NPTEL : Elementary Numerical Analysis (Mathematics)

Co-ordinators : Prof. Rekha P. Kulkarni

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: Basic Rules

Lecture 11 - Composite Numerical Integration

Lecture 12 - Gauss 2-point Rule: Construction

Lecture 13 - Gauss 2-point Rule: Error

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 : Measure and Integration (Mathematics)

Co-ordinators : Prof. Inder K Rana

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 : Mathematics in India - From Vedic Period to Modern Times (Mathematics)

Co-ordinators : Prof. M.D. Srinivas, Prof. K. Ramasubramanian, Prof. M.S. Sriram

Lecture 1 - Indian Mathematics: An Overview

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: Computation of Rsines

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 : NOC:Measure Theory (Mathematics)

Co-ordinators : Prof. Inder K Rana

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 : NOC:Calculus for Economics, Commerce and Management (Mathematics)

Co-ordinators : Prof.Inder Kumar Rana

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 Conditions

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 : NOC:Basic Linear Algebra (Mathematics)

Co-ordinators : Prof.Inder Kumar Rana

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 : NOC:Commutative Algebra (Mathematics)

Co-ordinators : Prof. Dilip P. Patil

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 Extension

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 PoincarÃƒÂ© Series

Lecture 22 - Graded Rings, Modules and PoincarÃƒÂ© 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 : NOC:Galois Theory (Mathematics)

Co-ordinators : Prof. Dilip P. Patil

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 : NOC:Basic Real Analysis (Mathematics)

Co-ordinators : Prof. I. K. Rana

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: Closed Sets - Part I

Lecture 11 - Topology of Real Numbers: Closed Sets - Part II

Lecture 12 - Topology of Real Numbers: Closed Sets - Part III

Lecture 13 - Topology of Real Numbers: Limit Points, Interior Points, Open Sets and Compact Sets - Part I

Lecture 14 - Topology of Real Numbers: Limit Points, Interior Points, Open Sets and Compact Sets - Part II

Lecture 15 - Topology of Real Numbers: Limit Points, Interior Points, Open Sets and Compact Sets - Part III

Lecture 16 - Topology of Real Numbers: Compact Sets and Connected Sets - Part I

Lecture 17 - Topology of Real Numbers: Compact Sets and Connected Sets - Part II

Lecture 18 - Topology of Real Numbers: Compact Sets and Connected Sets - Part III

Lecture 19 - Topology of Real Numbers: Connected Sets; Limits and Continuity - Part I

Lecture 20 - Topology of Real Numbers: Connected Sets; Limits and Continuity - Part II

Lecture 21 - Topology of Real Numbers: Connected Sets; Limits and Continuity - Part III

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 : NOC:A Basic Course in Number Theory (Mathematics)

Co-ordinators : Prof. Shripad Garge

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 ðœ‘-function - I

Lecture 24 - Euler ðœ‘-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: the imaginary case

Lecture 61 - Units in quadratic fields: the real case

Lecture 62 - Brahmagupta-Pell equations

Lecture 63 - Tying some loose ends

NPTEL : NOC:Introduction to Algebraic Topology - Part I (Mathematics)

Co-ordinators : Prof. Anant R. Shastri

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 : NOC:Introduction to Algebraic Topology - Part II (Mathematics)

Co-ordinators : Prof. Anant R. Shastri

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 : NOC:Partial Differential Equations (Mathematics)

Co-ordinators : Prof. Sivaji Ganesh

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 : NOC:An Introduction to Point-Set-Topology - Part I (Mathematics)

Co-ordinators : Prof. Anant R Shastri

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 : NOC:An Introduction to Point-Set-Topology - Part II (Mathematics)

Co-ordinators : Prof. Anant R Shastri

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 : NOC:Fourier Analysis and its Applications (Mathematics)

Co-ordinators : Prof. G. K Srinivasan

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 : NOC:Numerical Analysis (2023) (Mathematics)

Co-ordinators : Prof. S. Baskar

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 : NOC:Point Set Topology (Mathematics)

Co-ordinators : Prof. Ronnie Sebastian

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 : Stochastic Processes (Mathematics)

Co-ordinators : Dr. S. Dharmaraja

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 : NOC:Stochastic Processes - 1 (Mathematics)

Co-ordinators : Dr. S. Dharmaraja

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 Distribution, Exponential Distribution, Normal Distribution and Poisson Distribution

Lecture 5 - Joint Distribution of Random Variables

Lecture 6 - Independent Random Variables, Covariance and Correlation Coefficient and Conditional Distribution

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...)

Lecture 15 - Problems in Sequences of Random Variables (Continued...)

Lecture 16 - Problems in Sequences of Random Variables (Continued...)

Lecture 17 - Definition of Stochastic Processes, Parameter and State Spaces

Lecture 18 - Classification of Stochastic Processes

Lecture 19 - Examples of Classification of Stochastic Processes

Lecture 20 - Examples of Classification of Stochastic Processes (Continued...)

Lecture 21 - Bernoulli Process

Lecture 22 - Poisson Process

Lecture 23 - Poisson Process (Continued...)

Lecture 24 - Simple Random Walk and Population Processes

Lecture 25 - Introduction to Discrete time Markov Chain

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

Lecture 30 - State Transition Diagram and Examples

Lecture 31 - Examples

Lecture 32 - Introduction to Classification of States and Periodicity

Lecture 33 - Closed set of States and Irreducible Markov Chain

Lecture 34 - First Passage time and Mean Recurrence Time

Lecture 35 - Recurrent State and Transient State

Lecture 36 - Introduction and example of Classification of states

Lecture 37 - Example of Classification of states (Continued...)

Lecture 38 - Example of Classification of states (Continued...)

Lecture 39 - Example of Classification of states (Continued...)

Lecture 40 - Introduction and Limiting Distribution

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 : NOC:Stochastic Processes (Mathematics)

Co-ordinators : Dr. S. Dharmaraja

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 Distribution, Exponential Distribution, Normal Distribution and Poisson Distribution

Lecture 5 - Joint Distribution of Random Variables

Lecture 6 - Independent Random Variables, Covariance and Correlation Coefficient and Conditional Distribution

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...)

Lecture 15 - Problems in Sequences of Random Variables (Continued...)

Lecture 16 - Problems in Sequences of Random Variables (Continued...)

Lecture 17 - Definition of Stochastic Processes, Parameter and State Spaces

Lecture 18 - Classification of Stochastic Processes

Lecture 19 - Examples of Discrete Time Markov Chain

Lecture 20 - Examples of Discrete Time Markov Chain (Continued...)

Lecture 21 - Bernoulli Process

Lecture 22 - Poisson Process

Lecture 23 - Poisson Process (Continued...)

Lecture 24 - Simple Random Walk and Population Processes

Lecture 25 - Introduction to Discrete time Markov Chain

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...)

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Lecture 31 - Examples

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Lecture 37 - Example of Classification of states (Continued...)

Lecture 38 - Example of Classification of states (Continued...)

Lecture 39 - Example of Classification of states (Continued...)

Lecture 40 - Introduction and Limiting Distribution

Lecture 41 - Example of Limiting Distribution and Ergodicity

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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

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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

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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

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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

Lecture 88 - Definition of Brownian Motion (Continued...)

Lecture 89 - Properties of Brownian Motion

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

Lecture 94 - Stochastic Differential Equations (Continued...)

Lecture 95 - Stochastic Differential Equations (Continued...)

Lecture 96 - Ito Integrals

Lecture 97 - Ito Integrals (Continued...)

Lecture 98 - Ito Integrals (Continued...)

Lecture 99 - Renewal Function and Renewal Equation

Lecture 100 - Renewal Function and Renewal Equation (Continued...)

Lecture 101 - Renewal Function and Renewal Equation (Continued...)

Lecture 102 - Generalized Renewal Processes and Renewal Limit Theorems

Lecture 103 - Generalized Renewal Processes and Renewal Limit Theorems (Continued...)

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 : NOC:Chaotic Dynamical Systems (Mathematics)

Co-ordinators : Dr. Anima Nagar

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 : NOC:Introduction to Probability Theory and Stochastic Processes (Mathematics)

Co-ordinators : Dr. S. Dharmaraja

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...)

Lecture 47 - Motivation for Stochastic Processes

Lecture 48 - Definition of a Stochastic Process

Lecture 49 - Classification of Stochastic Processes

Lecture 50 - Examples of Stochastic Process

Lecture 51 - Examples Of Stochastic Process (Continued...)

Lecture 52 - Bernoulli Process

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 : NOC:Statistical Inference (Mathematics)

Co-ordinators : Prof. Nilladri Chaterjee

Lecture 1 - Statistical Inference - 1

Lecture 2 - Statistical Inference - 2

Lecture 3 - Statistical Inference - 3

Lecture 4 - Statistical Inference - 4

Lecture 5 - Statistical Inference - 5

Lecture 6 - Statistical Inference - 6

Lecture 7 - Statistical Inference - 7

Lecture 8 - Statistical Inference - 8

Lecture 9 - Statistical Inference - 9

Lecture 10 - Statistical Inference - 10

Lecture 11 - Statistical Inference - 11

Lecture 12 - Statistical Inference - 12

Lecture 13 - Statistical Inference - 13

Lecture 14 - Statistical Inference - 14

Lecture 15 - Statistical Inference - 15

Lecture 16 - Stasistical Inference - 16

Lecture 17 - Stasistical Inference - 17

Lecture 18 - Statistical Inference - 18

Lecture 19 - Stasistical Inference - 19

Lecture 20 - Stasistical Inference - 20

Lecture 21 - Stasistical Inference - 21

NPTEL : NOC:Integral Transforms and their Applications (Mathematics)

Co-ordinators : Prof. Sarthok Sircar

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

Lecture 25 - Introduction to Hankel Transforms - Part 1

Lecture 26 - Introduction to Hankel Transforms - Part 2

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

Lecture 32 - Introduction to Hilbert Transforms - Part 2

Lecture 33 - Introduction to Hilbert Transforms - Part 3

Lecture 34 - Applications of Hilbert Transfroms, Introduction to Stieltjes Transform - Part 1

Lecture 35 - Applications of Hilbert Transfroms, Introduction to Stieltjes Transform - Part 2

Lecture 36 - Applications of Hilbert Transfroms, Introduction to Stieltjes Transform - Part 3

Lecture 37 - Applications of Stieltjes Transform, Generalized Stieltjes Transform - Part 1

Lecture 38 - Applications of Stieltjes Transform, Generalized Stieltjes Transform - Part 2

Lecture 39 - Applications of Stieltjes Transform, Generalized Stieltjes Transform - Part 3

Lecture 40 - Introduction to Legendre Transform - Part 1

Lecture 41 - Introduction to Legendre Transform - Part 2

Lecture 42 - Introduction to Legendre Transform - Part 3

Lecture 43 - Introduction to Z-transform - Part 1

Lecture 44 - Introduction to Z-transform - Part 2

Lecture 45 - Introduction to Z-transform - Part 3

Lecture 46 - Inverse Z-transfrom, Applciations of Z-Transform - Part 1

Lecture 47 - Inverse Z-transfrom, Applciations of Z-Transform - Part 2

Lecture 48 - Inverse Z-transfrom, Applciations of Z-Transform - Part 3

Lecture 49 - Introduction to Radon Transform - Part 1

Lecture 50 - Introduction to Radon Transform - Part 2

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

Lecture 62 - Fractional PDEs - Part 2

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 : NOC:Introduction to Fuzzy Set Theory, Arithmetic and Logic (Mathematics)

