**NPTEL : Elementary Numerical Analysis (Mathematics)**

**Co-ordinators : Prof. Rekha P. Kulkarni**

**NPTEL : Measure and Integration (Mathematics)**

**Co-ordinators : Prof. Inder K Rana**

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

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

**NPTEL : NOC:Measure Theory (Mathematics)**

**Co-ordinators : Prof. Inder K Rana**

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**

**NPTEL : NOC:Basic Linear Algebra (Mathematics)**

**Co-ordinators : Prof.Inder Kumar Rana**

**NPTEL : NOC:Commutative Algebra (Mathematics)**

**Co-ordinators : Prof. Dilip P. Patil**

**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

**NPTEL : NOC:Basic Real Analysis (Mathematics)**

**Co-ordinators : Prof. I. K. Rana**

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 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**

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

**Co-ordinators : Prof. Anant R. Shastri**

**NPTEL : NOC:Partial Differential Equations (Mathematics)**

**Co-ordinators : Prof. Sivaji Ganesh**

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

**Co-ordinators : Prof. Anant R Shastri**

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

**Co-ordinators : Prof. Anant R Shastri**

**NPTEL : NOC:Fourier Analysis and its Applications (Mathematics)**

**Co-ordinators : Prof. G. K Srinivasan**

**NPTEL : NOC:Numerical Analysis (2023) (Mathematics)**

**Co-ordinators : Prof. S. Baskar**

**NPTEL : NOC:Point Set Topology (Mathematics)**

**Co-ordinators : Prof. Ronnie Sebastian**

**NPTEL : NOC:High Performance Scientific Computing (Mathematics)**

**Co-ordinators : Prof. Shivasubramanian Gopalakrishnan**

**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

**NPTEL : NOC:Stochastic Processes - 1 (Mathematics)**

**Co-ordinators : Dr. S. Dharmaraja**

**NPTEL : NOC:Stochastic Processes (Mathematics)**

**Co-ordinators : Dr. S. Dharmaraja**

**NPTEL : NOC:Chaotic Dynamical Systems (Mathematics)**

**Co-ordinators : Dr. Anima Nagar**

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

**Co-ordinators : Dr. S. Dharmaraja**

**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**

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

**Co-ordinators : Prof. Nilladri Chaterjee**

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

**Co-ordinators : Prof. Vivek Kumar Aggarwal**

Lecture 32 - Wavelet Transform and Shannon Wavelet

**NPTEL : NOC:Advanced Probability Theory (Mathematics)**

**Co-ordinators : Prof. Niladri Chatterjee**

**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 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**

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

**Co-ordinators : Prof. Vivek K. Aggarwal**

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

**Co-ordinators : Prof. S Dharmaraja**

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

**Co-ordinators : Prof. S Dharmaraja**

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

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

**NPTEL : NOC:Introduction to Probability and Statistics (in Hindi) (Mathematics)**

**Co-ordinators : Prof. Abhay Gopal Bhatt**

**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

**NPTEL : Complex Analysis (Mathematics)**

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

**NPTEL : NOC:Mathematical Finance (Mathematics)**

**Co-ordinators : Prof. Siddhartha Pratim Chakrabarty**

**NPTEL : NOC:Mathematical Portfolio Theory (Mathematics)**

**Co-ordinators : Prof. Siddhartha Pratim Chakrabarty**

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

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

**NPTEL : NOC:Introduction to Queueing Theory (Mathematics)**

**Co-ordinators : Prof. N. Selvaraju**

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 : NOC:Calculus-II (Mathematics)**

