesgue dominated convergence theorem
Lecture 63 - Applications of the convergence theorems
Lecture 64 - The problem of measure
Lecture 65 - The Lebesgue integral on unbounded intervals
Lecture 66 - Measurable functions
Lecture 67 - Solution to the problem of measure
Lecture 68 - The Lebesgue integral on arbitrary subsets

Lecture 69 - Square integrable functions
Lecture 70 - Norms and inner-products on complex vector spaces
Lecture 71 - Convergence in L2
Lecture 72 - The Riesz-Fischer theorem
Lecture 73 - Multiple Riemann integration
Lecture 74 - Multiple Lebesgue integration

NPTEL Video Course - Mathematics - NOC:Sobolev Spaces and Partial Differential Equations

Subject Co-ordinator - Prof. Kesavan

Co-ordinating Institute - IMSc

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Test Functions - Part 1
Lecture 2 - Test Functions - Part 2
Lecture 3 - Distributions
Lecture 4 - Examples - Part 1
Lecture 5 - Distribution Derivatives
Lecture 6 - More operations on distributions
Lecture 7 - Support of a distribution
Lecture 8 - Distributions with compact support; singular support - Part 1
Lecture 9 - Distributions with compact support; singular support - Part 2
Lecture 10 - Exercises - Part 1
Lecture 11 - Convolution of functions - Part 1
Lecture 12 - Convolution of functions - Part 2
Lecture 13 - Convolution of functions - Part 3
Lecture 14 - Convolution of distributions - Part 1
Lecture 15 - Convolution of distributions - Part 2
Lecture 16 - Convolution of distributions - Part 3
Lecture 17 - Exercises - Part 2
Lecture 18 - Fundamental solutions
Lecture 19 - The Fourier transform
Lecture 20 - The Schwarz space - Part 1
Lecture 21 - The Schwarz space - Part 2
Lecture 22 - Examples - Part 1
Lecture 23 - Fourier inversion formula
Lecture 24 - Tempered distributions
Lecture 25 - Exercises - Part 3
Lecture 26 - Sobolev spaces - Part 1
Lecture 27 - Sobolev spaces - Part 2
Lecture 28 - Sobolev spaces - Part 3
Lecture 29 - Approximation by smooth functions

Lecture 30 - Chain rule and applications - Part 1
Lecture 31 - Chain rule and applications - Part 2
Lecture 32 - Extension theorems - Part 1
Lecture 33 - Extension theorems - Part 2
Lecture 34 - Poincare's inequlity
Lecture 35 - Exercises - Part 4
Lecture 36 - Exercises - Part 5
Lecture 37 - Imbedding theorems
Lecture 38 - Imbedding theorems: Case p less than N - Part 1
Lecture 39 - Imbedding theorems: Case p = N - Part 2
Lecture 40 - Imbedding theorems: Case p greater than N - Part 3
Lecture 41 - Compactness theorems - Part 1
Lecture 42 - Compactness theorems - Part 2
Lecture 43 - Compactness theorems - Part 3
Lecture 44 - The spaces W^{s,p}
Lecture 45 - spaces W^{s,p} and Trace spaces
Lecture 46 - Trace theory - Part 1
Lecture 47 - Trace theory - Part 2
Lecture 48 - Trace theory - Part 3
Lecture 49 - Trace theory - Part 4
Lecture 50 - Exercises - Part 6
Lecture 51 - Exercises - Part 7
Lecture 52 - Abstract variational problems - Part 1
Lecture 53 - Abstract variational problems - Part 2
Lecture 54 - Weak solutions of elliptic boundary value problems - Part 1
Lecture 55 - Weak solutions of elliptic boundary value problems - Part 2
Lecture 56 - Neumann problems
Lecture 57 - The Biharmonic operator
Lecture 58 - The elasticity system
Lecture 59 - Exercises - Part 8
Lecture 60 - Exercises - Part 9
Lecture 61 - Exercises - Part 9
Lecture 62 - Maximum Principles - Part 1
Lecture 63 - Maximum Principles - Part 2
Lecture 64 - Exercises - Part 10
Lecture 65 - Exercises - Part 11
Lecture 66 - Eigenvalue problems - Part 1
Lecture 67 - Eigenvalue problems - Part 2
Lecture 68 - Eigenvalue problems - Part 3

Lecture 69 - Exercises - Part 12
Lecture 70 - Exercises - Part 13
Lecture 71 - Unbounded operators - Part 1
Lecture 72 - Unbounded operators - Part 2
Lecture 73 - The exponential map
Lecture 74 - C_0 Semigroups - Part 1
Lecture 75 - C_0 Semigroups - Part 2
Lecture 76 - Infinitesimal generators of contraction semigroups
Lecture 77 - Hille-Yosida theorem
Lecture 78 - Regularity
Lecture 79 - Contraction semigroups on Hilbert spaces
Lecture 80 - Self-adjoint case and the case of isometries
Lecture 81 - The heat equation
Lecture 82 - The wave equation
Lecture 83 - The Schrodinger equation
Lecture 84 - The inhomogeneous equation
Lecture 85 - Exercises - 14

NPTEL Video Course - Mathematics - NOC:Combinatorics

Subject Co-ordinator - Prof. Narayanan N

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Pigeonhole Principle
Lecture 2 - Dirichlet theorem and Erdos-Szekeres Theorem
Lecture 3 - Ramey theorem as generalisation of PHP
Lecture 4 - An infinite flock of Pigeons
Lecture 5 - Basic Counting - the sum and product rules
Lecture 6 - Examples of basic counting
Lecture 7 - Examples: Product and Division rules
Lecture 8 - Binomial theorem and bijective counting
Lecture 9 - Counting lattice paths
Lecture 10 - Multinomial theorem
Lecture 11 - Applying Multinomial theorem
Lecture 12 - Integer compositions
Lecture 13 - Set partitions and Stirling numbers
Lecture 14 - Stirling and Hemachandra recursions
Lecture 15 - Integer partitions
Lecture 16 - Young's diagram and Integer partitions
Lecture 17 - Principle of Inclusion and Exclusion
Lecture 18 - Applications of PIE
Lecture 19 - The twelvefold way
Lecture 20 - Inclusion exclusion: Linear algebra view
Lecture 21 - Partial Orders
Lecture 22 - Mobius Inversion Formula
Lecture 23 - Product theorem and applications of Mobius Inversion
Lecture 24 - Formal power series, ordinary generating functions
Lecture 25 - Application of Ordinary generating functions
Lecture 26 - Product of Generating functions
Lecture 27 - Composition of generating functions
Lecture 28 - Exponential Generating Function
Lecture 29 - Composition of EGF

Lecture 30 - Euler pentagonal number theorem
Lecture 31 - Graphs - introduction
Lecture 32 - Paths Walks, Cycles
Lecture 33 - Digraphs and functional digraphs
Lecture 34 - Componenets, Connectivity, Bipartite graphs
Lecture 35 - Acyclic graphs
Lecture 36 - Graph colouring
Lecture 37 - Mycielski graphs
Lecture 38 - Product of graphs
Lecture 39 - Menger's theorem
Lecture 40 - System of Distinct representatives
Lecture 41 - Planar graphs
Lecture 42 - Euler identity
Lecture 43 - Map colouring problem - History
Lecture 44 - The Discharging Method - Part 1
Lecture 45 - The Discharging Method - Part 2
Lecture 46 - Introduction to Group actions
Lecture 47 - Colouring and symmetries - examples
Lecture 48 - Bursides lemma
Lecture 49 - Proof of Bursides lemma
Lecture 50 - Polya's theorem
Lecture 51 - Species of structures- definitions and examples
Lecture 52 - Associated seris and Product of species
Lecture 53 - Species: Substitution and Derivative
Lecture 54 - Species: Pointing and countilg labelled trees
Lecture 55 - Review and Further directions
Lecture 56 - More on further topics
Lecture 57 - Linear Algebra method: Ultra short introduction
Lecture 58 - Probabiistic Method: Ultra short introduction

NPTEL Video Course - Mathematics - NOC:Our Mathematical Senses

Subject Co-ordinator - Prof. Vijay Ravikumar

Co-ordinating Institute - Chennai Mathematical Institute

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Why do the images of parallel lines converge?
Lecture 2 - The power of vanishing points
Lecture 3 - Bonus material: Perspective in visual art
Lecture 4 - Understanding Points at Infinity
Lecture 5 - The Extended Euclidean Plane
Lecture 6 - Harmonic tetrads
Lecture 7 - Perspective Drawing as a Perspectivity
Lecture 8 - Perspectivities of the Extended Euclidean Plane
Lecture 9 - Projectivities
Lecture 10 - Projectivities as Functions on the Real Numbers
Lecture 11 - Proving Pappus's Theorem
Lecture 12 - The Fundamental Theorem of Projective Geometry
Lecture 13 - The Cross Ratio
Lecture 14 - Applications of the Cross Ratio
Lecture 15 - The Real Projective Plane
Lecture 16 - Transformations of the Real Projective Plane

NPTEL Video Course - Mathematics - NOC:Algebraic Combinatorics

Subject Co-ordinator - Prof. Amritanshu Prasad, Prof. Sankaran Viswanath

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Examples of Mobius Inversion
Lecture 2 - Partially Ordered Sets
Lecture 3 - Hasse Diagrams
Lecture 4 - Isomorphsms of Posets
Lecture 5 - Maximal, Minimal, Greatest, Least
Lecture 6 - Induced Subposets
Lecture 7 - Incidence Algebras
Lecture 8 - Inversion in Incidence Algebras
Lecture 9 - Mobius Inversion
Lecture 10 - Examples of Mobius Functions
Lecture 11 - Product Posets and their Mobius Functions
Lecture 12 - Opposite of a Poset
Lecture 13 - The Poset of Set Partitions
Lecture 14 - Connected Structures
Lecture 15 - Lattices
Lecture 16 - Weisner's Theorem
Lecture 17 - The Lattice of Non-Crossing Partitions
Lecture 18 - The Canonical Product Decoposition for Intervals of Non-Crossing Partitions
Lecture 19 - The Mobius Function for Non-Crossing Partitions
Lecture 20 - Ideals in a Poset
Lecture 21 - Mobius Function of J(P)
Lecture 22 - Young's Lattice
Lecture 23 - Distributive Lattices
Lecture 24 - Formal Power Series
Lecture 25 - The Necklace Problem
Lecture 26 - Combinatorial Classes
Lecture 27 - Sums, Products, and Sequences of Combinatorial Classes
Lecture 28 - Power Set, Multisets, and Sequences
Lecture 29 - A Little Dendrology

Lecture 30 - Super Catalan/Little Schroeder numbers
Lecture 31 - Regular Languages
Lecture 32 - Finite Automata
Lecture 33 - The Pumping Lemma
Lecture 34 - The Dyck Language
Lecture 35 - Permutations and their cycles
Lecture 36 - Permutation Groups
Lecture 37 - Orbits, fixed points, stabilizers
Lecture 38 - The orbit counting theorem
Lecture 39 - The Polya Enumeration Theorem
Lecture 40 - The Cycle Index Polynomials
Lecture 41 - Cycle Index of the Octahedral Group
Lecture 42 - Cycle Index of the Full Permutation Group
Lecture 43 - Combinatorial Species
Lecture 44 - Generating Series of a Species
Lecture 45 - Cycle Index Series of a Species
Lecture 46 - Isomorphism of Species
Lecture 47 - Visualization of Species
Lecture 48 - Sum of Species
Lecture 49 - Product of Species
Lecture 50 - Sums and Products: More Examples
Lecture 51 - Substitution of Species
Lecture 52 - Derivative of a Species
Lecture 53 - Powers and Seqeunces of Binomial Type
Lecture 54 - Pointing and Cayley's Theorem
Lecture 55 - R-enriched Trees
Lecture 56 - R-enriched Endofunctions
Lecture 57 - Lagrange Inversion Forumla
Lecture 58 - Motivation for the LGV Lemma
Lecture 59 - Statement of the LGV Lemma
Lecture 60 - Nice Applications of the LGV Lemma
Lecture 61 - Sign-Reversing Involutions
Lecture 62 - Proof of the LGV Lemma
Lecture 63 - The Cauchy-Binet Formula
Lecture 64 - Symmetric polynomials: definition and examples
Lecture 65 - Monomial symmetric polynomials
Lecture 66 - Elementary and Complete symmetric polynomials - Part 1
Lecture 67 - Elementary and Complete symmetric polynomials - Part 2
Lecture 68 - Alternating polynomials

Lecture 69 - Labelled abaci and alternants
Lecture 70 - Schur polynomials
Lecture 71 - Pieri Rule - Statement and Examples
Lecture 72 - Pieri Rule - Proof
Lecture 73 - The second Pieri rule
Lecture 74 - Semi-standard tableaux
Lecture 75 - Triangularity of Kostka matrix
Lecture 76 - Monomial expansion of Schur
Lecture 77 - The RSK correspondence
Lecture 78 - Jacobi Trudi identities via LGV lemma
Lecture 79 - Formal ring of symmetric functions in infinitely many variables
Lecture 80 - Monomial expansions and RSK
Lecture 81 - Generating functions for e, h
Lecture 82 - The power sum symmetric functions
Lecture 83 - The inner product and Cauchy identity
Lecture 84 - Skew Schur functions and the LR rule

NPTEL Video Course - Mathematics - NOC:An Invitation to Topology

Subject Co-ordinator - Prof. Indrava Roy

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Topology
Lecture 2 - Basic Set theory
Lecture 3 - Mathematical Logic - Part 1
Lecture 4 - Mathematical Logic - Part 2
Lecture 5 - Functions
Lecture 6 - Finite Sets - Part 1
Lecture 7 - Finite Sets - Part 2
Lecture 8 - Infinite Sets
Lecture 9 - Infinite Sets and Axiom of Choice
Lecture 10 - Definition of aTopology
Lecture 11 - Examples of different topologies
Lecture 12 - Basis for a topology
Lecture 13 - Various topologies on the real line
Lecture 14 - Comparison of topologies - Part 1: Finer and coarser topologies
Lecture 15 - Comparison of topologies - Part 2: Comparing the various topologies on R
Lecture 16 - Basis and Sub-basis for a topology
Lecture 17 - Various topologies: the subspace topology
Lecture 18 - The Product topology
Lecture 19 - Topologies on arbitrary Cartesian products
Lecture 20 - Metric topology - Part 1
Lecture 21 - Metric topology - Part 2
Lecture 22 - Metric topology - Part 3
Lecture 23 - Closed Sets
Lecture 24 - Closure and Limit points
Lecture 25 - Continuous functions
Lecture 26 - Construction of continuous functions
Lecture 27 - Continuous functions on metric spaces - Part 1
Lecture 28 - Continuous functions on metric spaces - Part 2
Lecture 29 - Connectedness