Co-ordinators : Prof. Nilladri Chaterjee

Lecture 1 - Fuzzy Sets Arithmetic and Logic - 1

Lecture 2 - Fuzzy Sets Arithmetic and Logic - 2

Lecture 3 - Fuzzy Sets Arithmetic and Logic - 3

Lecture 4 - Fuzzy Sets Arithmetic and Logic - 4

Lecture 5 - Fuzzy Sets Arithmetic and Logic - 5

Lecture 6 - Fuzzy Sets Arithmetic and Logic - 6

Lecture 7 - Fuzzy Sets Arithmetic and Logic - 7

Lecture 8 - Fuzzy Sets Arithmetic and Logic - 8

Lecture 9 - Fuzzy Sets Arithmetic and Logic - 9

Lecture 10 - Fuzzy Sets Arithmetic and Logic - 10

Lecture 11 - Fuzzy Sets Arithmetic and Logic - 11

Lecture 12 - Fuzzy Sets Arithmetic and Logic - 12

Lecture 13 - Fuzzy Sets Arithmetic and Logic - 13

Lecture 14 - Fuzzy Sets Arithmetic and Logic - 14

Lecture 15 - Fuzzy Sets Arithmetic and Logic - 15

Lecture 16 - Fuzzy Sets Arithmetic and Logic - 16

Lecture 17 - Fuzzy Sets Arithmetic and Logic - 17

Lecture 18 - Fuzzy Sets Arithmetic and Logic - 18

Lecture 19 - Fuzzy Sets Arithmetic and Logic - 19

Lecture 20 - Fuzzy Sets Arithmetic and Logic - 20

Lecture 21 - Fuzzy Sets Arithmetic and Logic - 21

Lecture 22 - Fuzzy Sets Arithmetic and Logic - 22

Lecture 23 - Fuzzy Sets Arithmetic and Logic - 23

Lecture 24 - Fuzzy Sets Arithmetic and Logic - 24

Lecture 25 - Fuzzy Sets Arithmetic and Logic - 25

Lecture 26 - Fuzzy Sets Arithmetic and Logic - 26

Lecture 27 - Fuzzy Sets Arithmetic and Logic - 27

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 : NOC:Introduction to Methods of Applied Mathematics (Mathematics)

Co-ordinators : Prof. Vivek Kumar Aggarwal

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 : NOC:Advanced Probability Theory (Mathematics)

Co-ordinators : Prof. Niladri Chatterjee

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

Lecture 15 - Advanced Probability Theory

Lecture 16 - Advanced Probability Theory

Lecture 17 - Advanced Probability Theory

Lecture 18 - Advanced Probability Theory

Lecture 19 - Advanced Probability Theory

Lecture 20 - Advanced Probability Theory

Lecture 21 - Advanced Probability Theory

Lecture 22 - Advanced Probability Theory

Lecture 23 - Advanced Probability Theory

Lecture 24 - Advanced Probability Theory

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 : NOC:Scientific Computing using Matlab (Mathematics)

Co-ordinators : Prof. Vivek Kumar Aggarwal, Prof. Mani Mehra

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 value Problem

NPTEL : NOC:Non-parametric Statistical Inference (Mathematics)

Co-ordinators : Prof. Niladri Chatterjee

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

NPTEL : NOC:Matrix Computation and its applications (Mathematics)

Co-ordinators : Prof. Vivek K. Aggarwal

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 equal to 3

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 : NOC:Introduction to Probability Theory and Statistics (Mathematics)

Co-ordinators : Prof. S Dharmaraja

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 : NOC:Introduction to Probability Theory and Stochastic Processes (Tamil) (Mathematics)

Co-ordinators : Prof. S Dharmaraja

Lecture 1 - Random Experiment, Sample Space and Sigma Field

Lecture 2 - Axiomatic Definition of Probability

Lecture 3 - Properties of Axiomatic Definition of Probability and Classical Definition of Probability

Lecture 4 - Conditional Probability, Independent Events and Baye's Rule

Lecture 5 - Definition of Random Variable

Lecture 6 - Cumulative Distribution Function

Lecture 7 - Discrete and Continuous Type Random Variables

Lecture 8 - Mixed Type Random Variable

Lecture 9 - Function of a Random Variable

Lecture 10 - Mean

Lecture 11 - Variance and Higher Order Moments

Lecture 12 - Inequalities of Markov and Chebyshev

Lecture 13 - Generating Functions

Lecture 14 - Standard Discrete Distributions

Lecture 15 - Standard Discrete Distributions (Continued...)

Lecture 16 - Standard Continuous Distributions

Lecture 17 - Standard Continuous Distributions (Continued...)

Lecture 18 - Definition and Joint Distribution of a Random Vector

Lecture 19 - Joint Probability Mass Function

Lecture 20 - Joint Probability Density Function

Lecture 21 - Independent Random Vector

Lecture 22 - Distribution of Functions of Random Variables (Discrete Type)

Lecture 23 - Distribution of Functions of Random Variables (Continuous Type)

Lecture 24 - Conditional Distribution of Random Variables (Discrete Type)

Lecture 25 - Conditional Distribution of Random Variables (Continuous Type)

Lecture 26 - Expectation for Several Random Variables

Lecture 27 - Covariance and Correlation Coefficient

Lecture 28 - Generating Functions for Several Random Variables

Lecture 29 - Conditional Expectation

Lecture 30 - Modes of Convergence

Lecture 31 - Modes of Convergence (Continued...)

Lecture 32 - Law of Large Numbers

Lecture 33 - Central Limit Theorem

Lecture 34 - Definition and Classification of Stochastic Processes

Lecture 35 - Properties of Stochastic Processes

Lecture 36 - Properties of Stochastic Processes (Continued...)

Lecture 37 - Standard Simple Stochastic Processes

Lecture 38 - Definition of Discrete Time Markov Chain (DTMC)

Lecture 39 - Chapman-Kolmogorov Equation

Lecture 40 - Classification of States

Lecture 41 - Classification of States (Continued...)

Lecture 42 - Limiting Distribution

Lecture 43 - Stationary Distribution

Lecture 44 - Reducible Markov Chains

Lecture 45 - Definition of Continuous Time Markov Chain (CTMC)

Lecture 46 - Infinitesimal Generator Matrix

Lecture 47 - Kolmogorov Differential Equations

Lecture 48 - Limiting Distribution and Steady-State Distribution

Lecture 49 - Birth Death Processes

Lecture 50 - Introduction to Queueing Models and Kendall Notation

Lecture 51 - Single-Server Queueing Models

Lecture 52 - Single-Server Queueing Models (Continued...)

Lecture 53 - Multi-Server Queueing Models

NPTEL : Formal Languages and Automata Theory (Mathematics)

Co-ordinators : Dr. K.V. Krishna, Dr. Diganta Goswami

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 : Complex Analysis (Mathematics)

Co-ordinators : Prof. P.A.S. Sree Krishna

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 : NOC:Mathematical Finance (Mathematics)

Co-ordinators : Prof. Siddhartha Pratim Chakrabarty

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 : NOC:Mathematical Portfolio Theory (Mathematics)

Co-ordinators : Prof. Siddhartha Pratim Chakrabarty

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: Estimation and backtesting

NPTEL : NOC:Discrete-time Markov Chains and Poission Processes (Mathematics)

Co-ordinators : Prof. Ayon Ganguly, Prof. Subhamay Saha

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 : NOC:Introduction to Queueing Theory (Mathematics)

Co-ordinators : Prof. N. Selvaraju

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/âˆž 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 : Applied Multivariate Analysis (Mathematics)

Co-ordinators : Dr. Sharmishtha Mitra

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 : Calculus of Variations and Integral Equations (Mathematics)

Co-ordinators : Dr. Malay Banerjee, Prof. D. Bahuguna

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

Lecture 17 - Calculus of Variations and Integral Equations

Lecture 18 - Calculus of Variations and Integral Equations

Lecture 19 - Calculus of Variations and Integral Equations

Lecture 20 - Calculus of Variations and Integral Equations

Lecture 21 - Calculus of Variations and Integral Equations

Lecture 22 - Calculus of Variations and Integral Equations

Lecture 23 - Calculus of Variations and Integral Equations

Lecture 24 - Calculus of Variations and Integral Equations

Lecture 25 - Calculus of Variations and Integral Equations

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 : Linear programming and Extensions (Mathematics)

Co-ordinators : Prof. Prabha Sharma

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-changes in the cost vector

Lecture 20 - Assignment 4, postoptimality analysis, changes in b, adding a new constraint, changes in {aij} , Parametric analysis

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 solution

Lecture 31 - Assignment 6, Shortest path problem, Shortest Path between any two nodes,Detection of negative cycles

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 : Convex Optimization (Mathematics)

Co-ordinators : Dr. Joydeep Dutta

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

Lecture 12 - Convex Optimization

Lecture 13 - Convex Optimization

Lecture 14 - Convex Optimization

Lecture 15 - Convex Optimization

Lecture 16 - Convex Optimization

Lecture 17 - Convex Optimization

Lecture 18 - Convex Optimization

Lecture 19 - Convex Optimization

Lecture 20 - Convex Optimization

Lecture 21 - Convex Optimization

Lecture 22 - Convex Optimization

Lecture 23 - Convex Optimization

Lecture 24 - Convex Optimization

Lecture 25 - Convex Optimization

Lecture 26 - Convex Optimization

Lecture 27 - Convex Optimization

Lecture 28 - Convex Optimization

Lecture 29 - Convex Optimization

Lecture 30 - Convex Optimization

Lecture 31 - Convex Optimization

Lecture 32 - Convex Optimization

Lecture 33 - Convex Optimization

Lecture 34 - Convex Optimization

Lecture 35 - Convex Optimization

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 : Foundations of Optimization (Mathematics)

Co-ordinators : Dr. Joydeep Dutta

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

Lecture 17 - Optimization

Lecture 18 - Optimization

Lecture 19 - Optimization

Lecture 20 - Optimization

Lecture 21 - Optimization

Lecture 22 - Optimization

Lecture 23 - Optimization

Lecture 24 - Optimization

Lecture 25 - Optimization

Lecture 26 - Optimization

Lecture 27 - Optimization

Lecture 28 - Optimization

Lecture 29 - Optimization

Lecture 30 - Optimization

Lecture 31 - Optimization

Lecture 32 - Optimization

Lecture 33 - Optimization

Lecture 34 - Optimization

Lecture 35 - Optimization

Lecture 36 - Optimization

Lecture 37 - Optimization

Lecture 38 - Optimization

NPTEL : Probability Theory and Applications (Mathematics)

Co-ordinators : Prof. Prabha Sharma

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: Markov process

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: M/M/I, Birth and death process, Littleâ€™s formulae

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 : NOC:Basic Calculus for Engineers, Scientists and Economists (Mathematics)

Co-ordinators : Dr. Joydeep Dutta

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 : NOC:Probability and Stochastics for finance (Mathematics)

Co-ordinators : Dr. Joydeep Dutta

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 : NOC:Differential Calculus in Several Variables (Mathematics)

Co-ordinators : Prof. Sudipta Dutta

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: Possible Definition

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: Lagrange's Multipliers Method

Lecture 19 - Application of IFT: Lagrange's Multipliers Method - b

Lecture 20 - Application of IFT: Lagrange's Multipliers Method - c

Lecture 21 - Application of IFT: Inverse Function Theorem - c

NPTEL : NOC:Curves and Surfaces (Mathematics)

Co-ordinators : Prof. Sudipta Dutta

Lecture 1 - Level curves and locus, definition of parametric curves, tangent, arc length, arc length parametrisation

Lecture 2 - How much a curve is Â‘curvedÂ’, signed unit normal and signed curvature, rigid motions, constant curvature

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, transition maps.

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 : NOC:Linear Regression Analysis and Forecasting (Mathematics)

Co-ordinators : Prof. Shalabh

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...) : Some Nice Properties

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 (Continued...)

