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 : NOC:High Performance Scientific Computing (Mathematics)

Co-ordinators : Prof. Shivasubramanian Gopalakrishnan

Lecture 1 - Introduction to Operating System

Lecture 2 - Linux Kernel Explained

Lecture 3 - Mastering Linux Directory and File Management

Lecture 4 - Understanding File Permissions and Ownership in Linux

Lecture 5 - Mastering Linux Text Processing and File Management

Lecture 6 - Linux Memory and Networking Commands

Lecture 7 - Understanding Shell Scripting: Parent-Child Processes and User Input Handling

Lecture 8 - Shell Scripting Tutorial for Beginners

Lecture 9 - Introduction to High-Performance Computing (HPC) and Its Key Components

Lecture 10 - Exploring Computing Platform Architecture and CPU Optimization Techniques

Lecture 11 - Hierarchical Memory Systems and Scalable Architectures in Large-Scale Computing

Lecture 12 - Concurrency and Synchronization in Parallel Programming:Techniques and Frameworks

Lecture 13 - Need for Parallel Computing

Lecture 14 - Role of Numerical Models in Solving complex problems on Computers

Lecture 15 - Common Challenges with Memory in Computer Architecture

Lecture 16 - Organization of hardware in Large HPC systems

Lecture 17 - Architecture of Nvidias Grace Hopper Superchip

Lecture 18 - Introduction to Shared Memory Programming using OpenMP

Lecture 19 - Distribution of work using multiple OpenMP Threads

Lecture 20 - Synchronization and Parallel Loops in OpenMP

Lecture 21 - Storage attributes of different variables in OpenMP

Lecture 22 - OpenMP Memory Model, Irregular Parallelism, and Tasks

Lecture 23 - Parallelization of example codes using OpenMP - Part 1

Lecture 24 - Parallelization of example codes using OpenMP - Part 2

Lecture 25 - Introduction to Message Passing Interface (MPI)

Lecture 26 - Sending and Receiving the messages using MPI

Lecture 27 - Collective Communication in MPI

Lecture 28 - Domain Decomposition

Lecture 29 - Parallelization of example code using MPI

Lecture 30 - Performance Analysis Frameworks for Parallel Programming

Lecture 31 - Examples of Collective Communication in MPI - Part 1

Lecture 32 - Examples of Collective Communication in MPI - Part 2

Lecture 33 - Introduction to GPU Computing

Lecture 34 - A Dive into Software Stack and Nvidia Architecture

Lecture 35 - Comparative Analysis of NVIDIA and Intel GPU Architectures

Lecture 36 - Understanding FLOPS and Memory Bandwidth Calculations for NVIDIA GPUs

Lecture 37 - SIMD vs. SIMT: Thread Mapping, Scheduling, and Pipelining in NVIDIA GPUs

Lecture 38 - Understanding 1D, 2D, and 3D Grid Arrangements - Part 1

Lecture 39 - Understanding 1D, 2D, and 3D Grid Arrangements - Part 2

Lecture 40 - Thread Block Mapping and Warp Scheduling in GPU

Lecture 41 - Exploring Warp Scheduling and Latency Management in NVIDIA GPUs

Lecture 42 - An Introduction to GPU Programming: Tools, Techniques, and CUDA - Part 1

Lecture 43 - An Introduction to GPU Programming: Tools, Techniques, and CUDA - Part 2

Lecture 44 - Understanding NVIDIA GPU Memory Types and Efficient Memory Management - Part 1

Lecture 45 - Understanding NVIDIA GPU Memory Types and Efficient Memory Management - Part 2

Lecture 46 - Understanding Third Divergence in Parallel Computing and Its Impact on GPU Performance

Lecture 47 - Memory Layouts and Their Role in Optimizing Computing Performance

Lecture 48 - CUDA Program Compilation and Execution: A Step-by-Step Guide - Part 1

Lecture 49 - CUDA Program Compilation and Execution: A Step-by-Step Guide - Part 2