Lecture 30 - Some conditions for Connectedness
Lecture 31 - Connectedness of the Real Line
Lecture 32 - Connectedness of a Linear Continuum
Lecture 33 - The Intermediate Value Theorem
Lecture 34 - Path-connectedness
Lecture 35 - Connectedness does not imply Path-connectedness - Part 1
Lecture 36 - Connectedness does not imply Path-connectedness - Part 2
Lecture 37 - Connected and Path-connected Components
Lecture 38 - Local connectedness and Local Path-connectedness
Lecture 39 - Compactness
Lecture 40 - Properties of compact spaces
Lecture 41 - The Heine-Borel Theorem
Lecture 42 - Tychonoff't theorem
Lecture 43 - Proof of Tychonoff's theorem - Part 1
Lecture 44 - Proof of Tychonoff's theorem - Part 2
Lecture 45 - Compactness in metric spaces
Lecture 46 - Lebesgue Number Lemma and the Uniform Continuity theorem
Lecture 47 - Different Kinds of Compactness
Lecture 48 - Equivalence of various compactness properties for Metric Spaces
Lecture 49 - Compactness and Sequential Compactness in arbitrary topological spaces
Lecture 50 - Baire Spaces
Lecture 51 - Properties and Examples of Baire Spaces
Lecture 52 - The Baire Category Theorem
Lecture 53 - Complete Metric Spaces and the Baire Category theorem - Part 1
Lecture 54 - Complete Metric Spaces and the Baire Category theorem - Part 2
Lecture 55 - Application of the Baire Category theorem
Lecture 56 - Regular and Normal spaces
Lecture 57 - Properties and examples of regular and normal spaces
Lecture 58 - Urysohn's Lemma
Lecture 59 - Proof of Urysohn's Lemma
Lecture 60 - Tietze Extension theorem - Part 1
Lecture 61 - Tietze Extension theorem - Part 2
Lecture 62 - Compactness and Completeness in Metric spaces
Lecture 63 - The space of continuous functions - Part 1
Lecture 64 - The space of continuous functions - Part 2
Lecture 65 - Equicontinuity
Lecture 66 - Total boundedness and Equicontinuity - Part 1
Lecture 67 - Total boundedness and Equicontinuity - Part 2
Lecture 68 - Topology of compact convergence - Part 1

Lecture 69 - Topology of compact convergence - Part 2
Lecture 70 - Equicontinuity revisited - Part 1
Lecture 71 - Equicontinuity revisited - Part 2
Lecture 72 - Locally compact Hausdorff spaces
Lecture 73 - The ArzelÃ - Ascoli theorem

NPTEL Video Course - Mathematics - NOC:Operator Theory

Subject Co-ordinator - Prof. G. Ramesh

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Semi Inner product spaces
Lecture 2 - Inner Product Spaces
Lecture 3 - Parallelogram law
Lecture 4 - Hilbert Spaces
Lecture 5 - Orthogonality
Lecture 6 - Projection Theorem
Lecture 7 - Linear Operator
Lecture 8 - Bounded Operators
Lecture 9 - Norm of a linear operator
Lecture 10 - Examples of bounded operators
Lecture 11 - The Adjoint Operator
Lecture 12 - The Adjoint: Properties
Lecture 13 - Closed range operators - 1
Lecture 14 - Closed range operators - 2
Lecture 15 - Self-adjoint Operators
Lecture 16 - Normal operators
Lecture 17 - Isometris and Unitaries
Lecture 18 - Isometris and Unitaries
Lecture 19 - Mutually Orthogonal Projections
Lecture 20 - Invariant Subspaces
Lecture 21 - Monotone Convergence Theorem
Lecture 22 - Square root
Lecture 23 - Polar decomposition
Lecture 24 - Invertibility
Lecture 25 - Spectrum
Lecture 26 - Spectral Mapping Theorem
Lecture 27 - The spectral radius formula
Lecture 28 - multiplicative linear functionals
Lecture 29 - The GKZ-theorem

Lecture 30 - Maximal Ideal Space
Lecture 31 - Commutative C*-algebras
Lecture 32 - Decomposition of spectrum
Lecture 33 - Computing spectrum: Examples
Lecture 34 - Approximate spectrum
Lecture 35 - Approximate spectrum: Properties
Lecture 36 - Numerical bounds
Lecture 37 - Compact Operators
Lecture 38 - Compact Operators; Properties
Lecture 39 - Spectral Theorem: Compact Self-Adjoint Operators
Lecture 40 - Spectral Theorem: Consequences
Lecture 41 - Compact Normal Operators
Lecture 42 - Compact Operators Singular value Decomposition
Lecture 43 - Fredholm Alternative Theorem
Lecture 44 - Orthogonal decomposition of self-adjoint operators
Lecture 45 - Spectral family; Properties - I
Lecture 46 - Spectral family; Properties - II
Lecture 47 - Spectral theorem Self adjoint Operators
Lecture 48 - Spectral theorem Examples
Lecture 49 - Spectral theorem: Consequences
Lecture 50 - Continuous functional Calculus
Lecture 51 - Spectral mapping theorem

NPTEL Video Course - Mathematics - NOC:Measure and Integration

Subject Co-ordinator - Prof. S. Kesavan

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Preamble
Lecture 2 - Algebras of sets
Lecture 3 - Measures on rings
Lecture 4 - Outer-measure
Lecture 5 - Measurable sets
Lecture 6 - Caratheodory's method
Lecture 7 - Exercises
Lecture 8 - Exercises
Lecture 9 - Lebesgue measure: the ring
Lecture 10 - Construction of the Lebesgue measure
Lecture 11 - Errata
Lecture 12 - The Cantor set
Lecture 13 - Approximation
Lecture 14 - Approximation
Lecture 15 - Approximation
Lecture 16 - Translation Invariance
Lecture 17 - Non-measurable sets
Lecture 18 - Exercises
Lecture 19 - Measurable functions
Lecture 20 - Measurable functions
Lecture 21 - The Cantor function
Lecture 22 - Exercises
Lecture 23 - Egorov's theorem
Lecture 24 - Convergence in measure
Lecture 25 - Convergence in measure
Lecture 26 - Convergence in measure
Lecture 27 - Exercises
Lecture 28 - Integration: Simple functions
Lecture 29 - Non-negative functions

Lecture 30 - Monotone convergence theorem
Lecture 31 - Examples
Lecture 32 - Fatou's lemma
Lecture 33 - Integrable functions
Lecture 34 - Dominated convergence theorem
Lecture 35 - Dominated convergence theorem: Applications
Lecture 36 - Absolute continuity
Lecture 37 - Integration on the real line
Lecture 38 - Examples
Lecture 39 - Weierstrass' theorem
Lecture 40 - Exercises
Lecture 41 - Exercises
Lecture 42 - Vitali covering lemma
Lecture 43 - Monotonic functions
Lecture 44 - Functions of bounded variation
Lecture 45 - Functions of bounded variation
Lecture 46 - Functions of bounded variation
Lecture 47 - Differentiation of an indefinite integral
Lecture 48 - Absolute continuity
Lecture 49 - Exercises
Lecture 50 - Product spaces
Lecture 51 - Product spaces: measurable functions
Lecture 52 - Product measure
Lecture 53 - Fubini's theorem
Lecture 54 - Examples
Lecture 55 - Examples
Lecture 56 - Integration of radial functions
Lecture 57 - Measure of the unit ball in N dimensions
Lecture 58 - Exercises
Lecture 59 - Signed measures
Lecture 60 - Hahn and Jordan decompositions
Lecture 61 - Upper,lower and totaal variations of a signed measure; Absolute continuity
Lecture 62 - Absolute continuity
Lecture 63 - Radon-Nikodym theorem
Lecture 64 - Radon-Nikodym theorem
Lecture 65 - Exercises
Lecture 66 - Lebesgue spaces
Lecture 67 - Examples. Inclusion questions
Lecture 68 - Convergence in L^p

Lecture 69 - Approximation
Lecture 70 - Applications
Lecture 71 - Duality
Lecture 72 - Duality
Lecture 73 - Convolutions
Lecture 74 - Convolutions
Lecture 75 - Convolutions
Lecture 76 - Exercises
Lecture 77 - Exercises
Lecture 78 - Change of variable
Lecture 79 - Change of variable

NPTEL Video Course - Mathematics - NOC:Approximate Reasoning using Fuzzy Set Theory

Subject Co-ordinator - Prof. Balasubramaniam Jayaram

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Flow of the Course: A not-so-sneak peek
Lecture 2 - Fuzzy Sets - The Necessity
Lecture 3 - Fuzzy Sets - Representations
Lecture 4 - Fuzziness vs Probability
Lecture 5 - Fuzzy Sets - Some Important Notions
Lecture 6 - Operations on Fuzzy Sets
Lecture 7 - Posets on Fuzzy Sets
Lecture 8 - Lattice of Fuzzy Sets
Lecture 9 - Boolean Algebra of Sets
Lecture 10 - Algebras on Fuzzy Sets
Lecture 11 - Triangular Norms
Lecture 12 - Triangular Norms: Analytical Aspects
Lecture 13 - Triangular Norms: Algebraic Aspects
Lecture 14 - T-Norms: Construction and Representations
Lecture 15 - T-Norms:Complementation and Duality
Lecture 16 - Fuzzy Implications
Lecture 17 - Fuzzy Implications - Desirable Properties
Lecture 18 - Construction of Fuzzy Implication - I
Lecture 19 - Construction of Fuzzy Implication - II
Lecture 20 - Construction of Fuzzy Implication - II
Lecture 21 - Construction of Fuzzy Implication - III
Lecture 22 - Construction of Fuzzy Implication - IV
Lecture 23 - (N, T, I)- An Organic Relationship
Lecture 24 - Fuzzy Relations
Lecture 25 - Composition of Fuzzy Relations
Lecture 26 - Similarity and Compatibility Classes
Lecture 27 - On the Transitivity of Fuzzy Relations - I
Lecture 28 - On the Transitivity of Fuzzy Relations - II
Lecture 29 - Fuzzy Propositions: Some Interpretations

Lecture 30 - Fuzzy If-Then Rules
Lecture 31 - Fuzzy Relational Inference
Lecture 32 - Fuzzy Relational Inference - MISO Case
Lecture 33 - Fuzzy Relational Inference - Multiple Rules
Lecture 34 - Fuzzy Inferencing Schemes - A Visual Illustration
Lecture 35 - Similarity Based Reasoning
Lecture 36 - SBR : Mamdani Fuzzy Systems
Lecture 37 - Introduction to Building a Mamdani FIS
Lecture 38 - Contrast Enhancement in Images: An FIS Approach
Lecture 39 - Takagi-Sugeno-Kang Fuzzy Systems
Lecture 40 - Fuzzy Inference Systems - Interpolativity
Lecture 41 - Interpolativity of FRI - Single SISO Rule
Lecture 42 - Fuzzy Relational Equations
Lecture 43 - Interpolativity of FRI - Multiple SISO Rules
Lecture 44 - Similarity Based Reasoning- Interpolativity
Lecture 45 - FRI~SBR : FITA~FATI : Some Connections
Lecture 46 - Continuous Models of FRI
Lecture 47 - Continuous Models of CRI and BKS
Lecture 48 - Continuous Models of SBR
Lecture 49 - Extensionality of a Fuzzy Set
Lecture 50 - Robustness of CRI
Lecture 51 - Robustness of BKS
Lecture 52 - Robustness of SBR
Lecture 53 - Monotonicity of an FIS
Lecture 54 - Monotonicity of an FRI
Lecture 55 - Monotonicity of an SBR
Lecture 56 - Functional (In)Equalities involving FLCs
Lecture 57 - Suitability of BKS with Yager's Implications
Lecture 58 - Law of Importation and Hierarchical CRI

NPTEL Video Course - Mathematics - NOC:Probability-II with Examples Using R

Subject Co-ordinator - Prof. Siva Athreya

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Continuous Random Variables - Part 1
Lecture 2 - Continuous Random Variables - Part 2
Lecture 3 - R Set Up
Lecture 4 - Exponential and Normal Random Variable
Lecture 5 - Normal Random Variable
Lecture 6 - Distribution Function
Lecture 7 - Normal Distribution
Lecture 8 - Problem Solving for Week 12 - Part 2
Lecture 9 - Joint Distribution of Continuous Random Variables
Lecture 10 - Marginal Density and Independence
Lecture 11 - Uniform Distribution in R2
Lecture 12 - Problem Solving
Lecture 13 - Bivariate Normal - Part 1
Lecture 14 - Problem Solving 1 - Calculating Probabilities
Lecture 15 - Problem Solving 2 - Quadratic Equation, Random Coefficients
Lecture 16 - Conditional Density
Lecture 17 - Sums of Independent Random Variables
Lecture 18 - Quotient of Independent Random Variables
Lecture 19 - Simulating Bivariate Normal Random Variables
Lecture 20 - Problem Solving Conditional Density
Lecture 21 - Expectation and Variance of Continuous Random Variables
Lecture 22 - Revisit of Variance and Expectation
Lecture 23 - Revisit of Properties of Variance
Lecture 24 - Covariance and Correlation
Lecture 25 - Conditional Expectation and Conditional Variance
Lecture 26 - Analysis of Variance Formula
Lecture 27 - Problem Solving Expectations
Lecture 28 - Moment Generating Function
Lecture 29 - Moments and Moment Generating Function