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 : NOC:Introduction to R Software (Mathematics)

Co-ordinators : Prof. Shalabh

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: Matrix Operations

Lecture 9 - Basics Calculations: Matrix operations

Lecture 10 - Basics Calculations: Missing data and logical operators

Lecture 11 - Basics Calculations: Logical operators

Lecture 12 - Basics Calculations: Truth table and conditional executions

Lecture 13 - Basics Calculations: Conditional executions and loops

Lecture 14 - Basics Calculations: Loops

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 : NOC:Descriptive Statistics with R Software (Mathematics)

Co-ordinators : Prof. Shalabh

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 : NOC:Calculus of Several Real Variables (Mathematics)

Co-ordinators : Dr. Joydeep Dutta

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 : NOC:Linear Algebra (Prof. A.K. Lal) (Mathematics)

Co-ordinators : Prof. A.K. Lal

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 : NOC:Computational Number Theory and Algebra (Mathematics)

Co-ordinators : Prof. Nitin Saxena

Lecture 1 - Introduction: Computation and Algebra

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: Irreducibility testing

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: Cantor-Zassenhaus algorithm

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: Solovay-Strassen and Miller-Rabin tests

Lecture 25 - Deterministic primality test (AKS) and RSA cryptosystem

Lecture 26 - Integer factoring: Smooth numbers and Pollard's rho method

Lecture 27 - Pollard's p-1, Fermat, Morrison-Brillhart, Quadratic and Number field sieve methods

NPTEL : NOC:Basic Calculus 1 and 2 (Mathematics)

Co-ordinators : Prof. Parasar Mohanty

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 : NOC:Advanced Partial Differential Equations (Mathematics)

Co-ordinators : Prof. Kaushik Bal

Lecture 1

Lecture 2

Lecture 3

Lecture 4

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Lecture 11

Lecture 12

Lecture 13

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Lecture 25

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Lecture 27

Lecture 28

Lecture 29

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Lecture 32

Lecture 33

NPTEL : NOC:Essentials of Data Science With R Software 1: Probability and Statistical Inference (Mathematics)

Co-ordinators : Prof. Shalabh

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 : NOC:Essentials of Data Science With R Software 2: Sampling Theory and Linear Regression Analysis (Mathematics)

Co-ordinators : Prof. Shalabh

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 Interval

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 Individual Regression Coefficients

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 : NOC:Measure Theoretic Probability 1 (Mathematics)

Co-ordinators : Prof. Suprio Bhar

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 : NOC:Foundations of R Software (Mathematics)

Co-ordinators : Prof. Shalabh

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

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Lecture 47

Lecture 48

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Lecture 50

Lecture 51

Lecture 52

Lecture 53

NPTEL : NOC:Foundations of R Software (In Hindi) (Mathematics)

Co-ordinators : Prof. Shalabh

Lecture 1

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Lecture 47

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Lecture 51

Lecture 52

Lecture 53

NPTEL : NOC:An Introduction to Hyperbolic Geometry (Mathematics)

Co-ordinators : Prof. Abhijit Pal

Lecture 1

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Lecture 11

Lecture 12

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Lecture 33

Lecture 34

Lecture 35

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Lecture 38

Lecture 39

Lecture 40

Lecture 41

NPTEL : NOC:A Primer to Mathematical Optimization (Mathematics)

Co-ordinators : Prof. Debdas Ghosh

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 : NOC:Measure Theoretic Probability 2 (Mathematics)

Co-ordinators : Prof. Suprio Bhar

Lecture 1

Lecture 2

Lecture 3

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Lecture 11

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Lecture 36

Lecture 37

Lecture 38

Lecture 39

Lecture 40

Lecture 41

Lecture 42

Lecture 43

Lecture 44

NPTEL : NOC:Set Theory and Mathematical Logic (Mathematics)

Co-ordinators : Prof. Amit Kuber

Lecture 1 - Introduction to Set Theory

Lecture 2 - Operations on Sets, and Functions

Lecture 3 - Bijective Functions

Lecture 4 - Equivalence Relations and Partitions

Lecture 5 - Cantor-Schroder-Bernstein Theorem

Lecture 6 - Natural Numbers in ZF Set Theory

Lecture 7 - Standard Number Systems in ZF Set Theory

Lecture 8 - (Finitary) Power Sets and Countability

Lecture 9 - Bijections of the set of real numbers: Dedekind cut and Cantor's middle-third set

Lecture 10 - Bijections of the real numbers: Continued Fractions

Lecture 11 - Principles of Mathematical Induction

Lecture 12 - Ordinal Numbers

Lecture 13 - Ordinal Arithmetic

Lecture 14 - Cardinal Numbers and Cardinal Arithmetic

Lecture 15 - Tutorial - Week 4

Lecture 16 - Partial Orders

Lecture 17 - Lattices

Lecture 18 - Equivalents of the Axiom of Choice (AC): Zorn's Lemma (ZL) and Well-ordering theorem (WOT)

Lecture 19 - Tutorial - Week 5

Lecture 20 - Boolean Algebras

Lecture 21 - Stone's Representation Theorems for Boolean Algebras

Lecture 22 - Some Exercises on Boolean Algebras

Lecture 23 - Ultrafilters in Boolean Algebras

Lecture 24 - Introduction to Mathematical Logic

Lecture 25 - Propositional Logic: Language, Formulas and Valuations

Lecture 26 - Propositional Logic: Logical Equivalence and Lindenbaum-Tarski Algebra

Lecture 27 - Tutorial - Week 7

Lecture 28 - Propositional Logic: Normal Forms of Formulas and Adequacy of Connectives

Lecture 29 - Propositional Logic: Semantic Consequence Relation

Lecture 30 - Propositional Logic: Syntactic Consequence Relation

Lecture 31 - Deduction Theorem (Continued...)

Lecture 32 - Tutorial - Week 8

Lecture 33 - Propositional Logic: Consistency and Soundness Theorem

Lecture 34 - Propositional Logic: Completeness Theorem - Part I

Lecture 35 - Propositional Logic: Completeness Theorem - Part II

Lecture 36 - Compactness Theorem and Konig's Lemma

Lecture 37 - Tutorial - Week 9

Lecture 38 - Introduction to First-Order Predicate Logic

Lecture 39 - Predicate Logic: Terms and Formulas

Lecture 40 - Predicate Logic: Validity of Formulas

Lecture 41 - Tutorial - Week 10

Lecture 42 - Predicate Logic Substructures, Semantic Consequence Relation, and Models of Theories

Lecture 43 - Predicate Logic: Standard Logical Equivalences, Normal Forms, and Definable Sets

Lecture 44 - Tutorial - Week 11

Lecture 45 - Hyperreal Numbers

Lecture 46 - Predicate Logic: Ultraproduct of Structures and Los's Theorem

Lecture 47 - Predicate Logic: Compactness Theorem

Lecture 48 - Tutorial - Week 12

Lecture 49 - Predicate Logic: Lowenheim-Skolem Theorems

Lecture 50 - Predicate Logic: Reduced Products, Categoricity

Lecture 51 - Predicate Logic: Categoricity (Continued...) and Quantifier Elimination

Lecture 52 - Godel's Incompleteness Theorems

NPTEL : NOC:Introduction to Fourier Analysis (Mathematics)

Co-ordinators : Prof. Parasar Mohanty

Lecture 1 - Origin of Fourier series

Lecture 2 - Convergence of a series and Riemann integration

Lecture 3 - Riemann integration and periodic functions

Lecture 4 - Fourier coefficients and series

Lecture 5 - Complex Fourier series

Lecture 6 - Riemann Lebesgue lemma and Dirichlet kernel

Lecture 7 - Convolution of two Riemann integrable functions

Lecture 8 - Properties of convolution

Lecture 9 - Cesaro summability and summation by parts

Lecture 10 - Fejer kernel

Lecture 11 - Fejer theorem and applications

Lecture 12 - Good kernels and Poisson kernel

Lecture 13 - Abel summability

Lecture 14 - Dirichlet problem

Lecture 15 - Convergence at jump discontinuity

Lecture 16 - Orthonormal families

Lecture 17 - Pythagoras theorem and Parseval identity

Lecture 18 - Pointwise convergence

Lecture 19 - Parseval identity applications

Lecture 20 - Divergent Fourier series

Lecture 21 - Pointwise convergence of S_N(f)

Lecture 22 - Isoperimetric problem

Lecture 23 - Weyl's equidistribution theorem

Lecture 24 - on Equidistributed sequences

Lecture 25 - Proof of Weyl's criterion

Lecture 26 - Fourier analysis on finite groups

Lecture 27 - Fourier transform on Z(N)

Lecture 28 - Inversion theorem and Parseval identity

Lecture 29 - Results on Fourier coefficients of two functions

Lecture 30 - Fast Fourier transform

Lecture 31 - Fourier analysis on finite abelian group

Lecture 32 - Fourier analysis on finite abelian groups

Lecture 33 - Simultaneously diagonalizable operators and characters

Lecture 34 - Results of Fourier series on finite abelian group

Lecture 35 - Applications in Number theory

Lecture 36 - Fourier transform on R

Lecture 37 - Properties of Fourier transform

Lecture 38 - Inversion formula and convolution

Lecture 39 - Fejer kernel on R

Lecture 40 - Schwartz space

Lecture 41 - Convolution and Good kernel in Schwartz space

Lecture 42 - Multiplication formula and Fourier inversion theorem

Lecture 43 - Plancherel formula and Poisson summation formula

Lecture 44 - Application of Poisson summation formula

Lecture 45 - Weierstrass theorem and Heisenberg uncertainty principle

Lecture 46 - Hermite operator

Lecture 47 - Solution of ODE by using Fourier transform

Lecture 48 - Laplacian equation

Lecture 49 - Poisson kermal and mean value theorem for harmonic functions

Lecture 50 - Wave equation

Lecture 51 - Eigenvalues of Fourier transform

Lecture 52 - Fourier transform on R^n

Lecture 53 - Properties of Fourier transform on R^n

Lecture 54 - Inversion theorem and Plancherel theorem

Lecture 55 - Wave equation, heat equation and Poisson kernel

Lecture 56 - Fourier series in higher dimension

Lecture 57 - Poission summation formula

Lecture 58 - Application of Poission summation formula

Lecture 59 - Radon transform

Lecture 60 - Reconstruction formula

NPTEL : NOC:Ordinary Differential Equations (Mathematics)

Co-ordinators : Prof. Kaushik Bal

Lecture 1 - Vector Spaces

Lecture 2 - Linear Transformation

Lecture 3 - Matrices

Lecture 4 - Calculus in Several Variable

Lecture 5 - Lipchitz Continuity

Lecture 6 - Cauchy-Schwatz and Gronwall Inequality

Lecture 7 - Ordinary Differential Equations: Introduction

Lecture 8 - Differential Inequalities

Lecture 9 - 2nd Order Constant coefficient linear equations

Lecture 10 - Picard Existence and Uniqueness Theorem

Lecture 11 - Linear System

Lecture 12 - Well-Posedness of a ODE

Lecture 13 - Linear System - 1

Lecture 14 - Linear System - 2

Lecture 15 - Fundamental Matrix

Lecture 16 - Exponential of a Linear Operator

Lecture 17 - Fundamental theorem of linear Systems

Lecture 18 - Higher Dimensional Matrix Exponential - 1

Lecture 19 - Higher Dimensional Matrix Exponential - 2

Lecture 20 - Method of Eigenvalue

Lecture 21 - Method of Eigenvalue (Continued...)

Lecture 22 - Maximal Interval of Existence

Lecture 23 - Maximal Interval of Existence: Worked out examples

Lecture 24 - Periodic Linear System

Lecture 25 - Asymptotic behavior of solution to linear system - I

Lecture 26 - Asymptotic behavior of solution to linear system - II

Lecture 27 - Asymptotic Behavior of Linear Systems - III

Lecture 28 - Exact and Adjoint equations

Lecture 29 - Sturm Comparison Theory

Lecture 30 - Oscillation Theory - 2

Lecture 31 - Linear Boundary Value Problem

Lecture 32 - Maximum Principle

Lecture 33 - Sturm Liouville Theory - 1

Lecture 34 - Sturm Liouville Theory - 2

Lecture 35 - Periodic Sturm Liouville Problem

Lecture 36 - Eigenfunction Expansion

Lecture 37 - Stability in the sense of Lyapunov - I

Lecture 38 - Stability in the sense of Lyapunov - II

Lecture 39 - Lyapunov Direct method

Lecture 40 - Linear two-dimensional phase space dynamics (Continued...)