Lecture 50 - Introduction to OpenACC

Lecture 51 - Parallelization of loops using OpenACC

Lecture 52 - OpenACC Data Management

Lecture 53 - OpenACC Loop Optimizations

Lecture 54 - Implementing Asynchronous behavior in OpenACC

Lecture 55 - Programming for multiple-device architecture using OpenACC

Lecture 56 - Profiling and Parallelizing the serial code using OpenACC

Lecture 57 - Programming for multiple-device architecture using MPI and CUDA

Lecture 58 - Programming for multiple-device architecture using MPI and OpenACC

Lecture 59 - Profiling Serial codes using GNU gprof

Lecture 60 - Profiling and Debugging of the codes using Valgrind

Lecture 61 - Code Debugging using GDB

Lecture 62 - Performance Analysis of MPI codes

Lecture 63 - Parallel Debugging of MPI Programs using Open Source Tools

Lecture 64 - Role of Numerical Methods in High Performance Scientific Computing

Lecture 65 - Libraries used in High Performance Scientific Computing

Lecture 66 - Introduction to HPC Schedulers using SLURM and PBS

Lecture 67 - Scientific Visualization

Lecture 68 - Revision and challenges in the future

Lecture 69 - OpenMP Revision

Lecture 70 - CUDA Revision

Lecture 71 - MPI Revision

Lecture 72 - OpenACC Revision

Lecture 73 - Heterogeneous Computing

Lecture 74 - Trends in Microprocessor Architectures

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...)

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

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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

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 : NOC:Scientific Computing using Python (Hindi) (Mathematics)

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

Lecture 1 - Introduction to Python

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

Lecture 3 - Introduction to Python (Continued...)

Lecture 4 - Introduction to Python (Continued...)

Lecture 5 - Introduction to Python (Continued...)

Lecture 6 - Introduction to Python (Continued...)

Lecture 7 - Errors in Computation

Lecture 8 - Errors in Computation (Continued...)

Lecture 9 - Solution of Non-Linear Equation

Lecture 10 - Solution of Non-Linear Equation (Continued...)

Lecture 11 - Solution of Non-Linear Equation (Continued...)

Lecture 12 - Vector and Matrix Norms

Lecture 13 - Solution of System of Linear Equations

Lecture 14 - Solution of System of Linear Equations (Continued...)

Lecture 15 - Positive Definite Matrices

Lecture 16 - Jacobi and Gauss-Seidal Iterative Methods

Lecture 17 - Matrix Eigenvalue Computation: Power Method

Lecture 18 - Gershgorin Theorem

Lecture 19 - Polynomial Interpolation

Lecture 20 - Polynomial Interpolation (Continued...)

Lecture 21 - Polynomial Interpolation (Continued...)

Lecture 22 - Polynomial Interpolation (Continued...)

Lecture 23 - Polynomial Interpolation (Continued...)

Lecture 24 - Polynomial Interpolation (Continued...)

Lecture 25 - Polynomial Interpolation (Continued...) (Spline Method)

Lecture 26 - Least Square Approximation

Lecture 27 - Least Square Approximation (Continued...)

Lecture 28 - Numerical Differentiation

Lecture 29 - Numerical Differentiation (Continued...)

Lecture 30 - Numerical Integration

Lecture 31 - Numerical Integration (Continued...)

Lecture 32 - Numerical Integration (Continued...)

Lecture 33 - Numerical Solution of Initial Value Problems

Lecture 34 - Numerical Solution of Initial Value Problems (Continued...)

Lecture 35 - Numerical Solution of Initial Value Problems (Continued...)