Lecture 30 - Bivariate Normal - Part 2
Lecture 31 - Problem Solving Conditional Expectation and Conditional Variance
Lecture 32 - Sampling Distribution and Sample Mean
Lecture 33 - Weak Law of Large Numbers
Lecture 34 - Revisit Weak Law of Large Numbers
Lecture 35 - Problem Solving
Lecture 36 - Demoivre-Laplace Central Limit Theorem and Normal Random Variables
Lecture 37 - Revisit Normal Random Variables
Lecture 38 - Normal Tables, Mean and Variance
Lecture 39 - Problem Solving
Lecture 40 - Bivariate Normal Random Variables_Characterisation
Lecture 41 - Bivariate Normal Random Variables_Independence
Lecture 42 - Problem Solving
Lecture 43 - Bivariate Normal Random Variables Joint Density Calculation - Part 1
Lecture 44 - Bivariate Normal Random Variables Joint Density Calculation - Part 2
Lecture 45 - Problem Solving - Review of Transformation of Random Variables

NPTEL Video Course - Mathematics - NOC:Predictive Analytics - Regression and Classification

Subject Co-ordinator - Prof. Sourish Das

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - Least Squares method
Lecture 3 - Hands-on with Python - Part 1
Lecture 4 - Hands-on with R - Part 1
Lecture 5 - Categorical Variable as Predictor - Part 1
Lecture 6 - Categorical Variable as Predictor - Part 2
Lecture 7 - Hands-on with R - Part 2
Lecture 8 - Understanding the joint probability from data perspective
Lecture 9 - Hands-on with R - Part 3
Lecture 10 - Regression Line as Conditional Expectation
Lecture 11 - Normal Equations
Lecture 12 - Gauss Markov Theorem
Lecture 13 - Hands-on with Python - Part 2
Lecture 14 - Geometry of Regression Model and Feature Engineering
Lecture 15 - Sampling Distribution and Statistical Inference of Regression Coefficient
Lecture 16 - Hands-on with R - Part 4
Lecture 17 - Checking Model Assumptions
Lecture 18 - Comparing Models with Predictive Accuracy
Lecture 19 - Hands-on with Julia
Lecture 20 - Model Complexity, Bias and Variance Tradeoff
Lecture 21 - Feature Selection, Variable Selection
Lecture 22 - Hands on with R - Part 5
Lecture 23 - Understanding Multicollinearity
Lecture 24 - Ill-Posed Problem and Regularisation, LASSO and Risdge
Lecture 25 - Hands-on with Python - Part 3
Lecture 26 - Time Series Forecasting with Regression Model
Lecture 27 - Hands on with R - Part 6
Lecture 28 - Granger Causal model
Lecture 29 - Hands on with R - Part 7

Lecture 30 - Capital Asset Pricing Model
Lecture 31 - Hands on with R for CAPM
Lecture 32 - Bootstrap Regression
Lecture 33 - Hands on with R for Bootstrap Regression
Lecture 34 - Hands on with Python: Handle multicollinearity with Ridge correction
Lecture 35 - Hands on with Julia: Implemente Chennai Temperature Analysis with Julia and CRRao
Lecture 36 - Introduction to logistic Regression
Lecture 37 - Maximum Likelihood Estimate for Logistic Regression
Lecture 38 - Hands on with R for Logistic Regression
Lecture 39 - Hands on with R: Measure Time performance of R code
Lecture 40 - Statistical Inference of Logistic Regression
Lecture 41 - Hands on with R with Iris Dataset
Lecture 42 - Multi-Class Classification with Discriminant Analysis
Lecture 43 - Hands on with R: Implement LDA
Lecture 44 - Effect of Feature Engineer in Logistic Regression
Lecture 45 - Logistic Regression to Deep Learning Neural Network
Lecture 46 - Hands on with R: Feature Engineer in Logistic Regression
Lecture 47 - Generalised Linear Model
Lecture 48 - Hands on with R: Poisson Regression with Football Data
Lecture 49 - Gaussian Process Regression
Lecture 50 - Hands on with R: Implement GP Regression from scratch
Lecture 51 - Tree Structured Regression
Lecture 52 - Hands on with R: Implement Tree Regression and Random Forest with Simulated Data
Lecture 53 - Hands on with R: Implement Tree Regression and Random Forest with EPL football Data
Lecture 54 - Hands on with Python : Analysis of Bangalore House Price Data
Lecture 55 - Hands on with R: Prediction of Bangalore House Price
Lecture 56 - Hands on with R: More Prediction of Bangalore House Price
Lecture 57 - Hands on with R: Some Correction with Bangalore House Price Data Prediction
Lecture 58 - Hands on with R: Classify fake bank note with GLM
Lecture 59 - Hands on with R: Dynamic Pricing with Cheese Data
Lecture 60 - Hands on with Julia - Bayesian Logistic Regression with Horse Shoe Prior - Genetic Data Analysis
Lecture 61 - Hands on with Julia - Bayesian Poisson Regression with Horse Shoe Prior English Premier League D
Lecture 62 - Why Julia is Future for Data Science Projects ?
Lecture 63 - Concluding Remarks
Lecture 64 - Course Review

NPTEL Video Course - Mathematics - NOC:Introduction to Algebraic Geometry

Subject Co-ordinator - Prof. Arijit Dey

Co-ordinating Institute - IIT - Madras

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Commutative Algebra - Part 1
Lecture 2 - Commutative Algebra - Part 2
Lecture 3 - Commutative Algebra - Part 3
Lecture 4 - Commutative Algebra - Part 4
Lecture 5 - Commutative Algebra - Part 5
Lecture 6 - Tutorial 1 : Cayley-Hamilton Theorem, Nakayama's Lemma
Lecture 7 - Commutative Algebra - Part 6
Lecture 8 - Commutative Algebra - Part 7
Lecture 9 - Commutative Algebra - Part 8
Lecture 10 - Affine Algebraic Sets - Part 1
Lecture 11 - Affine Algebraic Sets - Part 2
Lecture 12 - Tutorial 2 : Noether Normalization Lemma,Some Important Results in Dimension Theory
Lecture 13 - Regular Morphisms
Lecture 14 - Abstract Algebraic Sets
Lecture 15 - Zariski Topology on Affine Space
Lecture 16 - Irreducible Affine Algebraic Sets
Lecture 17 - Ring of Regular Functions
Lecture 18 - Projective Space
Lecture 19 - Tutorial 3 : Some Applications of Dimension Theory
Lecture 20 - Zariski Topology on Projective Space
Lecture 21 - Affine Open Cover of Projective Space
Lecture 22 - Projective and Quasi-Projective Varieties
Lecture 23 - Regular Functions on Quasi-Projective Varieties
Lecture 24 - Presheaves and Sheaves
Lecture 25 - Morphism of Presheaves/Sheaves
Lecture 26 - Tutorial 4 : More Applications of Dimension Theory
Lecture 27 - A Brief Overview of Sheaf Theory - Part 1
Lecture 28 - A Brief Overview of Sheaf Theory - Part 2
Lecture 29 - A Brief Overview of Sheaf Theory - Part 3

Lecture 30 - Prevarieties
Lecture 31 - Sheaf of Regular Functions
Lecture 32 - Ring of Germs of Regular Functions at a point, Field of Rational Functions
Lecture 33 - Tutorial 5 : Sheafification
Lecture 34 - Ring of Regular Functions, Local Ring at a Point,and Field of Rational Functions of an AffineVar
Lecture 35 - Equivalence of Categories of the Category of Affine Varieties over a Field k and the Category
Lecture 36 - Equivalence of Categories of the Category of Affine Varieties over a Field k (Continued...)
Lecture 37 - Some Examples, Open Immersions and Closed Immersions
Lecture 38 - Product of Quasi-affine Varieties
Lecture 39 - Diagonal Morphisms, Abstract Varieties
Lecture 40 - Tutorial 6 : Normal Varieties and Normalization of a Variety
Lecture 41 - Projective Varieties Revisited - Part 1
Lecture 42 - Projective Varieties Revisited - Part 2
Lecture 43 - Global Regular Functions on ProjectiveVarieties are Constants - Part 1
Lecture 44 - Global Regular Functions on ProjectiveVarieties are Constants - Part 2
Lecture 45 - Product of Prevarieties - Part 1
Lecture 46 - Product of Prevarieties - Part 2
Lecture 47 - Tutorial 7 : A Result on Tensor Products of k-algebras
Lecture 48 - Morphisms of Prevarieties - Part 1
Lecture 49 - Morphisms of Prevarieties - Part 2
Lecture 50 - Finite Morphisms - Part 1
Lecture 51 - Finite Morphisms - Part 2
Lecture 52 - Fiber Products
Lecture 53 - Tutorial 8 : Finite Morphisms
Lecture 54 - Immersions
Lecture 55 - Fiber Products, Separatedness
Lecture 56 - Criterion of Separatedness
Lecture 57 - Proper Morphisms and Complete Varieties
Lecture 58 - Tutorial 9 : Closed Immersions and Graph of a Morphism
Lecture 59 - Projective Varieties are Complete
Lecture 60 - Zariski Tangent Space, Singular and Nonsingular Points
Lecture 61 - Smooth Points Form a Non-empty Open Subset
Lecture 62 - Blow-Ups, Rational Maps and Birational Maps
Lecture 63 - Tutorial 10 : Zariski Tangent Space at a Point of an Affine Variety
Lecture 64 - Blow-Ups (Continued...)
Lecture 65 - Smooth Morphisms
Lecture 66 - Bertini's Theorem
Lecture 67 - Sard's Theorem
Lecture 68 - Tutorial 11 : Dimension of fiber of a morphism

Lecture 69 - Introduction to Affine Schemes - Spectrum of a Ring
Lecture 70 - Introduction to Affine Schemes - Topology on Spec A
Lecture 71 - Introduction to Affine Schemes - Topology on Spec A (Continued...)
Lecture 72 - Introduction to Affine Schemes - Sheaf Structure on Spec A
Lecture 73 - Abstract Non-singular Curves - Part 1
Lecture 74 - Abstract Non-singular Curves - Part 2
Lecture 75 - Tutorial 12 : Extension of Regular Functions

NPTEL Video Course - Mathematics - Discrete Mathematics

Subject Co-ordinator - Dr. Aditi Gangopadhyay, Dr. Sugata Gangopadhyay, Dr. Tanuja Srivastava

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to the theory of sets
Lecture 2 - Set operation and laws of set operation
Lecture 3 - The principle of inclusion and exclusion
Lecture 4 - Application of the principle of inclusion and exclusion
Lecture 5 - Fundamentals of logic
Lecture 6 - Logical Inferences
Lecture 7 - Methods of proof of an implication
Lecture 8 - First order logic (1)
Lecture 9 - First order logic (2)
Lecture 10 - Rules of influence for quantified propositions
Lecture 11 - Mathematical Induction (1)
Lecture 12 - Mathematical Induction (2)
Lecture 13 - Sample space, events
Lecture 14 - Probability, conditional probability
Lecture 15 - Independent events, Bayes theorem
Lecture 16 - Information and mutual information
Lecture 17 - Basic definition
Lecture 18 - Isomorphism and sub graphs
Lecture 19 - Walks, paths and circuits operations on graphs
Lecture 20 - Euler graphs, Hamiltonian circuits
Lecture 21 - Shortest path problem
Lecture 22 - Planar graphs
Lecture 23 - Basic definition
Lecture 24 - Properties of relations
Lecture 25 - Graph of relations
Lecture 26 - Matrix of relation
Lecture 27 - Closure of relaton (1)
Lecture 28 - Closure of relaton (2)
Lecture 29 - Warshall's algorithm

Lecture 30 - Partially ordered relation
Lecture 31 - Partially ordered sets
Lecture 32 - Lattices
Lecture 33 - Boolean algebra
Lecture 34 - Boolean function (1)
Lecture 35 - Boolean function (2)
Lecture 36 - Discrete numeric function
Lecture 37 - Generating function
Lecture 38 - Introduction to recurrence relations
Lecture 39 - Second order recurrence relation with constant coefficients (1)
Lecture 40 - Second order recurrence relation with constant coefficients (2)
Lecture 41 - Application of recurrence relation

NPTEL Video Course - Mathematics - NOC:Mathematical Methods and its Applications

Subject Co-ordinator - Prof. P.N. Agarwal, S. K. Gupta

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to linear differential equations
Lecture 2 - Linear dependence, independence and Wronskian of functions
Lecture 3 - Solution of second-order homogenous linear differential equations with constant coefficients - I
Lecture 4 - Solution of second-order homogenous linear differential equations with constant coefficients - II
Lecture 5 - Method of undetermined coefficients
Lecture 6 - Methods for finding Particular Integral for second-order linear differential equations with const
Lecture 7 - Methods for finding Particular Integral for second-order linear differential equations with const
Lecture 8 - Methods for finding Particular Integral for second-order linear differential equations with const
Lecture 9 - Euler-Cauchy equations
Lecture 10 - Method of reduction for second-order linear differential equations
Lecture 11 - Method of variation of parameters
Lecture 12 - Solution of second order differential equations by changing dependent variable
Lecture 13 - Solution of second order differential equations by changing independent variable
Lecture 14 - Solution of higher-order homogenous linear differential equations with constant coefficients
Lecture 15 - Methods for finding Particular Integral for higher-order linear differential equations
Lecture 16 - Formulation of Partial differential equations
Lecture 17 - Solution of LagrangeÂ s equation - I
Lecture 18 - Solution of LagrangeÂ s equation - II
Lecture 19 - Solution of first order nonlinear equations - I
Lecture 20 - Solution of first order nonlinear equations - II
Lecture 21 - Solution of first order nonlinear equations - III
Lecture 22 - Solution of first order nonlinear equations - IV
Lecture 23 - Introduction to Laplace transforms
Lecture 24 - Laplace transforms of some standard functions
Lecture 25 - Existence theorem for Laplace transforms
Lecture 26 - Properties of Laplace transforms - I
Lecture 27 - Properties of Laplace transforms - II
Lecture 28 - Properties of Laplace transforms - III
Lecture 29 - Properties of Laplace transforms - IV