**Co-ordinators : Prof. M. Guru Prem Prasad, Prof. Arup Chattopadhyay**

**NPTEL : Applied Multivariate Analysis (Mathematics)**

**Co-ordinators : Dr. Sharmishtha Mitra**

**NPTEL : Calculus of Variations and Integral Equations (Mathematics)**

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

**NPTEL : Linear programming and Extensions (Mathematics)**

**Co-ordinators : Prof. Prabha Sharma**

**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

**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

**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**

**NPTEL : NOC:Probability and Stochastics for finance (Mathematics)**

**Co-ordinators : Dr. Joydeep Dutta**

**NPTEL : NOC:Differential Calculus in Several Variables (Mathematics)**

**Co-ordinators : Prof. Sudipta Dutta**

**NPTEL : NOC:Curves and Surfaces (Mathematics)**

**Co-ordinators : Prof. Sudipta Dutta**

**NPTEL : NOC:Linear Regression Analysis and Forecasting (Mathematics)**

**Co-ordinators : Prof. Shalabh**

**NPTEL : NOC:Introduction to R Software (Mathematics)**

**Co-ordinators : Prof. Shalabh**

**NPTEL : NOC:Descriptive Statistics with R Software (Mathematics)**

**Co-ordinators : Prof. Shalabh**

**NPTEL : NOC:Calculus of Several Real Variables (Mathematics)**

**Co-ordinators : Dr. Joydeep Dutta**

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

**Co-ordinators : Prof. A.K. Lal**

**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**

**NPTEL : NOC:Advanced Partial Differential Equations (Mathematics)**

**Co-ordinators : Prof. Kaushik Bal**

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

**Co-ordinators : Prof. Shalabh**

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

**Co-ordinators : Prof. Shalabh**

**NPTEL : NOC:Measure Theoretic Probability 1 (Mathematics)**

**Co-ordinators : Prof. Suprio Bhar**

**NPTEL : NOC:Foundations of R Software (Mathematics)**

**Co-ordinators : Prof. Shalabh**

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

**Co-ordinators : Prof. Shalabh**

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

**Co-ordinators : Prof. Abhijit Pal**

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

**Co-ordinators : Prof. Debdas Ghosh**

**NPTEL : NOC:Measure Theoretic Probability 2 (Mathematics)**

**Co-ordinators : Prof. Suprio Bhar**

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

**Co-ordinators : Prof. Amit Kuber**

**NPTEL : NOC:Introduction to Fourier Analysis (Mathematics)**

**Co-ordinators : Prof. Parasar Mohanty**

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**

**NPTEL : NOC:Category Theory (Mathematics)**

**Co-ordinators : Prof. Amit Kuber**

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

**Co-ordinators : Prof. Shalabh**

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**

**NPTEL : NOC:Geometry of Curves and Surfaces (Mathematics)**

**Co-ordinators : Prof. Abhijit Pal**

**NPTEL : NOC:Partial Differential Equations (2025) (Mathematics)**

**Co-ordinators : Prof. Kaushik Bal**

Lecture 32 - Nonhomogeneous Equations

**NPTEL : Advanced Engineering Mathematics (Mathematics)**

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

**NPTEL : Functional Analysis (Mathematics)**

**Co-ordinators : Prof. P.D. Srivastava**

**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

**NPTEL : Optimization (Mathematics)**

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

**NPTEL : Probability and Statistics (Mathematics)**

**Co-ordinators : Prof. Somesh Kumar**

**NPTEL : Regression Analysis (Mathematics)**

**Co-ordinators : Dr. Soumen Maity**

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**

**NPTEL : A Basic Course in Real Analysis (Mathematics)**

**Co-ordinators : Prof. P.D. Srivastava**

**NPTEL : Statistical Methods for Scientists and Engineers (Mathematics)**

**Co-ordinators : Prof. Somesh Kumar**

**NPTEL : NOC:Probability and Statistics (Mathematics)**

**Co-ordinators : Prof. Somesh Kumar**

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

**NPTEL : NOC:Applied Multivariate Statistical Modeling (Mathematics)**

**Co-ordinators : Dr J Maiti**

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

**Co-ordinators : Prof. S. De**

**NPTEL : NOC:Introductory Course in Real Analysis (Mathematics)**

**Co-ordinators : Prof. P.D. Srivastava**

**NPTEL : NOC:Modeling Transport Phenomena of Microparticles (Mathematics)**

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

**NPTEL : NOC:Constrained and Unconstrained Optimization (Mathematics)**

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