Lecture 36 - Numerical Solution of Boundary Value Problems

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

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

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Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31

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

Lecture 11

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Lecture 13

Lecture 14

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Lecture 16

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Lecture 49

Lecture 50

Lecture 51

Lecture 52

Lecture 53

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

Co-ordinators : Prof. Shalabh

Lecture 1

Lecture 2

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Lecture 4

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Lecture 6

Lecture 7

Lecture 8

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Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

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Lecture 47

Lecture 48

Lecture 49

Lecture 50

Lecture 51

Lecture 52

Lecture 53

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

Co-ordinators : Prof. Abhijit Pal

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

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Lecture 33

Lecture 34

Lecture 35

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Lecture 37

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

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

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Lecture 36

Lecture 37

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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 : NOC:Multivariate Procedures with R (Hindi) (Mathematics)

Co-ordinators : Prof. Shalabh

Lecture 1 - R Software and its Installation

Lecture 2 - Help, Demonstration, Examples, Packages and Libraries

Lecture 3 - Command line and Data Editor

Lecture 4 - Introduction to R Studio

Lecture 5 - R as a Calculator

Lecture 6 - Calculations with Data Vectors and Built-in Functions

Lecture 7 - Matrix Operations

Lecture 8 - Matrix Operations

Lecture 9 - Univariate Data - Central Tendency and Variability

Lecture 10 - Bivariate Data

Lecture 11 - Missing Data Handling

Lecture 12 - Measuring Central Tendency with Missing Data

Lecture 13 - Measuring Variation with Missing Data

Lecture 14 - Coefficient of Variation and Summary

Lecture 15 - Boxplots and Grouped Boxplots

Lecture 16 - Bar Diagram, Subdivided and Multiple Bar Diagrams

Lecture 17 - Pie Diagram, Histogram and Multiple Histogram

Lecture 18 - Scatter Plots, Smooth Scatter Plots and Matrix Plots

Lecture 19 - Three Dimensional Plots, Star Plots and Chernoff Faces

Lecture 20 - Continuous and Discrete

Lecture 21 - Probability Functions

Lecture 22 - Probability Functions for Continuous Bivariate and Multivariate Random Variables

Lecture 23 - Theoretical Properties

Lecture 24 - Application in R Software

Lecture 25 - Bivariate Normal and Multivariate Normal Distributions in R

Lecture 26 - Chi square (ðŒ^ðŸ), t and F Distribution

Lecture 27 - Point and Interval Estimation

Lecture 28 - Maximum Likelihood Estimation

Lecture 29 - Basics of Tests of Hypothesis

Lecture 30 - Test and Confidence Interval for Mean in One Sample with Known Variance in Univariate Data

Lecture 31 - Test and Confidence Interval for Mean in One Sample with Unknown Variance in Univariate Data

Lecture 32 - Tests for Mean in Two Samples with Univariate Data

Lecture 33 - Analysis of Variance and Homogeneity of Variances with Univariate Data

Lecture 34 - Tests for Mean Vector with Multivariate Data in One Sample

Lecture 35 - Tests for Mean Vector with Multivariate Data in Two Samples

Lecture 36 - Centering, Scaling and Z-Scores

Lecture 37 - Introduction and Basic Concepts

Lecture 38 - Estimation of Parameters

Lecture 39 - Model Fitting With R Software

Lecture 40 - Test of Hypothesis and Confidence Interval Estimation on Individual Regression Coefficients

Lecture 41 - Analysis of Variance and Implementation in R Software

Lecture 42 - Goodness of Fit and Testing of Normality

Lecture 43 - Logistic Regression Model

Lecture 44 - Introduction to Classification

Lecture 45 - Bayes Procedure for Classification

Lecture 46 - Classification Procedure for Multivariate Normal Distributions

Lecture 47 - Classification Procedure and Analysis in R

Lecture 48 - Basic Concepts and Definitions

Lecture 49 - Hierarchical Classification

Lecture 50 - Hierarchical Classification and Analysis with R

Lecture 51 - Hierarchical Classification with Example in R

Lecture 52 - Concepts and Theoretical Setup

Lecture 53 - Principle Component and Its Graphical Analysis in R

Lecture 54 - Canonical Variables and Concepts

Lecture 55 - Statistical Analysis of Canonical Variables

Lecture 56 - Canonical Variables Analysis in R

NPTEL : NOC:Optimization Algorithms: Theory and Software Implementation (Mathematics)

Co-ordinators : Prof. Thirumulanathan D

Lecture 1 - Introduction to Optimization

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

Lecture 3 - Introduction to Optimization (Continued...)