Lecture 30 - Convolution theorem for Laplace transforms - I
Lecture 31 - Convolution theorem for Laplace transforms - II
Lecture 32 - Initial and final value theorems for Laplace transforms
Lecture 33 - Laplace transforms of periodic functions
Lecture 34 - Laplace transforms of Heaviside unit step function
Lecture 35 - Laplace transforms of Dirac delta function
Lecture 36 - Applications of Laplace transforms - I
Lecture 37 - Applications of Laplace transforms - II
Lecture 38 - Applications of Laplace transforms - III
Lecture 39 - ZÂ transform and inverse Z-transform of elementary functions
Lecture 40 - Properties of Z-transforms - I
Lecture 41 - Properties of Z-transforms - II
Lecture 42 - Initial and final value theorem for Z-transforms
Lecture 43 - Convolution theorem for Z-transforms
Lecture 44 - Applications of Z-transforms - I
Lecture 45 - Applications of Z-transforms - II
Lecture 46 - Applications of Z-transforms - III
Lecture 47 - Fourier series and its convergence - I
Lecture 48 - Fourier series and its convergence - II
Lecture 49 - Fourier series of even and odd functions
Lecture 50 - Fourier half-range series
Lecture 51 - ParsevelÂ s Identity
Lecture 52 - Complex form of Fourier series
Lecture 53 - Fourier integrals
Lecture 54 - Fourier sine and cosine integrals
Lecture 55 - Fourier transforms
Lecture 56 - Fourier sine and cosine transforms
Lecture 57 - Convolution theorem for Fourier transforms
Lecture 58 - Applications of Fourier transforms to BVP - I
Lecture 59 - Applications of Fourier transforms to BVP - II
Lecture 60 - Applications of Fourier transforms to BVP - III

NPTEL Video Course - Mathematics - NOC:Integral Equations, Calculus of Variations and its Applications

Subject Co-ordinator - Prof.D. N Pandey, Prof. P.N. Agarwal

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Definition and classification of linear integral equations
Lecture 2 - Conversion of IVP into integral equations
Lecture 3 - Conversion of BVP into an integral equations
Lecture 4 - Conversion of integral equations into differential equations
Lecture 5 - Integro-differential equations
Lecture 6 - Fredholm integral equation with separable kernel
Lecture 7 - Fredholm integral equation with separable kernel
Lecture 8 - Solution of integral equations by successive substitutions
Lecture 9 - Solution of integral equations by successive approximations
Lecture 10 - Solution of integral equations by successive approximations
Lecture 11 - Fredholm integral equations with symmetric kernels
Lecture 12 - Fredholm integral equations with symmetric kernels
Lecture 13 - Fredholm integral equations with symmetric kernels
Lecture 14 - Construction of Green function - I
Lecture 15 - Construction of Green function - II
Lecture 16 - Green function for self adjoint linear differential equations
Lecture 17 - Green function for non-homogeneous boundary value problem
Lecture 18 - Fredholm alternative theorem - I
Lecture 19 - Fredholm alternative theorem - II
Lecture 20 - Fredholm method of solutions
Lecture 21 - Classical Fredholm theory
Lecture 22 - Classical Fredholm theory
Lecture 23 - Classical Fredholm theory
Lecture 24 - Method of successive approximations
Lecture 25 - Neumann series and resolvent kernels - I
Lecture 26 - Neumann series and resolvent kernels - II
Lecture 27 - Equations with convolution type kernels - I
Lecture 28 - Equations with convolution type kernels - II
Lecture 29 - Singular integral equations - I

Lecture 30 - Singular integral equations - II
Lecture 31 - Cauchy type integral equations - I
Lecture 32 - Cauchy type integral equations - II
Lecture 33 - Cauchy type integral equations - III
Lecture 34 - Cauchy type integral equations - IV
Lecture 35 - Cauchy type integral equations - V
Lecture 36 - Solution of integral equations using Fourier transform
Lecture 37 - Solution of integral equations using Hilbert transform - I
Lecture 38 - Solution of integral equations using Hilbert transform - II
Lecture 39 - Calculus of variations
Lecture 40 - Calculus of variations
Lecture 41 - Calculus of variations
Lecture 42 - Calculus of variations
Lecture 43 - Euler equation
Lecture 44 - Euler equation
Lecture 45 - Brachistochrone problem and Euler equation - I
Lecture 46 - Euler's equation - II
Lecture 47 - Functions of several independent variables
Lecture 48 - Variational problems in parametric form
Lecture 49 - Variational problems of general type
Lecture 50 - Variational derivative and invariance of Euler's equation
Lecture 51 - Invariance of Euler's equation and isoperimetric problem - I
Lecture 52 - Isoperimetric problem - II
Lecture 53 - Variational problem involving a conditional extremum - I
Lecture 54 - Variational problem involving a conditional extremum - II
Lecture 55 - Variational problems with moving boundaries - I
Lecture 56 - Variational problems with moving boundaries - II
Lecture 57 - Variational problems with moving boundaries - III
Lecture 58 - Variational problems with moving boundaries; One sided variation
Lecture 59 - Variational problem with a movable boundary for a functional dependent on two functions
Lecture 60 - Hamilton's principle

NPTEL Video Course - Mathematics - NOC:Nonlinear Programming

Subject Co-ordinator - S. K. Gupta

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Convex Sets and Functions
Lecture 2 - Properties of Convex Functions - I
Lecture 3 - Properties of Convex Functions - II
Lecture 4 - Properties of Convex Functions- III
Lecture 5 - Convex Programming Problems
Lecture 6 - KKT optimality conditions
Lecture 7 - Quadratic Programming Problems - I
Lecture 8 - Quadratic Programming Problems - II
Lecture 9 - Separable Programming - I
Lecture 10 - Separable Programming - II
Lecture 11 - Geometric Programming - I
Lecture 12 - Geometric Programming - II
Lecture 13 - Geometric Programming - III
Lecture 14 - Dynamic Programming - I
Lecture 15 - Dynamic Programming - II
Lecture 16 - Dynamic programming approach to find shortest path in any network
Lecture 17 - Dynamic Programming - IV
Lecture 18 - Search Techniques - I
Lecture 19 - Search Techniques - II
Lecture 20 - Search Techniques - III

NPTEL Video Course - Mathematics - NOC:Numerical Methods

Subject Co-ordinator - Prof. Sanjeev Kumar, Prof. Ameeya Kumar Nayak

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to error analysis and linear systems
Lecture 2 - Gaussian elimination with Partial pivoting
Lecture 3 - LU decomposition
Lecture 4 - Jacobi and Gauss Seidel methods
Lecture 5 - Iterative methods-II
Lecture 6 - Introduction to Non-linear equations and Bisection method
Lecture 7 - Regula Falsi and Secant methods
Lecture 8 - Newton-Raphson method
Lecture 9 - Fixed point iteration method
Lecture 10 - System of Nonlinear equations
Lecture 11 - Introduction to Eigenvalues and Eigenvectors
Lecture 12 - Similarity Transformations and Gershgorin Theorem
Lecture 13 - Jacobi's Method for Computing Eigenvalues
Lecture 14 - Power Method
Lecture 15 - Inverse Power Method
Lecture 16 - Interpolation - Part I (Introduction to Interpolation)
Lecture 17 - Interpolation - Part II (Some basic operators and their properties)
Lecture 18 - Interpolation - Part III (Newtonâ s Forward/ Backward difference and derivation of general erro
Lecture 19 - Interpolation - Part IV (Error in approximating a function by a polynomial using Newtonâ s Forw
Lecture 20 - Interpolation - Part V (Solving problems using Newton's Forward and Backward difference formula)
Lecture 21 - Interpolation - Part VI (Central difference formula)
Lecture 22 - Interpolation - Part VII (Lagrange interpolation formula with examples)
Lecture 23 - Interpolation - Part VIII (Divided difference interpolation with examples)
Lecture 24 - Interpolation - Part IX (Hermite's interpolation with examples)
Lecture 25 - Numerical differentiation - Part I (Introduction to numerical differentiation by interpolation f
Lecture 26 - Numerical differentiation - Part II (Numerical differentiation based on Lagrangeâ s interpolati
Lecture 27 - Numerical differentiation - Part III (Numerical differentiation based on Divided difference form
Lecture 28 - Numerical differentiation - Part IV (Maxima and minima of a tabulated function and differentiati
Lecture 29 - Numerical differentiation - Part V (Differentiation based on finite difference operators)

Lecture 30 - Numerical differentiation - Part VI (Method of undetermined coefficients and Derivatives with ur
Lecture 31 - Numerical Integration - Part I (Methodology of Numerical Integration and Rectangular rule)
Lecture 32 - Numerical Integration - Part II (Quadrature formula and Trapezoidal rule with associated errors)
Lecture 33 - Numerical Integration - Part III (Simpsons 1/3rd rule with associated errors)
Lecture 34 - Numerical Integration - Part IV (Composite Simpsons 1/3rd rule and Simpsons 3/8th rule with exam
Lecture 35 - Numerical Integration - Part V (Gauss Legendre 2-point and 3-point formula with examples)
Lecture 36 - Introduction to Ordinary Differential equations
Lecture 37 - Numerical methods for ODE-1
Lecture 38 - Numerical Methods - II
Lecture 39 - R-K Methods for solving ODEs
Lecture 40 - Multi-step Method for solving ODEs

NPTEL Video Course - Mathematics - NOC:Numerical Linear Algebra

Subject Co-ordinator - Prof.D. N Pandey, Prof. P.N. Agrawal

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Matrix Operations and Types of Matrices
Lecture 2 - Determinant of a Matrix
Lecture 3 - Rank of a Matrix
Lecture 4 - Vector Space - I
Lecture 5 - Vector Space - II
Lecture 6 - Linear dependence and independence
Lecture 7 - Bases and Dimension - I
Lecture 8 - Bases and Dimension - II
Lecture 9 - Linear Transformation - I
Lecture 10 - Linear Transformation - II
Lecture 11 - Orthogonal Subspaces
Lecture 12 - Row Space, Column Space and Null Space
Lecture 13 - Eigen Values and Eigen Vectors - I
Lecture 14 - Eigen Values and Eigen Vectors - II
Lecture 15 - Diagonalizable Matrices
Lecture 16 - Orthogonal Sets
Lecture 17 - Gram Schmidt ortthogonalization and orthogonal bases
Lecture 18 - Introduction to Matlab
Lecture 19 - Sign Integer Representation
Lecture 20 - Computer Representation of Numbers
Lecture 21 - Floating Point Representation
Lecture 22 - Round-off Error
Lecture 23 - Error Propagation in Computer Arithmetic
Lecture 24 - Addition and Multiplication of Floating Point Numbers
Lecture 25 - Conditioning and Condition Numbers - I
Lecture 26 - Conditioning and Condition Numbers - II
Lecture 27 - Stability of Numerical Algorithms - I
Lecture 28 - Stability of Numerical Algorithms - II
Lecture 29 - Vector Norms - I

Lecture 30 - Vector Norms - II
Lecture 31 - Matrix Norms - I
Lecture 32 - Matrix Norms - II
Lecture 33 - Convergent Matrices - I
Lecture 34 - Convergent Matrices - II
Lecture 35 - Stability of non linear system
Lecture 36 - Condition number of a matrix
Lecture 37 - Sensitivity Analysis - I
Lecture 38 - Sensitivity Analysis - II
Lecture 39 - Residual Theorem
Lecture 40 - Nearness to Singularity
Lecture 41 - Estimation of the Condition Number
Lecture 42 - Singular value decomposition of a matrix - I
Lecture 43 - Singular value decomposition of a matrix - II
Lecture 44 - Orthonormal Projections
Lecture 45 - Algebraic and geometric properties of SVD
Lecture 46 - SVD and their applications
Lecture 47 - Perturbation theorem for singular values
Lecture 48 - Outer product expansion of a matrix
Lecture 49 - Least square solutions - I
Lecture 50 - Least square solutions - II
Lecture 51 - Householder matrices
Lecture 52 - Householder matrices and their applications
Lecture 53 - Householder QR factorization - I
Lecture 54 - Householder QR factorization - II
Lecture 55 - Basic theorems on eigenvalues and QR method
Lecture 56 - Power Method
Lecture 57 - Rate of Convergence of Power Method
Lecture 58 - Applications of Power Method with Shift
Lecture 59 - Jacobi Method - I
Lecture 60 - Jacobi Method - II

NPTEL Video Course - Mathematics - NOC:Numerical Methods - Finite Difference Approach

Subject Co-ordinator - Prof. Ameeya Kumar Nayak

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Numerical solutions
Lecture 2 - Numerical Solution of ODE
Lecture 3 - Numerical solution of PDE
Lecture 4 - Finite difference approximation
Lecture 5 - Polynomial fitting and one-sided approximation
Lecture 6 - Solution of parabolic equation
Lecture 7 - Implicit and C-N scheme for solving 1D parabolic equation
Lecture 8 - Stability analysis of Explicit scheme for solving parabolic equation
Lecture 9 - Stability of Crank-Nicoloson's scheme
Lecture 10 - Approximation of derivative boundary conditions
Lecture 11 - Solution of two-dimensional parabolic equation
Lecture 12 - Solution of 2D parabolic equation using ADI scheme
Lecture 13 - Solution of Elliptic Equation
Lecture 14 - Solution of Elliptic equation using SOR method
Lecture 15 - Solution of Elliptic equation using ADI scheme
Lecture 16 - Solution of Hyperbolic equation
Lecture 17 - Stability analysis for Hyperbolic equations
Lecture 18 - Characteristics of PDE
Lecture 19 - Lax-Wendroff's method
Lecture 20 - Wendroff's method

NPTEL Video Course - Mathematics - NOC:Multivariable Calculus

Subject Co-ordinator - Dr. Sanjeev Kumar, S. K. Gupta

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Functions of several variables
Lecture 2 - Limits for multivariable functions - I
Lecture 3 - Limits for multivariable functions - II
Lecture 4 - Continuity of multivariable functions
Lecture 5 - Partial Derivatives - I
Lecture 6 - Partial Derivatives - II
Lecture 7 - Differentiability - I
Lecture 8 - Differentiability - II
Lecture 9 - Chain rule - I
Lecture 10 - Chain rule - II
Lecture 11 - Change of variables
Lecture 12 - Eulerâ s theorem for homogeneous functions
Lecture 13 - Tangent planes and Normal lines
Lecture 14 - Extreme values - I
Lecture 15 - Extreme values - II
Lecture 16 - Lagrange multipliers
Lecture 17 - Taylorâ s theorem
Lecture 18 - Error approximation
Lecture 19 - Polar-curves
Lecture 20 - Multiple Integrals
Lecture 21 - Change Of Order Of Integration
Lecture 22 - Change of Variables in Multiple Integral
Lecture 23 - Introduction to Gamma Function
Lecture 24 - Introduction to Beta Function
Lecture 25 - Properties of Beta and Gamma Functions - I
Lecture 26 - Properties of Beta and Gamma Functions - II
Lecture 27 - Dirichlet's Integral
Lecture 28 - Applications of Multiple Integrals
Lecture 29 - Vector Differentiation