Lecture 41 - Phase Portrait for Planar Systems

NPTEL : NOC:Category Theory (Mathematics)

Co-ordinators : Prof. Amit Kuber

Lecture 1 - Introduction to Category Theory

Lecture 2 - Examples of Categories

Lecture 3 - Functors

Lecture 4 - Natural Transformations and Equivalences of Categories

Lecture 5 - Equivalence of Categories and some properties of morphisms

Lecture 6 - The Yoneda lemma and Representable functors

Lecture 7 - Limits and colimits - Part 1

Lecture 8 - Limits and colimits - Part 2

Lecture 9 - Limits and colimits - Part 3 - Interaction with functors - Adjuctions - I Definitions

Lecture 10 - Adjunctions - II Examples

Lecture 11 - Adjunctions - III Triangular identities

Lecture 12 - Adjunctions - IV General adjoint functor theorem

Lecture 13 - Adjunctions - V Special adjoint functor theorem Filtered colimits-I Basics

Lecture 14 - Filtered colimits - II Locally finitely presentable (LFP) categories

Lecture 15 - Monads - I Eilenberg-Moore and Kleisli categories

Lecture 16 - Monads - II Monadicity theorem

Lecture 17 - Monoidal categories and enriched categories

Lecture 18 - Abelian categories

Lecture 19 - Grothendieck categories and localization

Lecture 20 - Freyd-Mitchell embedding theorem Homological algebra I Diagram chasing

Lecture 21 - Homological algebra II Chain homotopy, projective resolutions and the derived category

Lecture 22 - Model categories

Lecture 23 - Topos Theory - I Elementary toposes

Lecture 24 - Topos Theory - II Grothendieck toposes

NPTEL : Advanced Engineering Mathematics (Mathematics)

Co-ordinators : Dr. P. Panigrahi, Prof. J. Kumar, Prof. P.D. Srivastava, Prof. Somesh Kumar

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 : Functional Analysis (Mathematics)

Co-ordinators : Prof. P.D. Srivastava

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 : Numerical methods of Ordinary and Partial Differential Equations (Mathematics)

Co-ordinators : Dr. G.P. Raja Sekhar

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 : Optimization (Mathematics)

Co-ordinators : Prof. A. Goswami, Dr. Debjani Chakraborty

Lecture 1 - Optimization - Introduction

Lecture 2 - Formulation of LPP

Lecture 3 - Geometry of LPP and Graphical Solution of LPP

Lecture 4 - Solution of LPP : Simplex Method

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 : Single variable optimization

Lecture 22 - Unconstarined multivariable optimization

Lecture 23 - Nonlinear programming with equality constraint

Lecture 24 - Nonlinear programming KKT conditions

Lecture 25 - Numerical optimization : Region elimination techniques

Lecture 26 - Numerical optimization : Region elimination techniques (Continued.)

Lecture 27 - Fibonacci Method

Lecture 28 - Golden Section Methods

Lecture 29 - Interpolation Methods

Lecture 30 - Unconstarined optimization techniques : Direct search method

Lecture 31 - Unconstarined optimization techniques : Indirect search method

Lecture 32 - Nonlinear programming : constrained optimization techniques

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 : Probability and Statistics (Mathematics)

Co-ordinators : Prof. Somesh Kumar

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 : Regression Analysis (Mathematics)

Co-ordinators : Dr. Soumen Maity

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 : Statistical Inference (Mathematics)

Co-ordinators : Prof. Somesh Kumar

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 : Basic Concepts

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 : Applications

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 : A Basic Course in Real Analysis (Mathematics)

Co-ordinators : Prof. P.D. Srivastava

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 : Statistical Methods for Scientists and Engineers (Mathematics)

Co-ordinators : Prof. Somesh Kumar

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 : NOC:Probability and Statistics (Mathematics)

Co-ordinators : Prof. Somesh Kumar

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 : NOC:Applied Multivariate Statistical Modeling (Mathematics)

Co-ordinators : Dr J Maiti

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 distribution

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 vectors

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 and cross products (SSCP)

Lecture 33 - Multivariate Analysis of Variance (MANOVA): Decomposition of total sum square and cross products (SSCP) (Continued...)

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 : NOC:Partial Differential Equations (PDE) for Engineers - Solution by Separation of Variables (Mathematics)

Co-ordinators : Prof. S. De

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: Rectangular Coordinate Systems

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 : NOC:Introductory Course in Real Analysis (Mathematics)

Co-ordinators : Prof. P.D. Srivastava

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 : NOC:Modeling Transport Phenomena of Microparticles (Mathematics)

Co-ordinators : Dr. G.P. Raja Sekhar, Prof. Somnath Bhattacharyya

Lecture 1 - Preliminary concepts: Fluid kinematics, stress, strain

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 : NOC:Constrained and Unconstrained Optimization (Mathematics)

Co-ordinators : Dr. Debjani Chakraborty, Prof. A. Goswami

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: Simplex Method

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: Introduction

Lecture 12 - Two Phase Method: Problem Solution

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: Branch and BBound Method

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 : NOC:Matrix Solver (Mathematics)

Co-ordinators : Prof. Somnath Roy

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: Jacobi and Gauss-Siedel

Lecture 33 - Basic Iterative Methods: Matrix Representation

Lecture 34 - Convergence Rate and Convergence Factor for Iterative Methods

Lecture 35 - Numerical Experiments on Convergence

Lecture 36 - Steepest Descent Method: Finding Minima of a Functional

Lecture 37 - Steepest Descent Method: Gradient Search

Lecture 38 - Steepest Descent Method: Algorithm and Convergence

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 : NOC:Introduction to Abstract and Linear Algebra (Mathematics)

Co-ordinators : Prof.Sourav Mukhopadhyay

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 : NOC:Engineering Mathematics-I (Mathematics)

Co-ordinators : Prof. Jitendra Kumar

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: Change of Variables

Lecture 33 - Integral Calculus Double Integrals: Surface Area

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: Diagonalization

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 : NOC:Integral and Vector Calculus (Mathematics)

Co-ordinators : Prof. Hari Shankar Mahato

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 : NOC:Transform Calculus and its applications in Differential Equations (Mathematics)

Co-ordinators : Prof. A. Goswami

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 solving Partial Differential Equations

Lecture 47 - Solution of Partial Differential Equations using Fourier Cosine Transform and Fourier Sine Transform

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 : NOC:Statistical Inference (2019) (Mathematics)

Co-ordinators : Prof. Somesh Kumar

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 : Basic Concepts - I

Lecture 32 - Testing of Hypotheses : Basic Concepts - II

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 : NOC:Mathematical Methods for Boundary Value Problems (Mathematics)

Co-ordinators : Prof. Somnath Bhattacharyya

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 expansions

Lecture 6 - Solutions of linear parabolic, hyperbolic and elliptic PDEs with finite domain by Eigen function expansions (Continued...)

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 equations

NPTEL : NOC:Engineering Mathematics-II (Mathematics)

Co-ordinators : Prof. Jitendra Kumar

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 : NOC:Advanced Calculus For Engineers (Mathematics)

Co-ordinators : Prof. Somesh Kumar, Prof. Jitendra Kumar

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 : NOC:Rings and Modules (Mathematics)

Co-ordinators : Prof. Ramakrishna Nanduri, Prof. Mousumi Mandal

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 : NOC:Advanced Computational Techniques (Mathematics)

Co-ordinators : Prof. Somnath Bhattacharyya

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 : NOC:Applied Linear Algebra in AI and ML (Mathematics)

Co-ordinators : Prof. Swanand Khare

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 : NOC:Advanced Engineering Mathematics (2023) (Mathematics)

Co-ordinators : Prof. H S Mahato

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 : NOC:Essentials of Topology (Mathematics)

Co-ordinators : Prof. S. P. Tiwari

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 : NOC:Numerical Linear Algebra and Application (Mathematics)

Co-ordinators : Prof. Srinivasa Rao Pentyala

Lecture 1 - Linear Algebra and Introduction

Lecture 2 - Computational Difficulties

Lecture 3 - Computational Error

Lecture 4 - Stability

Lecture 5 - Gaussian Elimination

Lecture 6 - LU Factorization

Lecture 7 - Iterative refinement

Lecture 8 - QR Factorization

Lecture 9 - Gram-Schmidt Orthogonalization

Lecture 10 - Cholesky Decomposition

Lecture 11 - Projections

Lecture 12 - House-Holder Reflectors

Lecture 13 - Image Compression

Lecture 14 - Singular Value Decomposition

Lecture 15 - Least Square Solutions

Lecture 16 - Pseudo-Inverse

Lecture 17 - Normal Equations

Lecture 18 - Eigenvalue problems

Lecture 19 - Gershgorin Theorem

Lecture 20 - Similarity Transforms

Lecture 21 - Eigenvalues

Lecture 22 - Sensitivity Vectors

Lecture 23 - Power method

Lecture 24 - Schur Decomposition

Lecture 25 - Jordan Canonical form

Lecture 26 - QR Iteration

Lecture 27 - Heisenberg transformation

Lecture 28 - Rayleigh Quotient

Lecture 29 - Symmetric eigenvalue problem

Lecture 30 - Jacobi Method

Lecture 31 - Divide and Conquer

Lecture 32 - Computing the Singular Value Decomposition

Lecture 33 - Golub-Kahan-Reinsch Algorithm

Lecture 34 - Chan SVD Algorithm

Lecture 35 - Generalized SVD

Lecture 36 - Generalized and Quadratic Eigenvalue Problems

Lecture 37 - Generalized Schur Decomposition (QZ Decomposition)

Lecture 38 - Iterative Methods for Large Linear Systems: Jacobi

Lecture 39 - Iterative methods for large linear systems: Gauss-Seidel Method

Lecture 40 - Iterative methods for large linear systems: SOR method

Lecture 41 - Convergence of iterative algorithms

Lecture 42 - Krylov subspace methods

Lecture 43 - Lanczos

Lecture 44 - Arnoldi

Lecture 45 - Stability of the Cholesky QR Algorithm

Lecture 46 - Conditioning of the eigenvalues

Lecture 47 - Symmetric definite pencil

Lecture 48 - AI applications

Lecture 49 - Sensitive systems

Lecture 50 - Real Life Systems

Lecture 51 - Transient thermal systems

Lecture 52 - Left Inverse

Lecture 53 - Right Inverse

Lecture 54 - Generalized Inverse

Lecture 55 - Applications

Lecture 56 - Applications (Continued...)

Lecture 57 - Applications (Continued...)

Lecture 58 - Applications (Continued...)

Lecture 59 - Applications (Continued...)

Lecture 60 - Applications of the Matrices in Real Life Systems

Lecture 61 - Matrices and Its Fundamentals: Recalling Examples

Lecture 62 - Properties of Matrices: Recalling and Revision, Examples

Lecture 63 - Matrices: Finite Digit Arithmetic: recalling and Examples

NPTEL : NOC:Mathematics for Machine Learning (Mathematics)

Co-ordinators : Prof. Debjani Chakraborty, Prof. Debashree Guha Adhya

Lecture 1 - Introduction to Machine Learning

Lecture 2 - Few Instances of Learning

Lecture 3 - Loss Function Optimization

Lecture 4 - Phases of Machine Learning Systems

Lecture 5 - Single-layer and multi-layer neurons

Lecture 6 - Introduction to Convexity

Lecture 7 - Study on Convex Function

Lecture 8 - Formation of Convex Hull

Lecture 9 - Optimization of Functions

Lecture 10 - Convex Optimization Problem

Lecture 11 - Directional derivative, Gradient, Jacobian, Firest Order Taylor Formula

Lecture 12 - Gradient, Jacobian, First order Taylor formula

Lecture 13 - Gradient Descent Optimization Technique

Lecture 14 - Gradient Descent, Interpretation from Taylor approximation

Lecture 15 - Sub-Gradient Descent Optimization Technique

Lecture 16 - Introduction to Underfitting and Overfitting

Lecture 17 - Relation of Bias and Variance to Underfitting and Overfitting

Lecture 18 - Bias-Variance Trade-off

Lecture 19 - Ridge Regression

Lecture 20 - LASSO Regression

Lecture 21 - Stochastic Gradient descent

Lecture 22 - Stochastic Gradient descent (Continued...)