Lecture 4 - Introduction to Optimization (Continued...)

Lecture 5 - Introduction to Optimization (Continued...)

Lecture 6 - Introduction to Python

Lecture 7 - Introduction to Python (Continued...)

Lecture 8 - Introduction to Python (Continued...)

Lecture 9 - Introduction to Python (Continued...)

Lecture 10 - Introduction to Python (Continued...)

Lecture 11 - Optimization Algorithms

Lecture 12 - Optimization Algorithms (Continued...)

Lecture 13 - Optimization Algorithms (Continued...)

Lecture 14 - Optimization Algorithms (Continued...)

Lecture 15 - Optimization Algorithms (Continued...)

Lecture 16 - Gradient Descent/Conjugate Gradient Algorithms

Lecture 17 - Gradient Descent/Conjugate Gradient Algorithms (Continued...)

Lecture 18 - Gradient Descent/Conjugate Gradient Algorithms (Continued...)

Lecture 19 - Gradient Descent/Conjugate Gradient Algorithms (Continued...)

Lecture 20 - Gradient Descent/Conjugate Gradient Algorithms (Continued...)

Lecture 21 - Newton's Method

Lecture 22 - Newton's Method (Continued...)

Lecture 23 - Newton's Method (Continued...)

Lecture 24 - Newton's Method (Continued...)

Lecture 25 - Newton's Method (Continued...)

Lecture 26 - Quasi-Newton Methods

Lecture 27 - Quasi-Newton Methods (Continued...)

Lecture 28 - Quasi-Newton Methods (Continued...)

Lecture 29 - Quasi-Newton Methods (Continued...)

Lecture 30 - Quasi-Newton Methods (Continued...)

Lecture 31 - Quadratic Penalty Method

Lecture 32 - Quadratic Penalty Method (Continued...)

Lecture 33 - Quadratic Penalty Method (Continued...)

Lecture 34 - Quadratic Penalty Method (Continued...)

Lecture 35 - Quadratic Penalty Method (Continued...)

Lecture 36 - Augmented Lagrangian Method

Lecture 37 - Augmented Lagrangian Method (Continued...)

Lecture 38 - Augmented Lagrangian Method (Continued...)

Lecture 39 - Augmented Lagrangian Method (Continued...)

Lecture 40 - Augmented Lagrangian Method (Continued...)

Lecture 41 - Simplex Method

Lecture 42 - Simplex Method (Continued...)

Lecture 43 - Simplex Method (Continued...)

Lecture 44 - Simplex Method (Continued...)

Lecture 45 - Simplex Method (Continued...)

Lecture 46 - Affine Scaling Method

Lecture 47 - Affine Scaling Method (Continued...)

Lecture 48 - Affine Scaling Method (Continued...)

Lecture 49 - Affine Scaling Method (Continued...)

Lecture 50 - Affine Scaling Method (Continued...)

Lecture 51 - Affine Scaling Method (Continued...)

Lecture 52 - Affine Scaling Method (Continued...)

Lecture 53 - Affine Scaling Method (Continued...)

Lecture 54 - Affine Scaling Method (Continued...)

Lecture 55 - Affine Scaling Method (Continued...)

Lecture 56 - An application from machine learning

Lecture 57 - An application from machine learning (Continued...)

Lecture 58 - An application from machine learning (Continued...)

Lecture 59 - An application from machine learning (Continued...)

Lecture 60 - An application from machine learning (Continued...)