Lecture 30 - Gradient of a Scalar Field and Directional Derivative
Lecture 31 - Normal Vector and Potential field
Lecture 32 - Gradient (Identities), Divergence and Curl (Identities)
Lecture 33 - Some Identities on Divergence and Curl
Lecture 34 - Line Integral (I)
Lecture 35 - Applications of Line Integrals
Lecture 36 - Green's Theorem
Lecture 37 - Surface Area
Lecture 38 - Surface Integral
Lecture 39 - Divergence Theorem of Gauss
Lecture 40 - Stoke's Theorem

NPTEL Video Course - Mathematics - NOC:Ordinary and Partial Differential Equations and Applications

Subject Co-ordinator - Prof.D. N Pandey, Prof. P.N. Agrawal

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to differential equations - I
Lecture 2 - Introduction to differential equations - II
Lecture 3 - Existence and uniqueness of solutions of differential equations - I
Lecture 4 - Existence and uniqueness of solutions of differential equations - II
Lecture 5 - Existence and uniqueness of solutions of differential equations - III
Lecture 6 - Existence and uniqueness of solutions of a system of differential equations
Lecture 7 - Linear System
Lecture 8 - Properties of Homogeneous Systems
Lecture 9 - Solution of Homogeneous Linear System with Constant Coefficients - I
Lecture 10 - Solution of Homogeneous Linear System with Constant Coefficients - II
Lecture 11 - Solution of Homogeneous Linear System with Constant Coefficients - III
Lecture 12 - Solution of Non-Homogeneous Linear System with Constant Coefficients
Lecture 13 - Power Series
Lecture 14 - Uniform Convergence of Power Series
Lecture 15 - Power Series Solution of Second Order Homogeneous Equations
Lecture 16 - Regular singular points - I
Lecture 17 - Regular singular points - II
Lecture 18 - Regular singular points - III
Lecture 19 - Regular singular points - IV
Lecture 20 - Regular singular points - V
Lecture 21 - Critical points
Lecture 22 - Stability of Linear Systems - I
Lecture 23 - Stability of Linear Systems - II
Lecture 24 - Stability of Linear Systems - III
Lecture 25 - Critical Points and Paths of Non-linear Systems
Lecture 26 - Boundary value problems for second order differential equations
Lecture 27 - Self - adjoint Forms
Lecture 28 - Sturm - Liouville problem and its properties
Lecture 29 - Sturm - Liouville problem and its applications

Lecture 30 - Greenâ s function and its applications - I
Lecture 31 - Greenâ s function and its applications - II
Lecture 32 - Origins and Classification of First Order PDE
Lecture 33 - Initial Value Problem for Quasi-linear First Order Equations
Lecture 34 - Existence and Uniqueness of Solutions
Lecture 35 - Surfaces orthogonal to a given system of surfaces
Lecture 36 - Nonlinear PDE of first order
Lecture 37 - Cauchy method of characteristics - I
Lecture 38 - Cauchy method of characteristics - II
Lecture 39 - Compatible systems of first order equations
Lecture 40 - Charpitâ s method - I
Lecture 41 - Charpitâ s method - II
Lecture 42 - Second Order PDE with Variable Coefficients
Lecture 43 - Classification and Canonical Form of Second Order PDE - I
Lecture 44 - Classification and Canonical Form of Second Order PDE - II
Lecture 45 - Classification and Characteristic Curves of Second Order PDEs
Lecture 46 - Review of Integral Transforms - I
Lecture 47 - Review of Integral Transforms - II
Lecture 48 - Review of Integral Transforms - II
Lecture 49 - Review of Integral Transforms - III
Lecture 50 - Laplace Equation - I
Lecture 51 - Laplace Equation - II
Lecture 52 - Laplace and Poisson Equations
Lecture 53 - One dimensional wave equation and its solution - I
Lecture 54 - One dimensional wave equation and its solution - II
Lecture 55 - One dimensional wave equation and its solution - III
Lecture 56 - Two dimensional wave equation and its solution - I
Lecture 57 - Solution of non-homogeneous wave equation
Lecture 58 - Solution of homogeneous diffusion equation - I
Lecture 59 - Solution of homogeneous diffusion equation - II
Lecture 60 - Duhamelâ s principle

NPTEL Video Course - Mathematics - NOC:Matrix Analysis with Applications

Subject Co-ordinator - Dr. Sanjeev Kumar, S. K. Gupta

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Elementary row operations
Lecture 2 - Echelon form of a matrix
Lecture 3 - Rank of a matrix
Lecture 4 - System of Linear Equations - I
Lecture 5 - System of Linear Equations - II
Lecture 6 - Introduction to Vector Spaces
Lecture 7 - Subspaces
Lecture 8 - Basis and Dimension
Lecture 9 - Linear Transformations
Lecture 10 - Rank and Nullity
Lecture 11 - Inverse of a Linear Transformation
Lecture 12 - Matrix Associated with a LT
Lecture 13 - Eigenvalues and Eigenvectors
Lecture 14 - Cayley-Hamilton Theorem and Minimal Polynomial
Lecture 15 - Diagonalization
Lecture 16 - Special Matrices
Lecture 17 - More on Special Matrices and Gerschgorin Theorem
Lecture 18 - Inner Product Spaces
Lecture 19 - Vector and Matrix Norms
Lecture 20 - Gram Schmidt Process
Lecture 21 - Normal Matrices
Lecture 22 - Positive Definite Matrices
Lecture 23 - Positive Definite and Quadratic Forms
Lecture 24 - Gram Matrix and Minimization of Quadratic Forms
Lecture 25 - Generalized Eigenvectors and Jordan Canonical Form
Lecture 26 - Evaluation of Matrix Functions
Lecture 27 - Least Square Approximation
Lecture 28 - Singular Value Decomposition
Lecture 29 - Pseudo-Inverse and SVD

Lecture 30 - Introduction to Ill-Conditioned Systems
Lecture 31 - Regularization of Ill-Conditioned Systems
Lecture 32 - Linear Systems
Lecture 33 - Linear Systems
Lecture 34 - Non-Stationary Iterative Methods
Lecture 35 - Non-Stationary Iterative Methods
Lecture 36 - Krylov Subspace Iterative Methods (Conjugate Gradient Method)
Lecture 37 - Krylov Subspace Iterative Methods (CG and Pre-Conditioning)
Lecture 38 - Introduction to Positive Matrices
Lecture 39 - Positive Matrices, Positive Eigenpair, Perron Root and vector, Example
Lecture 40 - Polar Decomposition

NPTEL Video Course - Mathematics - NOC:Mathematical Modelling: Analysis and Applications

Subject Co-ordinator - Prof. Ameeya Kumar Nayak

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Mathematical Modeling
Lecture 2 - Discrete Time Linear Models in Population Dynamics - I
Lecture 3 - Discrete Time Linear Models in Population Dynamics - II
Lecture 4 - Discrete Time Linear Age Structured Models
Lecture 5 - Numerical Methods to Compute Eigen Values
Lecture 6 - Discrete Time Non-Linear Models in Population Dynamics - II
Lecture 7 - Analysis on Logistic Difference Equation
Lecture 8 - Classifications of Bifurcation
Lecture 9 - Discrete Time Non - Linear Models in Population Dynamics - II
Lecture 10 - Discrete Time Prey - Predator Model
Lecture 11 - Introduction to Continuous Time Models
Lecture 12 - Solution of First Order First Degree Differential Equations
Lecture 13 - Continuous Time Models in Population Dynamics - I
Lecture 14 - Continuous Time Models in Population Dynamics - II
Lecture 15 - Stability and Linearization of System of Ordinary Differential Equations
Lecture 16 - Continuous Time Single Species Models
Lecture 17 - Qualitative Solution of Differential Equations - Phase Diagrams - I
Lecture 18 - Qualitative Solution of Differential Equations - Phase Diagrams - II
Lecture 19 - Continuous Time Lotka - Volterra Competition Model
Lecture 20 - Continuous Time Prey - Predator Model

NPTEL Video Course - Mathematics - NOC:Dynamical System and Control

Subject Co-ordinator - Prof.D. N Pandey, Dr. N. Sukavanam

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Formulation of Dynamical Systems - I
Lecture 2 - Formulation of Dynamical Systems - II
Lecture 3 - Existence and Uniqueness Theorem - I
Lecture 4 - Existence and Uniqueness Theorem - II
Lecture 5 - Linear Systems - I
Lecture 6 - Linear Systems - II
Lecture 7 - Solutions of Linear Systems - I
Lecture 8 - Solutions of Linear Systems - II
Lecture 9 - Solutions of Linear Systems - III
Lecture 10 - Fundamental Matrix - I
Lecture 11 - Fundamental Matrix - II
Lecture 12 - Fundamental Matrix for Non-Autonomous systems
Lecture 13 - Solutions of Non-Homogeneous Systems
Lecture 14 - Stability of Systems
Lecture 15 - Stability of Linear Autonomous Systems - I
Lecture 16 - Stability of Linear Autonomous Systems - II
Lecture 17 - Stability of Linear Autonomous Systems - III
Lecture 18 - Stability of Weakly Non-Linear Systems - I
Lecture 19 - Stability of Weakly Non-Linear Systems - II
Lecture 20 - Stability of Non-Linear Systems using Linearization
Lecture 21 - Properties of Phase Portrait
Lecture 22 - Properties of Orbits
Lecture 23 - Phase Portrait
Lecture 24 - Phase Portrait of Linear Differential Equations - I
Lecture 25 - Phase Portrait of Linear Differential Equations - II
Lecture 26 - Phase Portrait of Linear Differential Equations - III
Lecture 27 - Poincare Bendixson Theorem
Lecture 28 - Limit Cycle
Lecture 29 - Lyapunov Stability - I

Lecture 30 - Lyapunov Stability - II
Lecture 31 - Introduction to Control Systems - I
Lecture 32 - Introduction to Control Systems - II
Lecture 33 - Controllability of Autonomous Systems
Lecture 34 - Controllability of Non-autonomous Systems
Lecture 35 - Observability - I
Lecture 36 - Observability - II
Lecture 37 - Results on Controllability and Observability
Lecture 38 - Companion Form
Lecture 39 - Feedback Control - I
Lecture 40 - Feedback Control - II
Lecture 41 - Feedback Control - III
Lecture 42 - Feedback Control - IV
Lecture 43 - State Observer
Lecture 44 - Stabilizability
Lecture 45 - Introduction to Discrete Systems - I
Lecture 46 - Introduction to Discrete Systems - II
Lecture 47 - Lyapunov Stability Theory - I
Lecture 48 - Lyapunov Stability Theory - II
Lecture 49 - Lyapunov Stability Theory - III
Lecture 50 - Optimal Control - I
Lecture 51 - Optimal Control - II
Lecture 52 - Optimal Control - III
Lecture 53 - Optimal Control - IV
Lecture 54 - Optimal Control for Discrete Systems - I
Lecture 55 - Optimal Control for Discrete Systems - II
Lecture 56 - Controllability of Discrete Systems
Lecture 57 - Observability of Discrete Systems
Lecture 58 - Stability for Discrete Systems
Lecture 59 - Relation between Continuous and Discrete Systems - I
Lecture 60 - Relation between Continuous and Discrete Systems - II

NPTEL Video Course - Mathematics - NOC:Advanced Engineering Mathematics

Subject Co-ordinator - Prof. P.N. Agarwal

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Analytic Function
Lecture 2 - Cauchy-Riemann Equations
Lecture 3 - Harmonic Functions, Harmonic Conjugates and Milne's Method
Lecture 4 - Applications to the Problems of Potential Flow - I
Lecture 5 - Applications to the Problems of Potential Flow - II
Lecture 6 - Complex Integration
Lecture 7 - Cauchy's Theorem - I
Lecture 8 - Cauchy's Theorem - II
Lecture 9 - Cauchy's Integral Formula for the Derivatives of Analytic Function
Lecture 10 - Morera's Theorem, Liouville's Theorem and Fundamental Theorem of Algebra
Lecture 11 - Winding Number and Maximum Modulus Principle
Lecture 12 - Sequences and Series
Lecture 13 - Uniform Convergence of Series
Lecture 14 - Power Series
Lecture 15 - Taylor Series
Lecture 16 - Laurent Series
Lecture 17 - Zeros and Singularities of an Analytic Function
Lecture 18 - Residue at a Singularity
Lecture 19 - Residue Theorem
Lecture 20 - Meromorphic Functions
Lecture 21 - Evaluation of real integrals using residues - I
Lecture 22 - Evaluation of real integrals using residues - II
Lecture 23 - Evaluation of real integrals using residues - III
Lecture 24 - Evaluation of real integrals using residues - IV
Lecture 25 - Evaluation of real integrals using residues - V
Lecture 26 - Bilinear Transformations
Lecture 27 - Cross Ratio
Lecture 28 - Conformal Mapping - I
Lecture 29 - Conformal Mapping - II

Lecture 30 - Conformal mapping from half plane to disk and half plane to half plane - I
Lecture 31 - Conformal mapping from disk to disk and angular region to disk
Lecture 32 - Application of Conformal Mapping to Potential Theory
Lecture 33 - Review of Z-transforms - I
Lecture 34 - Review of Z-transforms - II
Lecture 35 - Review of Z-transforms - III
Lecture 36 - Review of Bilateral Z-transforms
Lecture 37 - Finite Fourier Transforms
Lecture 38 - Fourier Integral and Fourier Transforms
Lecture 39 - Fourier Series
Lecture 40 - Discrete Fourier Transforms - I
Lecture 41 - Discrete Fourier Transforms - II
Lecture 42 - Basic Concepts of Probability
Lecture 43 - Conditional Probability
Lecture 44 - Bayes Theorem and Probability Networks
Lecture 45 - Discrete Probability Distribution
Lecture 46 - Binomial Distribution
Lecture 47 - Negative Binomial Distribution and Poisson Distribution
Lecture 48 - Continuous Probability Distribution
Lecture 49 - Poisson Process
Lecture 50 - Exponential Distribution
Lecture 51 - Normal Distribution
Lecture 52 - Joint Probability Distribution - I
Lecture 53 - Joint Probability Distribution - II
Lecture 54 - Joint Probability Distribution - III
Lecture 55 - Correlation and Regression - I
Lecture 56 - Correlation and Regression - II
Lecture 57 - Testing of Hypotheses - I
Lecture 58 - Testing of Hypotheses - II
Lecture 59 - Testing of Hypotheses - III
Lecture 60 - Application to Queuing Theory and Reliability Theory