Lecture 23 - Variants of Gradient descent

Lecture 24 - Momentum based Gradient descent

Lecture 25 - Accelerated Gradient descent

Lecture 26 - Linear Predictors (Logistic Regression)

Lecture 27 - Linear Predictors (Logistic Regression) (Continued....)

Lecture 28 - Linear Predictors (Logistic Regression) (Continued....)

Lecture 29 - Linear Predictors (Logistic Regression) (Continued....)

Lecture 30 - Linear Predictors (Support Vector Machines)

Lecture 31 - Introduction to Theory of Estimation

Lecture 32 - Probability Theory

Lecture 33 - Discrete Probability Distribution

Lecture 34 - Continuous Probability Distribution

Lecture 35 - Maximum likelihood Estimation

Lecture 36 - MLE for Discrete Probability Distribution

Lecture 37 - MLE for Continuous Probability Distribution

Lecture 38 - Properties of Estimators

Lecture 39 - MLE for Linear and Logistic Regression

Lecture 40 - MLE for NaÃ¯ve Bayes Model

Lecture 41 - Eigen value and eigen vector, Linearly independent vectors

Lecture 42 - Orthogonal Basis, Eigen value decomposition

Lecture 43 - Orthogonal Basis, Eigen value decomposition (Continued...)

Lecture 44 - Principal Component Analysis

Lecture 45 - Principal Component Analysis (Continued...)

Lecture 46 - Introduction to Dynamical System

Lecture 47 - Dynamical System and Control

Lecture 48 - Discrete Fourier Transform

Lecture 49 - Inverse Fourier Transform

Lecture 50 - Applications: Discrete Fourier Transform

Lecture 51 - Introduction to Mixture models

Lecture 52 - Introduction to Gaussian Mixture Models

Lecture 53 - EM Algorithm

Lecture 54 - EM Algorithm (Continued...)

Lecture 55 - A brief application to predict HMM parameters

Lecture 56 - Conditional probability, Bayes theorem

Lecture 57 - Bayes Decision Rule

Lecture 58 - Bayes Decision Rule (Continued...)

Lecture 59 - Bayes Decision Rule (Bayesian minimum risk classifier)

Lecture 60 - Bayes Decision Rule (Linear Discriminant Analysis)

NPTEL : NOC:Advanced Theory of Ordinary Differential Equations (Mathematics)

Co-ordinators : Prof. Hari Sankar Mahato

Lecture 1 - Introduction to ODEs

Lecture 2 - Introduction to ODEs (Continued...)

Lecture 3 - Existence of local solution. Theorems and Examples

Lecture 4 - Continuation of solutions upto the boundary. Global existence of Solution

Lecture 5 - Continuation of solution and dependence on initital data

Lecture 6 - Dependence on Initial data : Examples

Lecture 7 - Regular Perturbations and linearisation

Lecture 8 - Linear System of equations and their stability

Lecture 9 - Linear System of equations and their stability (Continued...)

Lecture 10 - Stability Analysis

Lecture 11 - Stability Analysis (Continued...)

Lecture 12 - Stability of linear systems with constant and periodic co-efficient Matrix

Lecture 13 - Stability of linear systems with constant and periodic co-efficient Matrix (Continued...)

Lecture 14 - Stability of nonlinear system, linearization and Lyapunov functions

Lecture 15 - Stability and Lyapunov functions

Lecture 16 - Stability and Lyapunov functions (Continued...)

Lecture 17 - Chaotic Theory - Introduction

Lecture 18 - Chaotic Theory - Introduction (Continued...)

Lecture 19 - Lorenz equation, attractor, Lyapunov exponent

Lecture 20 - Lorenz equation, attractor, Lyapunov exponent (Continued...)

Lecture 21 - Local divergence, Lyapunov exponents and related topics

Lecture 22 - Local divergence, Lyapunov exponents and related topics (Continued...)

Lecture 23 - Strange and Chaotic attractors

Lecture 24 - Strange and Chaotic attractors

Lecture 25 - Fractal Dimension and Reconstruction

Lecture 26 - Fractal Dimension and Reconstruction (Continued...)

Lecture 27 - Stiff Differential Equations: Introduction

Lecture 28 - Stiff Differential Equations: Slow and fast time scales

Lecture 29 - Stiff differential equations: Introduction

Lecture 30 - Increment function, A-stable

Lecture 31 - BDF methods and their implementation, Bifurcation Theory: Introduction

Lecture 32 - Bifurcation Theory

Lecture 33 - One dimensional bifurcation for scalar equations

Lecture 34 - One dimensional bifurcations for planar systems

Lecture 35 - Few definitions related to Hopf bifurcation

Lecture 36 - Few definitions related to Hopf bifurcation (Continued...)

Lecture 37 - Mathematical models with second order equations - Undamped free oscillations

Lecture 38 - Damped free oscillations

Lecture 39 - Undamped and Damped Forced Oscillations

Lecture 40 - Undamped and Damped Forced Oscillations (Continued...)

Lecture 41 - Higher order linear ODEs

Lecture 42 - Higher order linear ODEs (Continued...)

Lecture 43 - Linear Differential Equations of Higher Order with Constant Coefficients

Lecture 44 - Linear Differential Equations of Higher Order with Constant Coefficients (Continued...)

Lecture 45 - Higher order linear ODEs - Particular Integrals

Lecture 46 - Higher order linear ODEs - Particular Integrals (Continued...)

Lecture 47 - Higher order linear ODEs - Variable Coefficients

Lecture 48 - Higher order linear ODEs - Variation of Parameters

Lecture 49 - Series Solution

Lecture 50 - Series Solution (Continued...)

Lecture 51 - Series Solution - Frobenius Method

Lecture 52 - Series Solution - Frobenius method (Continued...)

Lecture 53 - Special functions

Lecture 54 - Special functions (Continued...)

Lecture 55 - Sturm-Liouville Problem - Eigenvalues and Eigenfunctions

Lecture 56 - Sturm-Liouville Problem - Eigenvalues and Eigenfunctions (Continued...)

Lecture 57 - Laplace Transform and Its Applications (Continued...)

Lecture 58 - Laplace Transform

Lecture 59 - Laplace Transform and Its Applications

Lecture 60 - Laplace Transform and Its Applications (Continued...)

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

Co-ordinators : Dr. T.E. Venkata Balaji

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: Universality of the Universal Covering

Lecture 16 - Completion of the Construction of the Universal Covering: The Fundamental Group of the base as the Deck Transformation Group

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: Riemann Surfaces with Universal Covering the Complex Plane

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 : Linear Algebra (Mathematics)

Co-ordinators : Dr. K.C. Sivakumar

Lecture 1 - Introduction to the Course Contents

Lecture 2 - Linear Equations

Lecture 3a - Equivalent Systems of Linear Equations I : Inverses of Elementary Row-operations, Row-equivalent matrices

Lecture 3b - Equivalent Systems of Linear Equations II : Homogeneous Equations, Examples

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: Least Squares Solutions

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 : Mathematical Logic (Mathematics)

Co-ordinators : Prof. Arindama Singh

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 : Real Analysis (Mathematics)

Co-ordinators : Prof. S.H. Kulkarni

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: Definition and Examples

Lecture 15 - Metric Spaces: Examples and Elementary Concepts

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: Weierstrass Theorem

Lecture 52 - Equicontinuous family of Functions: Arzela - Ascoli Theorem

NPTEL : Dynamic Data Assimilation: An Introduction (Mathematics)

Co-ordinators : Prof. S. Lakshmivarahan

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 : NOC:An Invitation to Mathematics (Mathematics)

Co-ordinators : Prof. Sankaran Vishwanath

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 : Advanced Complex Analysis (Mathematics)

Co-ordinators : Dr. T.E. Venkata Balaji

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: The Integral Inversion Formula for the Inverse Function

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: Topological Preliminaries

Lecture 12 - Proof of the Implicit Function Theorem: The Integral Formula for & Analyticity of the Explicit Function

Lecture 13 - Doing Complex Analysis on a Real Surface: The Idea of a Riemann 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 along Paths

Lecture 24 - Analytic Continuability along Paths: Dependence on the Initial Function and on the Path - First Version of the Monodromy Theorem

Lecture 25 - Maximal Domains of Direct and Indirect Analytic Continuation: Second Version of the Monodromy Theorem

Lecture 26 - Deducing the Second (Simply Connected) Version of the Monodromy Theorem from the First (Homotopy) Version

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 Function at a Critical Point

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 Geodesics on the Unit Disc

Lecture 35 - Differential or Infinitesimal Schwarzs Lemma, Picks Lemma, Hyperbolic Arclengths, Metric and Geodesics on the Unit Disc

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: Under Uniform Boundedness, Equicontinuity and Uniform Sequential Compactness are Equivalent

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 : NOC:Discrete Mathematics (Mathematics)

Co-ordinators : Prof. Sourav Chakraborty

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: Graph Theory and Linear Programming

Lecture 51 - Combinatorics

NPTEL : Advanced Complex Analysis - Part 2 (Mathematics)

Co-ordinators : Dr. T.E. Venkata Balaji

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 Essential Singularities

Lecture 3 - Recalling Riemann's Theorem on Removable Singularities

Lecture 4 - Casorati-Weierstrass Theorem; Dealing with the Point at Infinity -- Riemann Sphere and Riemann Stereographic Projection

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 Infinity

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 Infinity

Lecture 9 - The Generalized Liouville Theorem - Little Brother of Little Picard and Analogue of Casorati-Weierstrass; Failure of Cauchy\'s Theorem at Infinity

Lecture 10 - Morera\'s Theorem at Infinity, Infinity as a Pole and Behaviour at Infinity of Rational and Meromorphic Functions

Lecture 11 - Residue at Infinity and Introduction to the Residue Theorem for the Extended Complex Plane - Residue Theorem for the Point at Infinity

Lecture 12 - Proofs of Two Avatars of the Residue Theorem for the Extended Complex Plane and Applications of the Residue at Infinity

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, Analysis and Topology

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 Analysis

Lecture 18 - Measuring Distances to Infinity, the Function Infinity and Normal Convergence of Holomorphic Functions in the Spherical Metric

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 Spherical Metric

Lecture 21 - Completion of Proof of Hurwitz\'s Theorem for Normal Limits of Analytic Functions in the Spherical Metric

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-invariance of the Spherical Derivative

Lecture 26 - Topological Preliminaries - Translating Compactness into Boundedness

Lecture 27 - Introduction to the Arzela-Ascoli Theorem - Passing from abstract Compactness to verifiable Equicontinuity

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 you get Equicontinuity for Free

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-Ascoli Theorems - Normal Uniform Boundedness of Spherical Derivatives Implies Normal Sequential Compactness

Lecture 34 - Proof of the other direction of Marty\'s Theorem - the Meromorphic Avatar of the Montel & Arzela-Ascoli Theorems - Normal Sequential Compactness Implies Normal Uniform Boundedness of Spherical Derivatives

Lecture 35 - Normal Convergence at Infinity and Hurwitz\'s Theorems for Normal Limits of Analytic and Meromorphic Functions at Infinity

Lecture 36 - Normal Sequential Compactness, Normal Uniform Boundedness and Montel\'s & Marty\'s Theorems at Infinity

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 Lemma

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 based on Omission of Values

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 Session

NPTEL : Basic Algebraic Geometry : Varieties, Morphisms, Local Rings, Function Fields and Nonsingularity (Mathematics)

Co-ordinators : Dr. T.E. Venkata Balaji

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 Algebra

Lecture 7 - Basic Algebraic Geometry : Varieties, Morphisms, Local Rings, Function Fields and Nonsingularity

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 Variety

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 Functions

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 Plane is Not Affine

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 Theory and Algebraic Geometry; The Key to the Definition of a Homogeneous Ideal

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 this Algebraic Fact ?

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, Quotients, Homogenisation and Dehomogenisation !