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 : NOC:Functional Analysis and its Applications (Mathematics)

Co-ordinators : Prof. Akhilesh Prasad

Lecture 1 - An Overview and Metric Spaces with Examples

Lecture 2 - Basic Inequalities and their Applications

Lecture 3 - Complete Metric Spaces with Examples

Lecture 4 - Vector Spaces and Subspaces with Examples

Lecture 5 - Linear Transformation with Examples

Lecture 6 - Normed Linear Space and Pseudo-Normed Linear Space with Examples

Lecture 7 - Convergence, Cauchy Sequence in Normed Linear Spaces and Banach Spaces with Examples

Lecture 8 - Further examples of Banach Spaces

Lecture 9 - The Linear Space C[a, b] as Normed Linear Space but not Banachspace

Lecture 10 - The Linear Spaces ?p and ?? as Banach Spaces

Lecture 11 - The Quotient Space as Banach Space

Lecture 12 - The Lp spaces as Banach Spaces

Lecture 13 - Bounded Linear Transformations and Equivalent Norms with Examples

Lecture 14 - Norm of Bounded (Continuous) LinearTransformations and Some Related Theorems

Lecture 15 - Continuity of Functions in Normed Linear Spaces and some related Theorems

Lecture 16 - The set of all Bounded Linear Transformations of Normed Linear Space N into N? as a

Lecture 17 - Further Theorems on Bounded Linear Transformations

Lecture 18 - Linear Functionals, Dual Vector Space and Dual Basis

Lecture 19 - Continuous (Bounded) Linear Functionals on Normed linear spaces

Lecture 20 - Consequences of Equivalent Norms with Examples and on a Finite-Dimensional space

Lecture 21 - Further Theorems on Finite-Dimensional Normed Linear Spaces

Lecture 22 - Dual Space of ?p^n, ?1^n and ??^n

Lecture 23 - Dual Space of ?p is ?q

Lecture 24 - Dual Space of ?1 is ??

Lecture 25 - Dual Space of ????0 is ?1

Lecture 26 - Dual Space of c is ?1

Lecture 27 - Inner Product Space with Examples

Lecture 28 - Further Example of Inner Product Space and Schwartzâ€™s Inequality

Lecture 29 - Continuity of Inner Product, Parallelogram Law and Polarization Identity

Lecture 30 - Hilbert Space with Examples

Lecture 31 - Application of Polarization Identity

Lecture 32 - Applications of the Parallelogram Law

Lecture 33 - Weak Convergence and Strong Convergence

Lecture 34 - Orthogonality of Vectors

Lecture 35 - Orthogonal Complement of an Orthogonal Complement

Lecture 36 - The Orthogonal Decomposition (Projection) Theorem

Lecture 37 - Orthonormal Sets in Hilbert Spaces and Besselâ€™s Inequality

Lecture 38 - Complete Orthonormal Sets

Lecture 39 - Further Theorems on Complete Orthonormal Sets and Riesz-Fischer Theorem

Lecture 40 - Gram-Schmidt Orthogonalization Process

Lecture 41 - The Conjugate Space H* and The Riesz Representation Theorem

Lecture 42 - Further Theorems on Conjugate Space H*

Lecture 43 - The Conjugate of an Operator

Lecture 44 - The Adjoint of an Operator on a Hilbert Space

Lecture 45 - Properties of Adjoint Operators on Hilbert Spaces

Lecture 46 - Self Adjoint Operators

Lecture 47 - Partially Ordered Set and Positive Operators

Lecture 48 - Normal Operators

Lecture 49 - Further Theorems of Normal Operators

Lecture 50 - Unitary Operators

Lecture 51 - Partial Order Relations, Total Order, Maximaland Minimal Elements, Zornâ€™s Lemma

Lecture 52 - Hahn-Banach Theorem - Part I

Lecture 53 - Hahn-Banach Theorem - Part II and Proofof the Main Theorem

Lecture 54 - Sublinear Functional and Generalized Hahn-Banach Theorem

Lecture 55 - Uniform Boundedness Principle

Lecture 56 - Application of the Uniform Boundedness Principle and Uniform Boundedness Principle

Lecture 57 - Applications of Uniform Boundedness Principle for Continuous Linear Functionals