NPTEL Video Course - Mathematics - NOC:Higher Engineering Mathematics

Subject Co-ordinator - Prof. P.N. Agarwal

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Symbolic Representation of Statements - I
Lecture 2 - Symbolic Representation of Statements - II
Lecture 3 - Tautologies and Contradictions
Lecture 4 - Predicates and Quantifires - I
Lecture 5 - Predicates and Quantifiers - II
Lecture 6 - Validity of Arguments
Lecture 7 - Language and Grammers - I
Lecture 8 - Language and Grammers - II
Lecture 9 - Language and Grammers - III
Lecture 10 - Finite- State Machines
Lecture 11 - Partially Ordered Sets - I
Lecture 12 - Partially Ordered Sets - II
Lecture 13 - Partially Ordered Sets - III
Lecture 14 - Lattices - I
Lecture 15 - Lattices - II
Lecture 16 - Lattices - III
Lecture 17 - Lattices - IV
Lecture 18 - Lattices - V
Lecture 19 - Boolean Algebra - I
Lecture 20 - Boolean Algebra - II
Lecture 21 - Boolean Algebra - III
Lecture 22 - Boolean Algebra - IV
Lecture 23 - Logic Gates
Lecture 24 - Karnaugh Map - I
Lecture 25 - Karnaugh Map - II
Lecture 26 - Various type of Graphs - I
Lecture 27 - Various types of Graphs - II
Lecture 28 - Paths and Connectivity
Lecture 29 - Subgraphs and Traversable Multigraphs

Lecture 30 - Undirected and Directed Graphs
Lecture 31 - Eulerian and Hamiltonian Graphs
Lecture 32 - Planar Graphs
Lecture 33 - Representation of Graphs
Lecture 34 - Isomorphic and Homeomorphic Graphs
Lecture 35 - Kuratowski's Theorem
Lecture 36 - Dual of a Graph
Lecture 37 - Coloring of Graphs - I
Lecture 38 - Coloring of Graphs - II
Lecture 39 - Tree - I
Lecture 40 - Tree - II
Lecture 41 - Graphical Method - I
Lecture 42 - Graphical Method - II
Lecture 43 - General Linear Programming Problem
Lecture 44 - Simplex Method - I
Lecture 45 - Simplex Method - II
Lecture 46 - Big - M Method - I
Lecture 47 - Big - M Method - II (Special Cases)
Lecture 48 - Two Phase Method - I
Lecture 49 - Two Phase method - II
Lecture 50 - Duality - I
Lecture 51 - Duality - II
Lecture 52 - Dual Simplex Method
Lecture 53 - Transportation Problem - I
Lecture 54 - Transportation Problem - II
Lecture 55 - Assignment Problem - I
Lecture 56 - Assignment Problem - II

NPTEL Video Course - Mathematics - NOC:Operations Research

Subject Co-ordinator - Prof. Kusumdeep

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to OR Models
Lecture 2 - More OR Models
Lecture 3 - Graphical Method for LPP
Lecture 4 - Convex sets
Lecture 5 - Simplex Method
Lecture 6 - Big M Method
Lecture 7 - Two Phase
Lecture 8 - Multiple solutions of LPP
Lecture 9 - Unbounded solution of LPP
Lecture 10 - Infeasible solution of LPP
Lecture 11 - Revised Simplex Method
Lecture 12 - Case studies and Exercises - I
Lecture 13 - Case studies and Exercises - II
Lecture 14 - Case studies and Exercises - III
Lecture 15 - Primal Dual Construction
Lecture 16 - Weak Duality Theorem
Lecture 17 - More Duality Theorems
Lecture 18 - Primal-Dual relationship of solutions
Lecture 19 - Dual Simplex Method
Lecture 20 - Sensitivity Analysis - I
Lecture 21 - Sensitivity Analysis - II
Lecture 22 - Case studies and Exercises - I
Lecture 23 - Case studies and Exercises - II
Lecture 24 - Integer Programming
Lecture 25 - Goal Programming
Lecture 26 - Multi-Objective Programming
Lecture 27 - Dynamic Programming
Lecture 28 - Transportation Problem
Lecture 29 - Assignment Problem

Lecture 30 - Case studies and Exercises
Lecture 31 - Processing n Jobs on Two Machines
Lecture 32 - Processing n Jobs through Three Machines
Lecture 33 - Processing two jobs through m machines
Lecture 34 - Processing n jobs through m machines
Lecture 35 - Case studies and Exercises
Lecture 36 - Two Person Zero-Sum Game
Lecture 37 - Theorems of Game Theory
Lecture 38 - Solution of Mixed Strategy Games
Lecture 39 - Linear Programming method for solving games
Lecture 40 - Case studies and Exercises

NPTEL Video Course - Mathematics - NOC:Essential Mathematics for Machine Learning

Subject Co-ordinator - Prof. S.K. Gupta, Dr. Sanjeev Kumar

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Vectors in Machine Learning
Lecture 2 - Basics of Matrix Algebra
Lecture 3 - Vector Space: Definition and Examples
Lecture 4 - Vector Subspace: Examples and Properties
Lecture 5 - Basis and Dimension
Lecture 6 - Linear Transformations
Lecture 7 - Norms and Spaces
Lecture 8 - Orthogonal Complement and Projection Mapping
Lecture 9 - Eigenvalues and Eigenvectors
Lecture 10 - Special matrices and Properties
Lecture 11 - Spectral Decomposition
Lecture 12 - Singular Value Decomposition
Lecture 13 - SVD: Properties and Applications
Lecture 14 - Low Rank Approximations
Lecture 15 - Python Implementation of SVD and Low - rank Approximation
Lecture 16 - Principal Component Analysis - I
Lecture 17 - PCA: Derivation and Examples
Lecture 18 - Python Implementation of PCA
Lecture 19 - Linear Discriminant Analysis
Lecture 20 - Python Implementation of LDA
Lecture 21 - Least Square Approximation and Minimum Normed Solution
Lecture 22 - Linear and Multiple Regression - I
Lecture 23 - Linear and Multiple Regression - II
Lecture 24 - Logistic Regression - I
Lecture 25 - Logistic Regression - II
Lecture 26 - Classification Metrics
Lecture 27 - Gram Schmidt Process
Lecture 28 - Polar Decomposition
Lecture 29 - Minimal Polynomial and Jordan Canonical Form - I

Lecture 30 - Minimal Polynomial and Jordan Canonical Form - II
Lecture 31 - Basic Concepts of Calculus - I
Lecture 32 - Basic Concepts of Calculus - II
Lecture 33 - Basic Concepts of Calculus - III
Lecture 34 - Basic Concepts of Calculus - IV
Lecture 35 - Basic Concepts of Calculus - V
Lecture 36 - Calculus in Python
Lecture 37 - Convex Sets and Functions
Lecture 38 - Properties of convex functions - I
Lecture 39 - Properties of Convex functions - II
Lecture 40 - Introduction to Optimization
Lecture 41 - Unconstrained Optimization
Lecture 42 - Constrained Optimization - I
Lecture 43 - Constrained Optimization - II
Lecture 44 - Steepest Descent method
Lecture 45 - Newton's and Penalty function method
Lecture 46 - Optimization using Python
Lecture 47 - Operations on Sets
Lecture 48 - Review on Probability
Lecture 49 - Bayes' theorem and Random variables
Lecture 50 - Expectation and Variance
Lecture 51 - Discrete probability distributions
Lecture 52 - Continuous probability distributions
Lecture 53 - Joint probability distribution and covariance
Lecture 54 - Introduction to SVM
Lecture 55 - Error Minimizing LPP
Lecture 56 - Concepts of Duality
Lecture 57 - Hard Margin classifier
Lecture 58 - Soft margin classifier
Lecture 59 - SVM using Python - I
Lecture 60 - SVM using Python - II

NPTEL Video Course - Mathematics - NOC:Advanced Linear Algebra

Subject Co-ordinator - Prof. Premananda Bera

Co-ordinating Institute - IIT - Roorkee

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - System of Linear Equations
Lecture 2 - Elementary Row Operations
Lecture 3 - Row-Reduced Echelon Form and its Applications
Lecture 4 - Vector Spaces - I
Lecture 5 - Vector Spaces - II
Lecture 6 - Basis and Dimensions - I
Lecture 7 - Basis and Dimensions - II
Lecture 8 - Change of Ordered Basis in F. D. V. S.
Lecture 9 - Row Space of a Matrix
Lecture 10 - Computations concerning Subspaces
Lecture 11 - Linear Transformations
Lecture 12 - Concept of Rank
Lecture 13 - Algebra of Linear Transformations - I
Lecture 14 - Algebra of Linear Transformations - II
Lecture 15 - Algebra of Linear Transformations - III
Lecture 16 - Matrix Representation of Linear Transformations - I
Lecture 17 - Matrix Representation of Linear Transformations - II
Lecture 18 - Linear Functional - I
Lecture 19 - Linear Functional - II
Lecture 20 - Linear Functional - III
Lecture 21 - Linear Functional and Transpose of L.T. - I
Lecture 22 - Linear Functional and Transpose of L.T. - II
Lecture 23 - Eigenvalue and Eigenvector of Linear Operator - I
Lecture 24 - Eigenvalue and Eigenvector of Linear Operator - II
Lecture 25 - Eigenvalue and Eigenvector of Digonalizable L.O.
Lecture 26 - Annihilating Polynomial of Linear Operator
Lecture 27 - Cayley-Hamilton Theorem and Its Applications - I
Lecture 28 - Cayley-Hamilton Theorem and its Applications - II
Lecture 29 - Invariant Subspaces - I

Lecture 30 - Invariant Subspaces - II
Lecture 31 - Application of Invariant Subspaces - I
Lecture 32 - Application of Invariant Subspaces - II
Lecture 33 - Direct Sum Decompositions - I
Lecture 34 - Direct Sum Decompositions - II
Lecture 35 - Invariant Direct Sums - I
Lecture 36 - Invariant Direct Sums - II
Lecture 37 - Decomposition of space and Operator - I
Lecture 38 - Decomposition of Space and Operator - II
Lecture 39 - Applications of Primary Decomposition Theorem - I
Lecture 40 - Applications of Primary Decomposition Theorem - II
Lecture 41 - Applications of Primary Decomposition Theorem - III
Lecture 42 - Inner Products - I
Lecture 43 - Inner Products - II
Lecture 44 - Inner Product Spaces - I
Lecture 45 - Inner Product Spaces - II
Lecture 46 - Best Approximation in I.P.S.
Lecture 47 - Orthogonal Projection in I.P.S.
Lecture 48 - Linear Functionals and Adjoints - I
Lecture 49 - Linear Functionals and Adjoints - II
Lecture 50 - Linear Functionals and Adjoints - III
Lecture 51 - Linear Functionals and Adjoints - IV
Lecture 52 - Isomorphism in Inner Product Spaces
Lecture 53 - Unitary Operators - I
Lecture 54 - Unitary Operators - II
Lecture 55 - Application of Unitary O. and Initiation of Normal Operator
Lecture 56 - Normal Operator - I
Lecture 57 - Normal Operator - II
Lecture 58 - Normal Operator and It's Spectral Resolution
Lecture 59 - Singular Value Decomposition of a Matrix
Lecture 60 - Forms on Inner product Spaces

NPTEL Video Course - Mathematics - Advanced Matrix Theory and Linear Algebra for Engineers

Subject Co-ordinator - Prof. Vittal Rao

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Prologue - Part 1
Lecture 2 - Prologue - Part 2
Lecture 3 - Prologue - Part 3
Lecture 4 - Linear Systems - Part 1
Lecture 5 - Linear Systems - Part 2
Lecture 6 - Linear Systems - Part 3
Lecture 7 - Linear Systems - Part 4
Lecture 8 - Vector Spaces - Part 1
Lecture 9 - Vector Spaces - Part 2
Lecture 10 - Linear Independence and Subspaces - Part 1
Lecture 11 - Linear Independence and Subspaces - Part 2
Lecture 12 - Linear Independence and Subspaces - Part 3
Lecture 13 - Linear Independence and Subspaces - Part 4
Lecture 14 - Basis - Part 1
Lecture 15 - Basis - Part 2
Lecture 16 - Basis - Part 3
Lecture 17 - Linear Transformations - Part 1
Lecture 18 - Linear Transformations - Part 2
Lecture 19 - Linear Transformations - Part 3
Lecture 20 - Linear Transformations - Part 4
Lecture 21 - Linear Transformations - Part 5
Lecture 22 - Inner Product and Orthogonality - Part 1
Lecture 23 - Inner Product and Orthogonality - Part 2
Lecture 24 - Inner Product and Orthogonality - Part 3
Lecture 25 - Inner Product and Orthogonality - Part 4
Lecture 26 - Inner Product and Orthogonality - Part 5
Lecture 27 - Inner Product and Orthogonality - Part 6
Lecture 28 - Diagonalization - Part 1
Lecture 29 - Diagonalization - Part 2

Lecture 30 - Diagonalization - Part 3
Lecture 31 - Diagonalization - Part 4
Lecture 32 - Hermitian and Symmetric matrices - Part 1
Lecture 33 - Hermitian and Symmetric matrices - Part 2
Lecture 34 - Hermitian and Symmetric matrices - Part 3
Lecture 35 - Hermitian and Symmetric matrices - Part 4
Lecture 36 - Singular Value Decomposition (SVD) - Part 1
Lecture 37 - Singular Value Decomposition (SVD) - Part 2
Lecture 38 - Back To Linear Systems - Part 1
Lecture 39 - Back To Linear Systems - Part 2
Lecture 40 - Epilogue

NPTEL Video Course - Mathematics - Ordinary Differential Equations and Applications