Lecture 31 - The Field of Rational Functions or Function Field of a Variety - The Local Ring at the Generic Point

Lecture 32 - Fields of Rational Functions or Function Fields of Affine and Projective Varieties and their Relationships with Dimensions

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 Projective Variety

Lecture 35 - The Importance of Local Rings - A Morphism is an Isomorphism if it is a Homeomorphism and Induces Isomorphisms at the Level of Local Rings

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 : NOC:Introduction to Commutative Algebra (Mathematics)

Co-ordinators : Prof. A.V.Jayanthan

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 : NOC:Differential Equations (Mathematics)

Co-ordinators : Prof. Srinivasa Manam

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 : NOC:Numerical Analysis (Mathematics)

Co-ordinators : Prof. R. Usha

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-Moulton)

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 : NOC:Graph Theory (Mathematics)

Co-ordinators : Dr. Soumen Maity

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 : NOC:Transform Techniques for Engineers (Mathematics)

Co-ordinators : Prof. Srinivasa Manam

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 : NOC:Introduction to Probability and Statistics (Mathematics)

Co-ordinators : Prof. G. Srinivasan

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 : NOC:Introduction to Abstract Group Theory (Mathematics)

Co-ordinators : Prof. Krishna Hanumanthu

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 : NOC:Groups: Motion, Symmetry and Puzzles (Mathematics)

Co-ordinators : Prof. Amit Kulshrestha

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 : NOC:Introduction to Rings and Fields (Mathematics)

Co-ordinators : Prof. Krishna Hanumanthu

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 : NOC:Probabilistic Methods in PDE (Mathematics)

Co-ordinators : Prof. Anindya Goswami

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 1

Lecture 37 - Kacâ€™s theorem on the stochastic representation of solution to a second-order linear ODE - Part 2

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: Uniqueness

Lecture 43 - Stochastic differential equations: Existence - Part 1

Lecture 44 - Stochastic differential equations: Existence - Part 2

Lecture 45 - Stochastic differential equations: Existence - Part 3

Lecture 46 - Stochastic differential equations: Weak solution

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: Feynman-Kac formula - Part 1

Lecture 50 - Cauchy Problem with variable coefficients: Feynman-Kac formula - Part 2

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 : NOC:Linear Algebra (Prof. Pranav Haridas) (Mathematics)

Co-ordinators : Prof. Pranav Haridas

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 - Linear Transformations

Lecture 10 - Rank Nullity

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 - Dual Spaces

Lecture 20 - Quotient 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 : NOC:Algebra - I (Mathematics)

Co-ordinators : Prof. Amritanshu Prasad, Prof. S. Viswanath

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: Fixed points of group actions

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: definition

Lecture 52 - Modules over polynomial rings $K[x]$

Lecture 53 - Modules: alternative definition

Lecture 54 - Modules: more examples

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 : NOC:Computational Commutative Algebra (Mathematics)

Co-ordinators : Prof. Manoj Kummini

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 : NOC:Laplace Transform (Mathematics)

Co-ordinators : Prof. Indrava Roy

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: Definition and Existence - Part 1

Lecture 4 - Improper Riemann integrals: Definition and Existence - Part 2

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 : NOC:Measure Theory (Prof. Indrava Roy) (Mathematics)

Co-ordinators : Prof. Indrava Roy

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: Inner regularity,Upward and Downwar Monotone convergence theorem, and Dominated convergence theorem for sets - Part 1

Lecture 29 - Properties of the Lebesgue measure: Inner regularity,Upward and Downwar Monotone convergence theorem, and Dominated convergence theorem for sets - Part 2

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: Boolean and Sigma-algebras

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: definition and basic properties - Part 1

Lecture 40 - Measurable functions: definition and basic properties - Part 2

Lecture 41 - Egorov's theorem: abstract version

Lecture 42 - Lebesgue integral of unsigned simple measurable functions: definition and properties

Lecture 43 - Lebesgue integral of unsigned measurable functions: motivation, definition and basic properties

Lecture 44 - Fundamental convergence theorems in Lebesgue integration: Monotone convergence theorem, Tonelli's theorem and Fatou's lemma

Lecture 45 - Lebesgue integral for complex and real measurable functions: the space of L^1 functions

Lecture 46 - Basic properties of L^1-functions and Lebesgue's Dominated convergence theorem

Lecture 47 - L^1 functions on R^d: Egorov's theorem revisited (Littlewood's third principle)

Lecture 48 - L^1 functions on R^d: Statement of Lusin's theorem (Littlewood's second principle), Density of simple functions, step functions, and continuous compactly supported functions in L^1

Lecture 49 - L^1 functions on R^d: Proof of Lusin's theorem, space of L^1 functions as a metric space

Lecture 50 - L^1 functions on R^d: the Riesz-Fischer theorem

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: motivation and discussion of product measure spaces

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: interchanging order of integration for measurable and L^1 functions on sigma-finite measure spaces

Lecture 68 - Lebesgue's differentiation theorem: introduction and motivation

Lecture 69 - Lebesgue's differentiation theorem: statement and proof - Part 1

Lecture 70 - Lebesgue's differentiation theorem: statement and proof - Part 2

Lecture 71 - DIfferentiation theorems: Almost everywhere differentiability for Monotone and Bounded Variation functions - Part 1

Lecture 72 - DIfferentiation theorems: Almost everywhere differentiability for Monotone and Bounded Variation functions - Part 2

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 for absolutely continuous functions

NPTEL : NOC:Complex Analysis (Mathematics)

Co-ordinators : Prof. Pranav Haridas

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 : NOC:Real Analysis - I (Mathematics)

Co-ordinators : Prof. Jaikrishnan J

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 : NOC:Variational Calculus and its applications in Control Theory and Nanomechanics (Mathematics)

Co-ordinators : Prof. Sarthok Sircar

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 : NOC:Introduction to Galois Theory (Mathematics)

Co-ordinators : Prof. Krishna Hanumanthu

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 : NOC:Basic Calculus 1 (Mathematics)

Co-ordinators : Prof. Arindama Singh

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 : NOC:Functional Analysis (Mathematics)

Co-ordinators : Prof. Kesavan

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 : NOC:Mathematical Methods in Physics 1 (Mathematics)

Co-ordinators : Prof. Auditya Sharma

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 : NOC:Computational Mathematics with SageMath (Mathematics)

Co-ordinators : Prof. Ajit Kumar

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 : NOC:Introduction to Probability (with examples using R) (Mathematics)

Co-ordinators : Prof. Siva Athreya

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 : NOC:Algebra-II (Mathematics)

Co-ordinators : Prof. Amritanshu Prasad, Prof. S. Viswanath

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 : NOC:Mathematical Methods in Physics 2 (Mathematics)

Co-ordinators : Prof. Auditya Sharma

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 : NOC:Real Analysis - II (Mathematics)

Co-ordinators : Prof. Jaikrishnan J

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 : NOC:Sobolev Spaces and Partial Differential Equations (Mathematics)

Co-ordinators : Prof. Kesavan

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 : NOC:Combinatorics (Mathematics)

Co-ordinators : Prof. Narayanan N

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 : NOC:Our Mathematical Senses (Mathematics)

Co-ordinators : Prof. Vijay Ravikumar

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 : NOC:Algebraic Combinatorics (Mathematics)

Co-ordinators : Prof. Amritanshu Prasad, Prof. Sankaran Viswanath

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 : NOC:An Invitation to Topology (Mathematics)

Co-ordinators : Prof. Indrava Roy

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 ArzelÃƒ - Ascoli theorem

NPTEL : NOC:Operator Theory (Mathematics)

Co-ordinators : Prof. G. Ramesh

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 : NOC:Measure and Integration (Mathematics)

Co-ordinators : Prof. S. Kesavan

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 : NOC:Approximate Reasoning using Fuzzy Set Theory (Mathematics)

Co-ordinators : Prof. Balasubramaniam Jayaram

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 : NOC:Probability-II with Examples Using R (Mathematics)

Co-ordinators : Prof. Siva Athreya

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 : NOC:Predictive Analytics - Regression and Classification (Mathematics)

Co-ordinators : Prof. Sourish Das

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 Data

Lecture 62 - Why Julia is Future for Data Science Projects ?

Lecture 63 - Concluding Remarks

Lecture 64 - Course Review

NPTEL : NOC:Introduction to Algebraic Geometry (Mathematics)

Co-ordinators : Prof. Arijit Dey

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 AffineVariety

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 : NOC:Introduction to Statistics (Mathematics)

Co-ordinators : Prof. Sameen Naqvi

Lecture 1 - Types of variables

Lecture 2 - Types of studies

Lecture 3 - Types of sampling strategies

Lecture 4 - Python - Session 1

Lecture 5 - Python - Session 2

Lecture 6 - Summary measures of categorical and numerical variables

Lecture 7 - Measures of Dispersion

Lecture 8 - Measures of Skewness

Lecture 9 - Python - Session 3

Lecture 10 - Python - Session 4

Lecture 11 - Visualizing categorical and numerical data

Lecture 12 - Visualizing numerical data

Lecture 13 - Python - Session 5

Lecture 14 - Python - Session 6

Lecture 15 - Python - Session 7

Lecture 16 - Sampling distribution of sample mean

Lecture 17 - Central Limit Theorem

Lecture 18 - Sampling distribution of sample variance and proportion

Lecture 19 - Python - Session 8

Lecture 20 - Python - Session 9

Lecture 21 - Sampling distribution of difference of sample means - Part 1

Lecture 22 - Sampling distribution of difference of sample means - Part 2

Lecture 23 - Sampling distribution of ratio of sample variances and difference of sample proportions

Lecture 24 - Python - Session 10

Lecture 25 - Python - Session 11

Lecture 26 - Point estimation - Part 1

Lecture 27 - Point estimation - Part 2

Lecture 28 - Point estimation - Part 3

Lecture 29 - Python - Session 12

Lecture 30 - Python - Session 13

Lecture 31 - Unbiased estimation

Lecture 32 - EM algorithm - Part 1

Lecture 33 - EM algorithm - Part 2

Lecture 34 - Python - Session 14

Lecture 35 - Python - Session 15

Lecture 36 - Hypothesis Testing - Part 1

Lecture 37 - Hypothesis Testing - Part 2

Lecture 38 - Hypothesis Testing - Part 3

Lecture 39 - Python - Session 16

Lecture 40 - Python - Session 17

Lecture 41 - Hypothesis Testing for two sample problem - Part 1

Lecture 42 - Hypothesis Testing for two sample problem - Part 2

Lecture 43 - Hypothesis Testing for two sample problem - Part 3

Lecture 44 - Python - Session 18

Lecture 45 - Python - Session 19

Lecture 46 - Bootstrap Hypothesis Testing - Part 1

Lecture 47 - Python - Session 20

Lecture 48 - Python - Session 21

Lecture 49 - Bootstrap Hypothesis Testing - Part 2

Lecture 50 - Python - Session 22

Lecture 51 - Confidence Interval Estimation - Part 1

Lecture 52 - Confidence Interval Estimation - Part 2

Lecture 53 - Confidence Interval Estimation - Part 3

Lecture 54 - Python - Session 23

Lecture 55 - Python - Session 24

Lecture 56 - Confidence interval for two sample problem

Lecture 57 - Python - Session 25

Lecture 58 - Bootstrap Confidence Interval

Lecture 59 - Python - Session 26

Lecture 60 - Python - Session 27

NPTEL : NOC:Probability Theory for Data Science (Mathematics)

Co-ordinators : Prof. Ishapathik Das

Lecture 1 - Introduction

Lecture 2 - Sample Space and Events

Lecture 3 - Special Events and Various Approaches to Defining Probability

Lecture 4 - Important Theorems

Lecture 5 - Numerical Examples and Introduction to Conditional Probability

Lecture 6 - Definition of Conditional Probability and Independence

Lecture 7 - Bayes' Theorem

Lecture 8 - Random Variable

Lecture 9 - Events Defined by a Random Variable

Lecture 10 - Cumulative Distribution Function

Lecture 11 - Properties of the Cumulative Distribution Function and Discrete Random Variable