Lecture 58 - Open Mapping Theorem

Lecture 59 - Applications of Open Mapping Theorem

Lecture 60 - The Closed Graph Theorem

NPTEL : NOC:Soft Computing Techniques (Mathematics)

Co-ordinators : Prof. Santimoy Kundu

Lecture 1 - Fuzzy Sets Fuzzy Membership Function Support Core Crossover points and Bandwidth of a Fuzzy set

Lecture 2 - Fuzzy Sets and Membership Function Alpha-Cut of a Fuzzy Set Fuzzy subset and Scalar cardinality

Lecture 3 - Fuzzy Sets and Membership Function Fuzzy subset and Scalar cardinality Basic operations and Properties

Lecture 4 - Fuzzy Sets and Membership functions, intersection etc

Lecture 5 - Fuzzy Sets Membership functions Basic operations

Lecture 6 - Crisp Relation and Example Fuzzy Relation and operations

Lecture 7 - Crisp relation and fuzzy relation Extension principle Fuzzy arithmetic numbers and operations

Lecture 8 - Fuzzy relation and operations Fuzzy multi-valued logic Fuzzy implications

Lecture 9 - Fuzzy relation and fuzzy implications Fuzzy multi-valued logic Defuzzification

Lecture 10 - Defuzzification

Lecture 11 - Fuzzy rules Generalised Modus Ponens Generalised Modus Tollens

Lecture 12 - Fuzzy rules Fuzzy inference system

Lecture 13 - Fuzzy inference system Mamdanis, Sugenos and Tsukamoto type inferences

Lecture 14 - Fuzzy inference systems with examples

Lecture 15 - Numerical examples

Lecture 16 - Introduction of Genetic Algorithm Darwinâ€™s Principle

Lecture 17 - Working principle and flow chart of Genetic Algorithm Important terms of Genetic Algorithm

Lecture 18 - Working procedure of Genetic Algorithm Initial population of Genetic Algorithm

Lecture 19 - Basic Concepts of Genetic Algorithm Some encoding technique of Genetic Algorithm

Lecture 20 - Working principle of Genetic Algorithm Population Set Encoding Techniques

Lecture 21 - Selection operator Population diversity and Selection Pressure Exploration and Exploitation

Lecture 22 - Population diversity and Selection Pressure Exploration and Exploitation Selection Methods

Lecture 23 - Selection Methods and Crossover Techniques

Lecture 24 - Selection Methods Crossover techniques Crossover Probability and Mutation Probability

Lecture 25 - Crossover techniques

Lecture 26 - Numerical Examples by using Genetic Algorithm

Lecture 27 - Numerical Examples

Lecture 28 - Numerical Examples (Continued...)

Lecture 29 - Numerical Examples (Continued...)

Lecture 30 - Numerical Examples (Continued...)

Lecture 31 - Introduction of Multi-objective optimization

Lecture 32 - Weighted Sum Method Epsilon-Constraint Method

Lecture 33 - Weighted Distance Metric Method Lexicographic Ordering Method Reference point method

Lecture 34 - Few Methods to solve problems of Multi-objective optimization

Lecture 35 - Introduction of Multi objective GAsVEGA Method

Lecture 36 - Vector Optimized Evolution Strategy (VOES) Weight-Based Genetic Algorithm (WBGA)

Lecture 37 - NSGA and NSGA - II

Lecture 38 - Numerical examples by using NSGA - II

Lecture 39 - Concepts on non-domination Ranking Crowding distance operator NSGA - II

Lecture 40 - Introduction of SPEA and SPEA 2

Lecture 41 - Introduction Rough Set theory

Lecture 42 - Introduction Rough Set theory Indiscernibility Relation

Lecture 43 - Indiscernibility Relation Lower Approximations Upper Approximations

Lecture 44 - Lower Approximations Upper Approximations Boundary Regions

Lecture 45 - Properties of Approximations and Basic classes of Rough Set theory with Numerical examples