Subject Co-ordinator - Prof. A.K. Nandakumaran, Prof. Raju K. George, Prof. P.S. Datti

Co-ordinating Institute - IISc - Bangalore | IIST - Trivandrum | TIFR-CAM - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - General Introduction
Lecture 2 - Examples
Lecture 3 - Examples (Continued - I)
Lecture 4 - Examples (Continued - II)
Lecture 5 - Linear Algebra
Lecture 6 - Linear Algebra (Continued - I)
Lecture 7 - Linear Algebra (Continued - II)
Lecture 8 - Analysis
Lecture 9 - Analysis (Continued...)
Lecture 10 - First Order Linear Equations
Lecture 11 - Exact Equations
Lecture 12 - Second Order Linear Equations
Lecture 13 - Second Order Linear Equations (Continued - I)
Lecture 14 - Second Order Linear Equations (Continued - II)
Lecture 15 - Well-posedness and Examples of IVP
Lecture 16 - Gronwall's Lemma
Lecture 17 - Basic Lemma and Uniqueness Theorem
Lecture 18 - Picard's Existence and Uniqueness Theorem
Lecture 19 - Picard's Existence and Uniqueness (Continued...)
Lecture 20 - Cauchy Peano Existence Theorem
Lecture 21 - Existence using Fixed Point Theorem
Lecture 22 - Continuation of Solutions
Lecture 23 - Series Solution
Lecture 24 - General System and Diagonalizability
Lecture 25 - 2 by 2 systems and Phase Plane Analysis
Lecture 26 - 2 by 2 systems and Phase Plane Analysis (Continued...)
Lecture 27 - General Systems
Lecture 28 - General Systems (Continued...) and Non-homogeneous Systems
Lecture 29 - Basic Definitions and Examples

Lecture 30 - Stability Equilibrium Points
Lecture 31 - Stability Equilibrium Points (Continued - I)
Lecture 32 - Stability Equilibrium Points (Continued - II)
Lecture 33 - Second Order Linear Equations (Continued - III)
Lecture 34 - Lyapunov Function
Lecture 35 - Lyapunov Function (Continued...)
Lecture 36 - Periodic Orbits and Poincare Bendixon Theory
Lecture 37 - Periodic Orbits and Poincare Bendixon Theory (Continued...)
Lecture 38 - Linear Second Order Equations
Lecture 39 - General Second Order Equations
Lecture 40 - General Second Order Equations (Continued...)

NPTEL Video Course - Mathematics - NOC:Linear Algebra

Subject Co-ordinator - Prof. Dilip P. Patil

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction to Algebraic Structures - Rings and Fields
Lecture 2 - Definition of Vector Spaces
Lecture 3 - Examples of Vector Spaces
Lecture 4 - Definition of subspaces
Lecture 5 - Examples of subspaces
Lecture 6 - Examples of subspaces (Continued...)
Lecture 7 - Sum of subspaces
Lecture 8 - System of linear equations
Lecture 9 - Gauss elimination
Lecture 10 - Generating system, linear independence and bases
Lecture 11 - Examples of a basis of a vector space
Lecture 12 - Review of univariate polynomials
Lecture 13 - Examples of univariate polynomials and rational functions
Lecture 14 - More examples of a basis of vector spaces
Lecture 15 - Vector spaces with finite generating system
Lecture 16 - Steinitzs exchange theorem and examples
Lecture 17 - Examples of finite dimensional vector spaces
Lecture 18 - Dimension formula and its examples
Lecture 19 - Existence of a basis
Lecture 20 - Existence of a basis (Continued...)
Lecture 21 - Existence of a basis (Continued...)
Lecture 22 - Introduction to Linear Maps
Lecture 23 - Examples of Linear Maps
Lecture 24 - Linear Maps and Bases
Lecture 25 - Pigeonhole principle in Linear Algebra
Lecture 26 - Interpolation and the rank theorem
Lecture 27 - Examples
Lecture 28 - Direct sums of vector spaces
Lecture 29 - Projections

Lecture 30 - Direct sum decomposition of a vector space
Lecture 31 - Dimension equality and examples
Lecture 32 - Dual spaces
Lecture 33 - Dual spaces (Continued...)
Lecture 34 - Quotient spaces
Lecture 35 - Homomorphism theorem of vector spaces
Lecture 36 - Isomorphism theorem of vector spaces
Lecture 37 - Matrix of a linear map
Lecture 38 - Matrix of a linear map (Continued...)
Lecture 39 - Matrix of a linear map (Continued...)
Lecture 40 - Change of bases
Lecture 41 - Computational rules for matrices
Lecture 42 - Rank of a matrix
Lecture 43 - Computation of the rank of a matrix
Lecture 44 - Elementary matrices
Lecture 45 - Elementary operations on matrices
Lecture 46 - LR decomposition
Lecture 47 - Elementary Divisor Theorem
Lecture 48 - Permutation groups
Lecture 49 - Canonical cycle decomposition of permutations
Lecture 50 - Signature of a permutation
Lecture 51 - Introduction to multilinear maps
Lecture 52 - Multilinear maps (Continued...)
Lecture 53 - Introduction to determinants
Lecture 54 - Determinants (Continued...)
Lecture 55 - Computational rules for determinants
Lecture 56 - Properties of determinants and adjoint of a matrix
Lecture 57 - Adjoint-determinant theorem
Lecture 58 - The determinant of a linear operator
Lecture 59 - Determinants and Volumes
Lecture 60 - Determinants and Volumes (Continued...)

NPTEL Video Course - Mathematics - NOC:An Introduction to Smooth Manifolds

Subject Co-ordinator - Prof. Harish Seshadri

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Basic linear algebra
Lecture 2 - Multivariable calculus - 1
Lecture 3 - Multivariable calculus - 2
Lecture 4 - The derivative map
Lecture 5 - Inverse Function Theorem
Lecture 6 - Constant Rank Theorem
Lecture 7 - Smooth functions with compact support
Lecture 8 - Smooth manifold
Lecture 9 - Examples of smooth manifolds
Lecture 10 - Higher dimensional spheres as smooth manifolds
Lecture 11 - Smooth maps
Lecture 12 - Examples of smooth maps
Lecture 13 - Tangent spaces - 1
Lecture 14 - Tangent spaces - 2
Lecture 15 - Derivatives of smooth maps
Lecture 16 - Chain rule on manifolds
Lecture 17 - Dimension of tangent space - 1
Lecture 18 - Dimension of tangent space - 2
Lecture 19 - Derivative of inclusion map
Lecture 20 - Basis of tangent space
Lecture 21 - Inverse Function Theorem for manifolds
Lecture 22 - Submanifolds
Lecture 23 - Tangent space of a submanifold
Lecture 24 - Regular Value Theorem
Lecture 25 - Special linear group as a submanifold of the set of all square matrices
Lecture 26 - Hypersurfaces
Lecture 27 - Tangent spaces to level sets
Lecture 28 - Vector fields - 1
Lecture 29 - Vector fields - 2

Lecture 30 - Vector fields - 3
Lecture 31 - Lie groups - 1
Lecture 32 - Lie groups - 2
Lecture 33 - Integral curve and flows - 1
Lecture 34 - Integral curve and flows - 2
Lecture 35 - Integral curve and flows - 3
Lecture 36 - Complete vector fields
Lecture 37 - Vector fields and smooth maps
Lecture 38 - Lie Brackets - 1
Lecture 39 - Lie brackets - 2
Lecture 40 - Lie brackets - 3
Lecture 41 - Lie algebras of matrix groups - 1
Lecture 42 - Lie algebras of matrix groups - 2
Lecture 43 - Exponential map
Lecture 44 - Frobenius theorems
Lecture 45 - Tensors and differential forms - 1
Lecture 46 - Tensors and differential forms - 2
Lecture 47 - Pull-back form
Lecture 48 - Symmetric Tensors
Lecture 49 - Alternating Tensors - 1
Lecture 50 - Alternating Tensors - 2
Lecture 51 - Alternating Tensors - 3
Lecture 52 - Alternating Tensors - 4
Lecture 53 - Alternating Tensors - 5
Lecture 54 - Alternating Tensors - 6
Lecture 55 - Alternating Tensors - 7
Lecture 56 - Alternating Tensors - 8
Lecture 57 - Alternating Tensors - 9
Lecture 58 - Differential forms on manifolds - 1
Lecture 59 - Differential forms on manifolds - 2
Lecture 60 - The Exterior derivative - 1
Lecture 61 - The Exterior derivative - 2
Lecture 62 - The Exterior derivative - 3
Lecture 63 - The Exterior derivative - 4
Lecture 64 - The Exterior derivative - 5
Lecture 65 - Special classes of forms
Lecture 66 - Orientation on manifolds - 1
Lecture 67 - Orientation on manifolds - 2
Lecture 68 - Orientation on manifolds - 3

NPTEL Video Course - Mathematics - NOC:Measure Theory (Prof. E. K. Narayanan)

Subject Co-ordinator - Prof. E. K. Narayanan

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Review of Riemann integration and introduction to sigma algebras
Lecture 2 - Sigma algebras and measurability
Lecture 3 - Measurable functions and approximation by simple functions
Lecture 4 - Properties of countably additive measures
Lecture 5 - Integration of positive measurable functions
Lecture 6 - Some properties of integrals of positive simple functions
Lecture 7 - Monotone convergence theorem and Fatou's lemma
Lecture 8 - Integration of complex valued measurable functions
Lecture 9 - Dominated convergence theorem
Lecture 10 - Sets of measure zero and completion
Lecture 11 - Consequences of MCT, Fatou's lemma and DCT
Lecture 12 - Rectangles in R^n and some properties
Lecture 13 - Outer measure on R^n
Lecture 14 - Properties of outer measure on R^n
Lecture 15 - Lebesgue measurable sets and Lebesgue measure on R^n
Lecture 16 - Lebesgue sigma algebra
Lecture 17 - Lebesgue measure
Lecture 18 - Fine properties of measurable sets
Lecture 19 - Invariance properties of Lebesgue measure
Lecture 20 - Non measurable set
Lecture 21 - Measurable functions
Lecture 22 - Riemann and Lebesgue integrals
Lecture 23 - Locally compact Hausdorff spaces
Lecture 24 - Riesz representation theorem
Lecture 25 - Positive Borel measures
Lecture 26 - Lebesgue measure via Riesz representation theorem
Lecture 27 - Construction of Lebesgue measure
Lecture 28 - Invariance properties of Lebesgue measure
Lecture 29 - Linear transformations and Lebesgue measure

Lecture 30 - Cantor set
Lecture 31 - Cantor function
Lecture 32 - Lebesgue set which is not Borel
Lecture 33 - L^p spaces
Lecture 34 - L^p norm
Lecture 35 - Completeness of L^p
Lecture 36 - Properties of L^p spaces
Lecture 37 - Examples of L^p spaces
Lecture 38 - Product sigma algebra
Lecture 39 - Product measures - I
Lecture 40 - Product measures - II
Lecture 41 - Fubini's theorem - I
Lecture 42 - Fubini's theorem - II
Lecture 43 - Completeness of product measures
Lecture 44 - Polar coordinates
Lecture 45 - Applications of Fubini's theorem
Lecture 46 - Complex measures - I
Lecture 47 - Complex measures - II
Lecture 48 - Absolutely continuous measures
Lecture 49 - L^2 space
Lecture 50 - Continuous linear functionals
Lecture 51 - Radon-Nikodym theorem - I
Lecture 52 - Radon Nikodym theorem - II
Lecture 53 - Consequences of Radon-Nikodym theorem - I
Lecture 54 - Consequences of Radon-Nikodym theorem - II
Lecture 55 - Continuous linear functionals on L^p spaces - I
Lecture 56 - Continuous linear functionals on L^p spaces - II
Lecture 57 - Riesz representation theorem - I
Lecture 58 - Riesz representation theorem - II
Lecture 59 - Hardy-Littlewood maximal function
Lecture 60 - Lebesgue differentiation theorem
Lecture 61 - Absolutely continuous functions - I
Lecture 62 - Absolutely continuous functions - II

NPTEL Video Course - Mathematics - NOC:Introduction to Algebraic Geometry and Commutative Algebra

Subject Co-ordinator - Prof. Dilip P. Patil

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Motivation for K-algebraic sets
Lecture 2 - Definitions and examples of Affine Algebraic Set
Lecture 3 - Rings and Ideals
Lecture 4 - Operation on Ideals
Lecture 5 - Prime Ideals and Maximal Ideals
Lecture 6 - Krull's Theorem and consequences
Lecture 7 - Module, submodules and quotient modules
Lecture 8 - Algebras and polynomial algebras
Lecture 9 - Universal property of polynomial algebra and examples
Lecture 10 - Finite and Finite type algebras
Lecture 11 - K-Spectrum (K-rational points)
Lecture 12 - Identity theorem for Polynomial functions
Lecture 13 - Basic properties of K-algebraic sets
Lecture 14 - Examples of K-algebraic sets
Lecture 15 - K-Zariski Topology
Lecture 16 - The map V L
Lecture 17 - Noetherian and Artinian Ordered sets
Lecture 18 - Noetherian induction and Transfinite induction
Lecture 19 - Modules with Chain Conditions
Lecture 20 - Properties of Noetherian and Artinian Modules
Lecture 21 - Examples of Artinian and Noetherian Modules
Lecture 22 - Finite modules over Noetherian Rings
Lecture 23 - Hilbertâ s Basis Theorem (HBT)
Lecture 24 - Consequences of HBT
Lecture 25 - Free Modules and rank
Lecture 26 - More on Noetherian and Artinian modules
Lecture 27 - Ring of Fractions (Localization)
Lecture 28 - Nil radical, contraction of ideals
Lecture 29 - Universal property of S -1 A