Lecture 12 - Probability Mass Function

Lecture 13 - Continuous Random Variable and Probability Density Function

Lecture 14 - Numerical Examples

Lecture 15 - Moments

Lecture 16 - Higher Order Moments and Variance of a Random Variable

Lecture 17 - Numerical Examples of Moments and Bernoulli Distribution

Lecture 18 - Binomial Distribution

Lecture 19 - Applications of Binomial Distribution

Lecture 20 - Poisson Distribution

Lecture 21 - Applications of Poisson Distribution

Lecture 22 - Numerical Examples of Poisson Distribution and Uniform Distribution

Lecture 23 - Application of Uniform Distribution and Exponential Distribution

Lecture 24 - Applications of Exponential Distribution

Lecture 25 - Memoryless Property and Gamma Distribution

Lecture 26 - Example of Gamma Distribution and Normal Distribution

Lecture 27 - Properties of Normal Distributions

Lecture 28 - Numerical Examples of Normal Distributions

Lecture 29 - Applications of Normal Distributions and Conditional Distribution Function

Lecture 30 - Examples of Conditional Distribution Function and Bivariate Random Variable

Lecture 31 - Example of Bivariate Random Variable

Lecture 32 - Properties of the Joint Cumulative Distribution Function of a Bivariate Random Variable

Lecture 33 - Independence Between Two Random Variables

Lecture 34 - Examples of Joint Cumulative Distribution Functions, Marginals, and Independence

Lecture 35 - Joint Probability Mass Function, Marginal Probability Mass Function, Examples

Lecture 36 - Numerical Examples on Bivariate Discrete Random Variables and the Concept of Joint Probability

Lecture 37 - Marginal Probability Density Function, Independence, and Examples

Lecture 38 - Numerical Examples on Probability Density Function

Lecture 39 - Conditional Probability Mass Function

Lecture 40 - Conditional Probability Density Function

Lecture 41 - Moments for Bivariate Random Variables

Lecture 42 - Association Between Two Random Variables

Lecture 43 - Numerical Examples on Moments for Bivariate Random Variables

Lecture 44 - Conditional Mean and Variance for Discrete Random Variables

Lecture 45 - Conditional Mean and Variance for Continuous Random Variables

Lecture 46 - Numerical Examples on Conditional Mean and Variance

Lecture 47 - Multivariate Random Variables

Lecture 48 - Multivariate Probability Density Function and Independence

Lecture 49 - Moments of a Multivariate Random Variable

Lecture 50 - Numerical Examples on Joint Probability Mass Functions

Lecture 51 - Numerical Examples on Joint Probability Density Functions

Lecture 52 - Multinomial Distribution and Multivariate Normal Distribution

Lecture 53 - Transformation of Random Variables

Lecture 54 - Theorem on Transformation of Random Variables

Lecture 55 - Transformation of Multivariate Random Variables

Lecture 56 - Examples of Transformation of Bivariate Random Variables

Lecture 57 - Convolution and Example on Transformation of n-variate Random Variables

Lecture 58 - Transformation of Discrete Random Variables

Lecture 59 - Moment Generating Functions

Lecture 60 - Example of Moment Generating Functions

Lecture 61 - Moment Generating Functions for the Transformation of Random Variables

Lecture 62 - Chebyshev's Inequality

Lecture 63 - Notions of Convergence, Law of Large Numbers, and the Central Limit Theorem

NPTEL : Discrete Mathematics (Mathematics)

Co-ordinators : Dr. Aditi Gangopadhyay, Dr. Sugata Gangopadhyay, Dr. Tanuja Srivastava

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 : NOC:Mathematical Methods and its Applications (Mathematics)

Co-ordinators : Prof. P.N. Agarwal, S. K. Gupta

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 constant coefficients - I

Lecture 7 - Methods for finding Particular Integral for second-order linear differential equations with constant coefficients - II

Lecture 8 - Methods for finding Particular Integral for second-order linear differential equations with constant coefficients - III

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 : NOC:Integral Equations, Calculus of Variations and its Applications (Mathematics)

Co-ordinators : Prof.D. N Pandey, Prof. P.N. Agarwal

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: Theory

Lecture 7 - Fredholm integral equation with separable kernel: Examples

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: Resolvent kernel

Lecture 11 - Fredholm integral equations with symmetric kernels: Properties of eigenvalues and eigenfunctions

Lecture 12 - Fredholm integral equations with symmetric kernels: Hilbert Schmidt theory

Lecture 13 - Fredholm integral equations with symmetric kernels: Examples

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: Fredholm first theorem - I

Lecture 22 - Classical Fredholm theory: Fredholm first theorem - II

Lecture 23 - Classical Fredholm theory: Fredholm second theorem and third theorem

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: Introduction

Lecture 40 - Calculus of variations: Basic concepts - I

Lecture 41 - Calculus of variations: Basic concepts - II

Lecture 42 - Calculus of variations: Basic concepts and Euler equation

Lecture 43 - Euler equation: Some particular cases

Lecture 44 - Euler equation : A particular case and Geodesics

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: Variational principle of least action

NPTEL : NOC:Nonlinear Programming (Mathematics)

Co-ordinators : S. K. Gupta

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 : NOC:Numerical Methods (Mathematics)

Co-ordinators : Prof. Sanjeev Kumar, Prof. Ameeya Kumar Nayak

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 error)

Lecture 19 - Interpolation - Part IV (Error in approximating a function by a polynomial using Newtonâ€™s Forward and Backward difference formula)

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 formula)

Lecture 26 - Numerical differentiation - Part II (Numerical differentiation based on Lagrangeâ€™s interpolation with examples)

Lecture 27 - Numerical differentiation - Part III (Numerical differentiation based on Divided difference formula with examples)

Lecture 28 - Numerical differentiation - Part IV (Maxima and minima of a tabulated function and differentiation errors)

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 unequal intervals)

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)merical Integration Part-I (Methodology of Numerical Integration and Rectangular rule)

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 examples)

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 : NOC:Numerical Linear Algebra (Mathematics)

Co-ordinators : Prof.D. N Pandey, Prof. P.N. Agrawal

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: Elementary Properties

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 : NOC:Numerical Methods - Finite Difference Approach (Mathematics)

Co-ordinators : Prof. Ameeya Kumar Nayak

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 : NOC:Multivariable Calculus (Mathematics)

Co-ordinators : Dr. Sanjeev Kumar, S. K. Gupta

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 : NOC:Ordinary and Partial Differential Equations and Applications (Mathematics)

Co-ordinators : Prof.D. N Pandey, Prof. P.N. Agrawal

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 : NOC:Matrix Analysis with Applications (Mathematics)

Co-ordinators : Dr. Sanjeev Kumar, S. K. Gupta

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: Iterative Methods - I

Lecture 33 - Linear Systems: Iterative Methods - II

Lecture 34 - Non-Stationary Iterative Methods: Steepest Descent - I

Lecture 35 - Non-Stationary Iterative Methods: Steepest Descent - II

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 : NOC:Mathematical Modelling: Analysis and Applications (Mathematics)

Co-ordinators : Prof. Ameeya Kumar Nayak

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 : NOC:Dynamical System and Control (Mathematics)

Co-ordinators : Prof.D. N Pandey, Dr. N. Sukavanam

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: Equilibrium Points

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: Types of Critical Points

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 : NOC:Advanced Engineering Mathematics (Mathematics)

Co-ordinators : Prof. P.N. Agarwal

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 : NOC:Higher Engineering Mathematics (Mathematics)

Co-ordinators : Prof. P.N. Agarwal

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 : NOC:Operations Research (Mathematics)

Co-ordinators : Prof. Kusumdeep

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 : NOC:Essential Mathematics for Machine Learning (Mathematics)

Co-ordinators : Prof. S.K. Gupta, Dr. Sanjeev Kumar

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 : NOC:Advanced Linear Algebra (Mathematics)

Co-ordinators : Prof. Premananda Bera

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 : NOC:EXCELing with Mathematical Modeling (Mathematics)

Co-ordinators : Prof. Sandip Banerjee

Lecture 1 - Introduction, Importance and Limitations

Lecture 2 - Units and Dimensions

Lecture 3 - Scaling

Lecture 4 - How to build mathematical models?

Lecture 5 - Basics of Excel - 1

Lecture 6 - Basics of Excel - 2

Lecture 7 - Basics of Excel - 3

Lecture 8 - Linear, Quadratic, Cubic Models

Lecture 9 - Linear Stability Analysis - I

Lecture 10 - Linear Stability Analysis - II

Lecture 11 - Lyapunov Stability

Lecture 12 - Phase Plane Analysis - 1

Lecture 13 - Phase Plane Analysis - 2

Lecture 14 - Phase Plane Analysis - 3

Lecture 15 - Growth Models (Continuous model)

Lecture 16 - Predator-Prey models

Lecture 17 - Two species competition model

Lecture 18 - Arms Race Model

Lecture 19 - Combat Model - I

Lecture 20 - Combat Model - II

Lecture 21 - Carbon Dating

Lecture 22 - Drug Distribution

Lecture 23 - Growth and decay in L-R circuit

Lecture 24 - Rectilinear motion under variable force

Lecture 25 - Dynamice of Rowing

Lecture 26 - Horizontal oscillations

Lecture 27 - Vertical oscillations

Lecture 28 - Epidemic model - 1

Lecture 29 - Epidemic model - 2

Lecture 30 - Rumor model

Lecture 31 - Varying Gravity model

Lecture 32 - Tumor model - I

Lecture 33 - Tumor model - II

Lecture 34 - Vegetation in a desert model

Lecture 35 - Mathematical model of love affairs

Lecture 36 - Discrete models: Difference Equation - I

Lecture 37 - Difference Equations - II

Lecture 38 - Basics of Excel - 4

Lecture 39 - Stability Analysis - I

Lecture 40 - Stability Analysis - II

Lecture 41 - Population Models

Lecture 42 - Bank Account Models

Lecture 43 - Economic Model (Harrod Model

Lecture 44 - Lake Pollutant Models

Lecture 45 - Mathematical Model of the Dynamics of Alcohol

Lecture 46 - Discrete Predator-Prey Model

Lecture 47 - Forsenic Model

Lecture 48 - Drug Delivery Models

Lecture 49 - Lanchester's Combat Model

Lecture 50 - Two-Species Competition Model (Discrete)

Lecture 51 - Infection model

Lecture 52 - Smoking Model

Lecture 53 - Price and Demand Model

Lecture 54 - Paper Towel model, Burning Calories Model

Lecture 55 - Learning model, Kidney function model

Lecture 56 - Empirical Modelling

Lecture 57 - Estimation of Parameters - I

Lecture 58 - Estimation of Parameters - II

Lecture 59 - Estimation of Parameters - III

Lecture 60 - Simulation Modeling

NPTEL : Advanced Matrix Theory and Linear Algebra for Engineers (Mathematics)

Co-ordinators : Prof. Vittal Rao

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 : Ordinary Differential Equations and Applications (Mathematics)

Co-ordinators : Prof. A.K. Nandakumaran, Prof. Raju K. George, Prof. P.S. Datti

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 : NOC:Linear Algebra (Mathematics)

Co-ordinators : Prof. Dilip P. Patil

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...)

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...)