Lecture 46 - Rough membership function Dependency of Attributes

Lecture 47 - Dependency of Attributes Reduct and Core

Lecture 48 - Indispensable and Dispensable Attributes Reduct and Core

Lecture 49 - Reduct and Core Discernibility Matrix and Function

Lecture 50 - Numerical examples of Discernibility Matrix and Function

Lecture 51 - Some concepts on Rough set theory Introduction to Rule Generation

Lecture 52 - Rule Generation based on Reduct and Core

Lecture 53 - Some Problems of Rule Generations

Lecture 54 - Fuzzy-Rough Sets

Lecture 55 - Some problems of Fuzzy-Rough sets

Lecture 56 - Introduction to Artificial Neural Networks

Lecture 57 - Numerical example of Backpropagation Algorithm

Lecture 58 - Intelligent Systems Introduction to Neuro-Fuzzy system

Lecture 59 - Adaptive Neuro-Fuzzy Systems

Lecture 60 - Ant colony optimization techniques

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

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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

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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

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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

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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:Geometry of Vision (Mathematics)

Co-ordinators : Prof. Vijay Ravikumar

Lecture 1 - Introduction - Geometry of Vision

Lecture 2 - Chapter One: The Power of Vanishing Points

Lecture 3 - Drawing parallel lines: a thought experiment

Lecture 4 - Why do the images of lines terminate ?

Lecture 5 - Why do some lines share a vanishing point ?

Lecture 6 - Why do some lines remain parallel ?

Lecture 7 - The vanishing point theorem

Lecture 8 - The horizon line theorem

Lecture 9 - Three views of a tiled floor

Lecture 10 - Demo: drawing the third perspective view

Lecture 11 - The second perspective view revisited

Lecture 12 - Demo: drawing railway tracks

Lecture 13 - Three views of a box

Lecture 14 - Demo: drawing in one point and two point perspective

Lecture 15 - What does a perspective drawing reveal about the viewer ?

Lecture 16 - Chapter Two: A Geometry of Coincidence

Lecture 17 - Incidence relations

Lecture 18 - Linear spaces

Lecture 19 - Extending the euclidean plane

Lecture 20 - The shape of this exended plane

Lecture 21 - Incidence relations in the extended plane

Lecture 22 - Coincidence #1 the harmonic conjugate theorem

Lecture 23 - Proof of the harmonic conjugate theorem

Lecture 24 - Coincidence #2 Pappus's theorem

Lecture 25 - Coincidence #3 Desargues's theorem

Lecture 26 - The exended euclidean space P3

Lecture 27 - Desargues's theorem in three dimensions

Lecture 28 - A Shadow drawing challenge

Lecture 29 - Solution to the Shadow drawing challenge

Lecture 30 - Proving Desargues's in three dimensions

Lecture 31 - Lifting Desargues's theorem from the plane

Lecture 32 - How to prove the converse

Lecture 33 - Chapter Three: The Shadow of a Square

Lecture 34 - Perspectivities the maps that shift perspective

Lecture 35 - Visualizing perspectivities

Lecture 36 - Perspectivities are well defined

Lecture 37 - The harmonic conjugate theorem revisited

Lecture 38 - Projectivities sequences of perspectivities

Lecture 39 - 1D projectivities a puzzle

Lecture 40 - 1D projectivities a harder puzzle

Lecture 41 - Projectivities as functions

Lecture 42 - The three fixed points theorem

Lecture 43 - 1D fundamental theorem of projective geometry

Lecture 44 - The criss cross construction

Lecture 45 - Proving pappusâ€™s theorem

Lecture 46 - 2D Fundamental theorem of projective geometry

Lecture 47 - The four fixed points lemma

Lecture 48 - The shadow of a square

Lecture 49 - Chapter Four: The Analytic Framework

Lecture 50 - Introducing the cross ratio

Lecture 51 - Evenly spaced points

Lecture 52 - How many cross ratios ?