Lecture 30 - Ideal structure in S -1 A
Lecture 31 - Consequences of the Correspondence of Ideals
Lecture 32 - Consequences of the Correspondence of Ideals (Continued...)
Lecture 33 - Modules of Fraction and universal properties
Lecture 34 - Exactness of the functor S -1
Lecture 35 - Universal property of Modules of Fractions
Lecture 36 - Further properties of Modules and Module of Fractions
Lecture 37 - Local-Global Principle
Lecture 38 - Consequences of Local-Global Principle
Lecture 39 - Properties of Artinian Rings
Lecture 40 - Krull-Nakayama Lemma
Lecture 41 - Properties of I K and V L maps
Lecture 42 - Hilbertâ s Nullstelensatz
Lecture 43 - Hilbertâ s Nullstelensatz (Continued...)
Lecture 44 - Proof of Zariskiâ s Lemma (HNS 3)
Lecture 45 - Consequences of HNS
Lecture 46 - Consequences of HNS (Continued...)
Lecture 47 - Jacobson Ring and examples
Lecture 48 - Irreducible subsets of Zariski Topology (Finite type K-algebra)
Lecture 49 - Spec functor on Finite type K-algebras
Lecture 50 - Properties of Irreducible topological spaces
Lecture 51 - Zariski Topology on arbitrary commutative rings
Lecture 52 - Spec functor on arbitrary commutative rings
Lecture 53 - Topological properties of Spec A
Lecture 54 - Example to support the term Spectrum
Lecture 55 - Integral Extensions
Lecture 56 - Elementwise characterization of Integral extensions
Lecture 57 - Properties and examples of Integral extensions
Lecture 58 - Prime and Maximal ideals in integral extensions
Lecture 59 - Lying over Theorem
Lecture 60 - Cohen-Siedelberg Theorem

NPTEL Video Course - Mathematics - NOC:First Course on Partial Differential Equations-I

Subject Co-ordinator - Prof. P. S. Datti, Prof. A. K. Nandakumaran

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction - 1
Lecture 2 - Introduction - 2
Lecture 3 - Priliminaries - 1
Lecture 4 - Priliminaries - 2
Lecture 5 - Priliminaries - 3
Lecture 6 - Priliminaries - 4
Lecture 7 - First order equations in two variables - 1
Lecture 8 - First order equations in two variables - 2
Lecture 9 - First order equations in two variables - 3
Lecture 10 - First order equations in two variables - 4
Lecture 11 - First order equations in two variables - 5
Lecture 12 - First order equations in more than two variables - 6
Lecture 13 - First order equations in more than two variables - 7
Lecture 14 - First order equations in more than two variables - 8
Lecture 15 - Classification - 1
Lecture 16 - Classification - 2
Lecture 17 - Classification - 3
Lecture 18 - Laplace and Poisson equations - 1
Lecture 19 - Laplace and Poisson equations - 2
Lecture 20 - Laplace and Poisson equations - 3
Lecture 21 - Laplace and Poisson equations - 4
Lecture 22 - Laplace and Poisson equations - 5
Lecture 23 - Laplace and Poisson equations - 6
Lecture 24 - Laplace and Poisson equations - 7
Lecture 25 - Laplace and Poisson equations - 8
Lecture 26 - Laplace and Poisson equations - 9
Lecture 27 - Laplace and Poisson equations - 10
Lecture 28 - One dimensional heat equation - 1
Lecture 29 - One dimensional heat equation - 2

Lecture 30 - One dimensional heat equation - 3
Lecture 31 - One dimensional heat equation - 4
Lecture 32 - One dimensional heat equation - 5
Lecture 33 - One dimensional heat equation - 6
Lecture 34 - One dimensional wave equation - 1
Lecture 35 - One dimensional wave equation - 2
Lecture 36 - One dimensional wave equation - 3
Lecture 37 - One dimensional wave equation - 4
Lecture 38 - One dimensional wave equation - 5
Lecture 39 - One dimensional wave equation - 6
Lecture 40 - One dimensional wave equation - 7
Lecture 41 - One dimensional wave equation - 8

NPTEL Video Course - Mathematics - NOC:First Course on Partial Differential Equations - II

Subject Co-ordinator - Prof. A. K. Nandakumaran

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction
Lecture 2 - HJE 1
Lecture 3 - HJE 2
Lecture 4 - HJE 3
Lecture 5 - HJE 4
Lecture 6 - HJE 5
Lecture 7 - HJE 6
Lecture 8 - CL1
Lecture 9 - CL2
Lecture 10 - CL3
Lecture 11 - CL4
Lecture 12 - CL5
Lecture 13 - CL6
Lecture 14 - Perron Method - 1
Lecture 15 - Perron Method - 2
Lecture 16 - Perron Method - 3
Lecture 17 - Perron Method - 4
Lecture 18 - Newtonian Potential - 1
Lecture 19 - Newtonian Potential - 2
Lecture 20 - Newtonian Potential - 3
Lecture 21 - Newtonian Potential - 4
Lecture 22 - Newtonian Potential - 5
Lecture 23 - Eigen Value Problem - 1
Lecture 24 - Eigen Value Problem - 2
Lecture 25 - Heat Equation - 1
Lecture 26 - Heat Equation - 2
Lecture 27 - Heat Equation - 3
Lecture 28 - Heat Equation - 4
Lecture 29 - Heat Equation - 5

Lecture 30 - Wave Equation - 1
Lecture 31 - Wave Equation - 2
Lecture 32 - Wave Equation - 3
Lecture 33 - Wave Equation - 4
Lecture 34 - Wave Equation - 5
Lecture 35 - Wave Equation - 6
Lecture 36 - Wave Equation - 7
Lecture 37 - Weak Solutions - 1
Lecture 38 - Weak Solutions - 2
Lecture 39 - Weak Solutions - 3
Lecture 40 - Weak Solutions - 4
Lecture 41 - Weak Solutions - 5

NPTEL Video Course - Mathematics - Matrix Theory

Subject Co-ordinator - Prof. Chandra Murthy

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Course introduction and properties of matrices
Lecture 2 - Vector spaces
Lecture 3 - Basis, dimension
Lecture 4 - Linear transforms
Lecture 5 - Fundamental subspaces of a matrix
Lecture 6 - Fundamental theorem of linear algebra
Lecture 7 - Properties of rank
Lecture 8 - Inner product
Lecture 9 - Gram-schmidt algorithm
Lecture 10 - Orthonormal matrices definition
Lecture 11 - Determinant
Lecture 12 - Properties of determinants
Lecture 13 - Introduction to norms and inner products
Lecture 14 - Vector norms and their properties
Lecture 15 - Applications and equivalence of vector norms
Lecture 16 - Summary of equivalence of norms
Lecture 17 - Dual norms
Lecture 18 - Properties and examples of dual norms
Lecture 19 - Matrix norms
Lecture 20 - Matrix norms: Properties
Lecture 21 - Induced norms
Lecture 22 - Induced norms and examples
Lecture 23 - Spectral radius
Lecture 24 - Properties of spectral radius
Lecture 25 - Convergent matrices, Banach lemma
Lecture 26 - Recap of matrix norms and Levy-Desplanques theorem
Lecture 27 - Equivalence of matrix norms and error in inverses of linear systems
Lecture 28 - Errors in inverses of matrices
Lecture 29 - Errors in solving systems of linear equations

Lecture 30 - Introduction to eigenvalues and eigenvectors
Lecture 31 - The characteristic polynomial
Lecture 32 - Solving characteristic polynomials, eigenvectors properties
Lecture 33 - Similarity
Lecture 34 - Diagonalization
Lecture 35 - Relationship between eigenvalues of BA and AB
Lecture 36 - Eigenvector and principle of biorthogonality
Lecture 37 - Unitary matrices
Lecture 38 - Properties of unitary matrices
Lecture 39 - Unitary equivalence
Lecture 40 - Schur's triangularization theorem
Lecture 41 - Cayley-Hamilton theorem
Lecture 42 - Uses of cayley-hamilton theorem and diagonalizability revisited
Lecture 43 - Normal matrices: Definition and fundamental properties
Lecture 44 - Fundamental properties of normal matrices
Lecture 45 - QR decomposition and canonical forms
Lecture 46 - Jordan canonical form
Lecture 47 - Determining the Jordan form of a matrix
Lecture 48 - Properties of the Jordan canonical form - Part 1
Lecture 49 - Properties of the Jordan canonical form - Part 2
Lecture 50 - Properties of convergent matrices
Lecture 51 - Polynomials and matrices
Lecture 52 - Other canonical forms and factorization of matrices: Gaussian elimination and LU factorization
Lecture 53 - LU decomposition
Lecture 54 - LU decomposition with pivoting
Lecture 55 - Solving pivoted system and LDM decomposition
Lecture 56 - Cholesky decomposition and uses
Lecture 57 - Hermitian and symmetric matrix
Lecture 58 - Properties of hermitian matrices
Lecture 59 - Variational characterization of Eigenvalues: Rayleigh-Ritz theorem
Lecture 60 - Variational characterization of eigenvalues (Continued...)
Lecture 61 - Courant-Fischer theorem
Lecture 62 - Summary of Rayliegh-Ritz and Courant-Fischer theorems
Lecture 63 - Weyl's theorem
Lecture 64 - Positive semi-definite matrix, monotonicity theorem and interlacing theorems
Lecture 65 - Interlacing theorem - I
Lecture 66 - Interlacing theorem - II (Converse)
Lecture 67 - Interlacing theorem (Continued...)
Lecture 68 - Eigenvalues: Majorization theorem and proof

Lecture 69 - Location and perturbation of Eigenvalues - Part 1: Dominant diagonal theorem
Lecture 70 - Location and perturbation of Eigenvalues - Part 2: Gersgorin's theorem
Lecture 71 - Implications of Gersgorin disc theorem, condition of eigenvalues
Lecture 72 - Condition of eigenvalues for diagonalizable matrices
Lecture 73 - Perturbation of eigenvalues Birkhoff's theorem Hoffman-Weiland ttheorem
Lecture 74 - Singular value definition and some remarks
Lecture 75 - Proof of singular value decomposition theorem
Lecture 76 - Partitioning the SVD
Lecture 77 - Properties of SVD
Lecture 78 - Generalized inverse of matrices
Lecture 79 - Least squares
Lecture 80 - Constrained least squares

NPTEL Video Course - Mathematics - NOC:C* Algebras and Spectral Theorem

Subject Co-ordinator - Prof. E K Narayanan

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Finite dimensional Spectral theorem
Lecture 2 - Compact operators
Lecture 3 - Spectral theorem for Compact self-adjoint operators
Lecture 4 - Spectral theorem for Compact Normal operators
Lecture 5 - Banach algebras
Lecture 6 - Gelfand-Mazur theorem
Lecture 7 - Spectral radius
Lecture 8 - Multiplicative functionals
Lecture 9 - Gelfand transform - I
Lecture 10 - Gelfand transform - II
Lecture 11 - C* algebras
Lecture 12 - Examples and Wienerâ s theorem
Lecture 13 - Gelfand-Naimark theorem
Lecture 14 - Non-unital Banach algebras
Lecture 15 - Non-unital C* algebra
Lecture 16 - Gelfand transform of non-unital C*algebras
Lecture 17 - Gelfand-Naimark theorem for non-unital C* algebras
Lecture 18 - Continuous functional calculus
Lecture 19 - Bounded functional calculus - I
Lecture 20 - Bounded functional calculus - II
Lecture 21 - Projection valued measures
Lecture 22 - Bounded functional calculus with respect to a projection valued measure
Lecture 23 - Spectral Theorem - I
Lecture 24 - Spectral theorem - II
Lecture 25 - Some applications
Lecture 26 - Spectral theorem for a bounded normal operator
Lecture 27 - Resolution of identity - I
Lecture 28 - Resolution of identity - II
Lecture 29 - Resolution of identity - III

Lecture 30 - Resolution of identity - IV
Lecture 31 - Equivalence of various forms of spectral theorems - I
Lecture 32 - Equivalence of various forms of spectral theorems - II
Lecture 33 - Spectrum of a self-adjoint operator - I
Lecture 34 - Spectrum of a self-adjoint operator - II
Lecture 35 - Commuting family of self-adjoint operators
Lecture 36 - Continuous functional calculus for commuting family of self-adjoint operators - I
Lecture 37 - Continuous functional calculus for commuting family of self-adjoint operators - II
Lecture 38 - Fugledeâ s theorem
Lecture 39 - Spectral theorem for commuting finite family of normal operators
Lecture 40 - Multiplicity theory

NPTEL Video Course - Mathematics - NOC:Advanced Partial Differential Equations (Part I: Distributions and Sob

Subject Co-ordinator - Prof. P.S. Datti, Prof. A K Nandakumaran

Co-ordinating Institute - IISc - Bangalore

Sub-Titles - Available / Unavailable | MP3 Audio Lectures - Available / Unavailable

Lecture 1 - Introduction - 1
Lecture 2 - Preliminaries - 1
Lecture 3 - Preliminaries - 2
Lecture 4 - Priliminaries - 3
Lecture 5 - Priliminaries - 4
Lecture 6 - Preliminaries - 5
Lecture 7 - Prelimunaries - 6
Lecture 8 - Preliminaries - 7
Lecture 9 - Preliminaries - 8
Lecture 10 - Preliminaries - 9
Lecture 11 - Introduction to Distributions
Lecture 12 - Properties and Examples
Lecture 13 - Convergence of distributions
Lecture 14 - Convergence of distributions
Lecture 15 - Calculus in the space of distributions
Lecture 16 - Further discussion on Distributions
Lecture 17 - Order and support of a distribution
Lecture 18 - Laplace and Poisson equations - Distributions with compact support
Lecture 19 - Validity of the definition of the support
Lecture 20 - Convolution and Fourier transform of distributions
Lecture 21 - The Schwartz space andAKN Lec 15 its dual
Lecture 22 - Fourier transform of a tempered distribution, convolution
Lecture 23 - Properties of Convolution
Lecture 24 - Further discussion on Fourier transform and convolution
Lecture 25 - Convolution of two distributions
Lecture 26 - Convolution of distributions
Lecture 27 - Introduction to Sobolev spaces
Lecture 28 - Properties of Sobloev Spaces
Lecture 29 - Extension and Density results

Lecture 30 - General Extension result
Lecture 31 - Integration on a smooth surface
Lecture 32 - A more general extension result
Lecture 33 - Notion of the trace
Lecture 34 - A compactness theorem
Lecture 35 - Equivalent norms
Lecture 36 - Sobolev lemma
Lecture 37 - Sobolev lemma (Continued...)
Lecture 38 - Analysis near the boundary
Lecture 39 - Trace in the upper half space
Lecture 40 - Trace in the upper half space
Lecture 41 - Supplementary lecture
Lecture 42 - Supplementary lecture