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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 : NOC:An Introduction to Smooth Manifolds (Mathematics)

Co-ordinators : Prof. Harish Seshadri

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 : NOC:Measure Theory (Prof. E. K. Narayanan) (Mathematics)

Co-ordinators : Prof. E. K. Narayanan

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 : NOC:Introduction to Algebraic Geometry and Commutative Algebra (Mathematics)

Co-ordinators : Prof. Dilip P. Patil

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 : NOC:First Course on Partial Differential Equations-I (Mathematics)

Co-ordinators : Prof. P. S. Datti, Prof. A. K. Nandakumaran

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 : NOC:First Course on Partial Differential Equations - II (Mathematics)

Co-ordinators : Prof. A. K. Nandakumaran

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 : Matrix Theory (Mathematics)

Co-ordinators : Prof. Chandra Murthy

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 : NOC:C* Algebras and Spectral Theorem (Mathematics)

Co-ordinators : Prof. E K Narayanan

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 : NOC:Advanced Partial Differential Equations (Part I: Distributions and Sobolev Spaces) (Mathematics)

Co-ordinators : Prof. P.S. Datti, Prof. A K Nandakumaran

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

NPTEL : NOC:Advanced Course on Partial Differential Equations - II (Mathematics)

Co-ordinators : Prof. A K Nandakumaran, Prof. P.S. Datti

Lecture 1 - Introduction and Outline

Lecture 2 - Review of Sobolev spaces - 1

Lecture 3 - Review of Sobolev spaces - 2

Lecture 4 - Review of Sobolev spaces - 3

Lecture 5 - Review of Sobolev spaces - 4

Lecture 6 - Review of Sobolev spaces - 5

Lecture 7 - Elliptic equations and weak formulation

Lecture 8 - Abstract Formulation

Lecture 9 - Variational Inequality

Lecture 10 - Babuska-Brezzi Theorem

Lecture 11 - Strong vs Weak Form of PDE

Lecture 12 - General Second Order Equations

Lecture 13 - Non-uniqueness of Neumann problem

Lecture 14 - Biharmonic equation, Stokes system

Lecture 15 - Stokes system (Continued...)

Lecture 16 - Regularity of Ellptic Equations

Lecture 17 - Regularity (Continued...)

Lecture 18 - Maximum and Minimum Principles for weak formulation

Lecture 19 - Spectrum of the Laplace operator

Lecture 20 - First eigenvalue of the Laplace operator and a brief discussion of a Galerkin method

Lecture 21 - Introduction to semi-groups and unbounded operators

Lecture 22 - Spectrum of an operator

Lecture 23 - Examples of operators and operators in a Hilbert space

Lecture 24 - Perturbation of an operator, Kato theorems. Definition of a semi-group

Lecture 25 - Semi-group and its infinitesimal generator

Lecture 26 - Examples of semi-groups; spectrum and resolvent of the infinitesimal generator

Lecture 27 - An application. Saturation theorem

Lecture 28 - Hille-Yosida Theorem

Lecture 29 - Lumer-Philips Theorem. Stone's theorem

Lecture 30 - Abstract Cauchy Problem

Lecture 31 - Semi-group arising from the heat equation

Lecture 32 - Geneartor of the heat semi-group

Lecture 33 - Semi-group arising from the wave equation

Lecture 34 - Semi-group arising from the wave equation in energy space

Lecture 35 - Wave equation in energy space

Lecture 36 - Wave equation in energy space (Continued...)

Lecture 37 - Semi-group arising from the wave equation in H^1 x L^2

Lecture 38 - Schroedinger equation in free space

Lecture 39 - Schroedinger equation with a potential. Application of Kato's theorem

Lecture 40 - Equations in a bounded domain. Concluding remarks

NPTEL : NOC:Introduction to Group Theory (Mathematics)

Co-ordinators : Prof. R. Venkatesh

Lecture 1 - Motivation of group theory

Lecture 2 - Definition of a group

Lecture 3 - Examples of groups

Lecture 4 - The symmetric group

Lecture 5 - Subgroups of integers

Lecture 6 - Basic properties of groups

Lecture 7 - Subgroups of a group

Lecture 8 - Subgroup generated by subsets of a group

Lecture 9 - Group of integers modulo n

Lecture 10 - Some elementary number theory - I

Lecture 11 - Some elementary number theory - II

Lecture 12 - Order of an elements in a group

Lecture 13 - Cyclic groups and its subgroups

Lecture 14 - Characterization of cyclic groups

Lecture 15 - Examples of cosets of a subgroup in a group

Lecture 16 - Cosets of a subgroup of a group

Lecture 17 - Lagrange's Theorem

Lecture 18 - Number theoretic applications of Lagrange's Theorem

Lecture 19 - Normal subgroup

Lecture 20 - Some useful definitions

Lecture 21 - Internal direct product

Lecture 22 - More on normal subgroups

Lecture 23 - Normalizer of a subgroup

Lecture 24 - First Isomorphism Theorem

Lecture 25 - Second Isomorphism Theorem

Lecture 26 - Third Isomorphism Theorem

Lecture 27 - Group acting on a set

Lecture 28 - Group action - Examples

Lecture 29 - Isometries of the plane is a group

Lecture 30 - Orthogonal maps

Lecture 31 - Dihedral groups

Lecture 32 - Finite subgroups of the orthogonal group

Lecture 33 - Group acting on a set

Lecture 34 - Group action - Examples

Lecture 35 - Orbit-decomposition Theorem

Lecture 36 - Stabilizer of a subset

Lecture 37 - Applications of group action

Lecture 38 - Class equation

Lecture 39 - Some more applications of group action

Lecture 40 - G-sets and morphisms

Lecture 41 - More examples

Lecture 42 - Burnside's lemma

Lecture 43 - The Sylow's theorems

Lecture 44 - The Sylow's theorems (Continued...)

Lecture 45 - Application of Sylow's Theorems

Lecture 46 - Semidirect product of groups

Lecture 47 - Automorphisms of groups

Lecture 48 - Symmetric and alternating groups

Lecture 49 - Conjugacy in the symmetric group

Lecture 50 - Conjugacy in the symmetric group (Continued...)

Lecture 51 - Simplicity of the alternating groups

Lecture 52 - The sign map

Lecture 53 - The sign map (Continued...)

Lecture 54 - Structure theorem for finite abelian groups (using invariant factors)

Lecture 55 - The structure theorem for finite abelian groups

Lecture 56 - Proof of the structure theorem for finite abelian groups (Continued...)

Lecture 57 - Proof of the structure theorem for finite abelian groups

Lecture 58 - Structure theory of finite abelian p-groups

NPTEL : NOC:Introduction to Lie Algebras (Mathematics)

Co-ordinators : Prof. R. Venkatesh

Lecture 1 - An Introduction to Lie Algebras

Lecture 2 - Lie subalgebra and Homomorphism

Lecture 3 - Some Problems

Lecture 4 - Ideals and Quotient algebras

Lecture 5 - Isomorphism theorems

Lecture 6 - Correspondence between ideals

Lecture 7 - Low dimensional Lie algebra - 1

Lecture 8 - Low dimensional Lie algebra - 2

Lecture 9 - Some more definitions

Lecture 10 - Solvable and nilpotent Lie algebra

Lecture 11 - Nilpotent Lie algebra

Lecture 12 - The invariance Lemma

Lecture 13 - Engel's and Lie's Theorem

Lecture 14 - Engel's and Lie's Theorem (Continued...)

Lecture 15 - Lie's Theorem

Lecture 16 - Basics of Representation Theory

Lecture 17 - Basics of Representation Theory (Continued...)

Lecture 18 - Schur's lemma

Lecture 19 - Finite dimensional representations of of sl2(C)

Lecture 20 - Classification of finite dimensional representations of sl2(C)

Lecture 21 - Complete reducibility of finite dimensional representation of sl2(C) - Part 1

Lecture 22 - Complete reducibility of finite dimensional representation of sl2(C) - Part 2

Lecture 23 - Applications of Lie's and Engel's theorem

Lecture 24 - Applications of Weyl's Theorem for sl2(C)

Lecture 25 - New representations form given representations

Lecture 26 - Primary decomposition Theorem and Jordan-Chevalley decomposition

Lecture 27 - Cartan's criteria for solvability

Lecture 28 - Cartan's criteria for semisimplicity and its consequences

Lecture 29 - Abstract Jordan decomposition in semisimple Lie algebras

Lecture 30 - Casimir element of a representation of a semisimple Lie algebra

Lecture 31 - Weyl's Theorem of complete reducibility for semisimple Lie algebras

Lecture 32 - Root space decomposition of semisimple Lie algebras

Lecture 33 - Centralizer of a maximal toral subalgebra

Lecture 34 - Properties of roots

Lecture 35 - More properties of roots

Lecture 36 - Rationality of roots

Lecture 37 - Abstract root system and Weyl groups

Lecture 38 - Isomorphism of Root systems and dual root systems

Lecture 39 - Root systems of Ranks 1 and 2

Lecture 40 - Classification of rank 2 root systems

Lecture 41 - Base of a root system

Lecture 42 - Classification of bases

Lecture 43 - Basic properties of simple roots

Lecture 44 - Characterization of length function

Lecture 45 - Decomposition of root systems

Lecture 46 - Root lengths, Cartan Matrices

Lecture 47 - Cartan matrices and Dynkin diagrams

Lecture 48 - Classification of Root systems

Lecture 49 - Classification of Root systems (Continued...)

Lecture 50 - Concrete description of root systems

Lecture 51 - Uniqueness of root systems

Lecture 52 - Isomorphism theorem

Lecture 53 - Isomorphism theorem (Continued...)

Lecture 54 - Generators and relations

Lecture 55 - Serre presentation

NPTEL : NOC:Representation Theory of General Linear Lie Algebra (Mathematics)

Co-ordinators : Prof. R. Venkatesh

Lecture 1 - Basic Theory of Lie algebras

Lecture 2 - Basic Theory of Lie algebras (Continued...)

Lecture 3 - Basic Theory of Lie algebras (Continued...)

Lecture 4 - Representation Theory of Lie algebras

Lecture 5 - Representation Theory of Lie algebras (Continued...)

Lecture 6 - Representation of Lie algebras

Lecture 7 - Classification of 2 dimensional representation of two dimensional non-abelian Lie algebra

Lecture 8 - Isomorphism Theorem

Lecture 9 - Characterization of completely reducible module

Lecture 10 - Representation theory of sl2(C)

Lecture 11 - Irreducible representation of sl2(C)

Lecture 12 - Irreducible representation of sl2(C) (Continued...)

Lecture 13 - Complete reducibility of sl2(C)

Lecture 14 - Complete reducibility of sl2(C) (Continued...)

Lecture 15 - Representation theory of sl2(C)-basic observation

Lecture 16 - Application of sl2(C) representation theory in combinatorics

Lecture 17 - Constructions of new representations

Lecture 18 - Construction of universal algebras - I

Lecture 19 - Construction of universal algebras - II

Lecture 20 - Non-degenerate and invariant bilinear forms

Lecture 21 - SchurÃ¢â‚¬â„¢s lemma and Killing form

Lecture 22 - Killing form of general and special linear Lie algebras

Lecture 23 - The universal enveloping algebra

Lecture 24 - Properties of the universal enveloping algebra

Lecture 25 - The Casimir operator for representations of gln(C) and sln(C)

Lecture 26 - Weylâ€™s theorem of complete reducibility

Lecture 27 - The structure of sln+1(C)

Lecture 28 - Representations of sln+1(C) - I

Lecture 29 - Representations of sln+1(C) - II

Lecture 30 - Representations of sln+1(C) - III

Lecture 31 - Casimir operator and highest weight modules - I

Lecture 32 - Casimir operator and highest weight modules - II

Lecture 33 - Irreducible representations of sln+1(C)

Lecture 34 - Verma module and its irreducible quotient

Lecture 35 - Verma modules and standard cyclic irreducible modules

Lecture 36 - Finite dimensional standard cyclic irreducible modules

Lecture 37 - Standard cyclic irreducible modules

Lecture 38 - Character Theory - I

Lecture 39 - Character Theory - II

Lecture 40 - Deniminator Identity - Prep 1

Lecture 41 - Deniminator Identity - Prep 2

Lecture 42 - Proof of the denominator identity

Lecture 43 - Freudenthal's formula

Lecture 44 - The Weyl character formula

Lecture 45 - The Laplacian operator and the Weyl Character Formula

Lecture 46 - Proof of the Weyl Character Formula

Lecture 47 - Applications of Weyl Character formula

Lecture 48 - The Weyl dimension formula, Schur polynomials

Lecture 49 - Semi-standard Young Tableaux

Lecture 50 - BGG resolution