Lecture 53 - Invariance of the cross ratio

Lecture 54 - Injectivity of the cross ratio

Lecture 55 - Proving the 3 fixed points theorem

Lecture 56 - Bonus: the cross ratio as a function

Lecture 57 - The real projective plane

Lecture 58 - Homogeneous coordinates

Lecture 59 - Homogenous proof that parallel lines converge

Lecture 60 - Bonus: join and meet as cross product

Lecture 61 - Affine charts

Lecture 62 - The matrix group of transformations of RP2

Lecture 63 - The fundamental theorem of PGL(3,R)

Lecture 64 - Visualizing the action of PGL(3,R)

Lecture 65 - Proving the fundamental theorem of PGL(3,R)

Lecture 66 - Conclusion to Geometry of Vision

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...)

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Lecture 33 - Dual spaces (Continued...)

Lecture 34 - Quotient spaces

Lecture 35 - Homomorphism theorem of vector spaces

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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 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

NPTEL : NOC:Algebraic Number Theory (Mathematics)

Co-ordinators : Prof. Mahesh Kakde

Lecture 1 - Overview and Motivation

Lecture 2 - Algebraic Numbers

Lecture 3 - The ring of integers

Lecture 4 - Lattices

Lecture 5 - Properties of ring of integers

Lecture 6 - Discriminant

Lecture 7 - Dedekind Domains (DD)

Lecture 8 - Algebraic properties of DD

Lecture 9 - Unique Factorization of Ideals - 1

Lecture 10 - Unique Factorization of Ideals - 2

Lecture 11 - Ring of Integers is a DD

Lecture 12 - Ideal Class Group

Lecture 13 - Integral Ideal in an ideal class

Lecture 14 - Finiteness of ideal class group

Lecture 15 - Geometry of numbers - 1

Lecture 16 - Geometry of numbers - 2

Lecture 17 - Dirichlet's Unit Theorem - 1

Lecture 18 - Dirichlet's Unit Theorem - 2

Lecture 19 - Relative extension - 1

Lecture 20 - Relative extension - 2

Lecture 21 - Decomposition Group

Lecture 22 - Inertia Group

Lecture 23 - The Artin map

Lecture 24 - Valuations

Lecture 25 - Archimedean valuations

Lecture 26 - Non-archimedean valuations

Lecture 27 - p-adic numbers

Lecture 28 - p-adic completion of a Number field

Lecture 29 - Product formula

Lecture 30 - Hensel's lemma

Lecture 31 - Finite extensions of local fields

Lecture 32 - Factorisation of conorm of a prime ideal in a finite extension - I

Lecture 33 - Factorisation of conorm of a prime ideal in a finite extension - II

Lecture 34 - Different - I

Lecture 35 - Different - II

Lecture 36 - Different - III

Lecture 37 - Ramification and different ideal

Lecture 38 - Quadratic Fields

Lecture 39 - Binary quadratic forms - I

Lecture 40 - Binary quadratic forms - II

Lecture 41 - Reduced binary quadratic forms

Lecture 42 - Class group of imaginary quadratic fields and binary quadratic forms - 1

Lecture 43 - Class group of imaginary quadratic fields and binary quadratic forms - 2

Lecture 44 - Computation of Class group of imaginary quadratic fields using binary quadratic forms

Lecture 45 - Order two elements in Class group of imaginary quadratic fields

Lecture 46 - Pure cubic fields - 1

Lecture 47 - Pure cubic fields - 2

Lecture 48 - Pell's equation - 1

Lecture 49 - Pell's equation - 2

Lecture 50 - Biquadratic fields - 1

Lecture 51 - Biquadratic fields - 2

Lecture 52 - Cyclotomic fields - 1

Lecture 53 - Cyclotomic fields - 2

Lecture 54 - Compuation of class groups - 1

Lecture 55 - Compuation of class groups - 2

Lecture 56 - Compuation of class groups - 3

Lecture 57 - Compuation of class groups - 4