**NPTEL : NOC:Matrix Solver (Mathematics)**

**Co-ordinators : Prof. Somnath Roy**

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

**Co-ordinators : Prof.Sourav Mukhopadhyay**

**NPTEL : NOC:Engineering Mathematics-I (Mathematics)**

**Co-ordinators : Prof. Jitendra Kumar**

**NPTEL : NOC:Integral and Vector Calculus (Mathematics)**

**Co-ordinators : Prof. Hari Shankar Mahato**

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

**Co-ordinators : Prof. A. Goswami**

**NPTEL : NOC:Statistical Inference (2019) (Mathematics)**

**Co-ordinators : Prof. Somesh Kumar**

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

**Co-ordinators : Prof. Somnath Bhattacharyya**

**NPTEL : NOC:Engineering Mathematics-II (Mathematics)**

**Co-ordinators : Prof. Jitendra Kumar**

**NPTEL : NOC:Advanced Calculus For Engineers (Mathematics)**

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

**NPTEL : NOC:Rings and Modules (Mathematics)**

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

**NPTEL : NOC:Advanced Computational Techniques (Mathematics)**

**Co-ordinators : Prof. Somnath Bhattacharyya**

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

**Co-ordinators : Prof. Swanand Khare**

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

**Co-ordinators : Prof. H S Mahato**

**NPTEL : NOC:Essentials of Topology (Mathematics)**

**Co-ordinators : Prof. S. P. Tiwari**

**NPTEL : NOC:Numerical Linear Algebra and Application (Mathematics)**

**Co-ordinators : Prof. Srinivasa Rao Pentyala**

**NPTEL : NOC:Mathematics for Machine Learning (Mathematics)**

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

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

**Co-ordinators : Prof. Hari Sankar Mahato**

**NPTEL : NOC:Functional Analysis and its Applications (Mathematics)**

**Co-ordinators : Prof. Akhilesh Prasad**

**NPTEL : NOC:Soft Computing Techniques (Mathematics)**

**Co-ordinators : Prof. Santimoy Kundu**

**NPTEL : NOC:Basics of Nonparametric Tests with Applications by R (Mathematics)**

**Co-ordinators : Prof. Saran Ishika Maiti**

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

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

**NPTEL : Linear Algebra (Mathematics)**

**Co-ordinators : Dr. K.C. Sivakumar**

**NPTEL : Mathematical Logic (Mathematics)**

**Co-ordinators : Prof. Arindama Singh**

**NPTEL : Real Analysis (Mathematics)**

**Co-ordinators : Prof. S.H. Kulkarni**

**NPTEL : Dynamic Data Assimilation: An Introduction (Mathematics)**

**Co-ordinators : Prof. S. Lakshmivarahan**

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**

**NPTEL : Advanced Complex Analysis (Mathematics)**

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

**NPTEL : NOC:Discrete Mathematics (Mathematics)**

**Co-ordinators : Prof. Sourav Chakraborty**

**NPTEL : Advanced Complex Analysis - Part 2 (Mathematics)**

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

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

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

**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

**NPTEL : NOC:Differential Equations (Mathematics)**

**Co-ordinators : Prof. Srinivasa Manam**

**NPTEL : NOC:Numerical Analysis (Mathematics)**

**Co-ordinators : Prof. R. Usha**

**NPTEL : NOC:Graph Theory (Mathematics)**

**Co-ordinators : Dr. Soumen Maity**

**NPTEL : NOC:Transform Techniques for Engineers (Mathematics)**

**Co-ordinators : Prof. Srinivasa Manam**

**NPTEL : NOC:Introduction to Probability and Statistics (Mathematics)**

**Co-ordinators : Prof. G. Srinivasan**

**NPTEL : NOC:Introduction to Abstract Group Theory (Mathematics)**

**Co-ordinators : Prof. Krishna Hanumanthu**

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

**Co-ordinators : Prof. Amit Kulshrestha**

**NPTEL : NOC:Introduction to Rings and Fields (Mathematics)**

**Co-ordinators : Prof. Krishna Hanumanthu**

**NPTEL : NOC:Probabilistic Methods in PDE (Mathematics)**

**Co-ordinators : Prof. Anindya Goswami**

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

**Co-ordinators : Prof. Pranav Haridas**

**NPTEL : NOC:Algebra - I (Mathematics)**

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

**NPTEL : NOC:Computational Commutative Algebra (Mathematics)**

**Co-ordinators : Prof. Manoj Kummini**

**NPTEL : NOC:Laplace Transform (Mathematics)**

**Co-ordinators : Prof. Indrava Roy**

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

**Co-ordinators : Prof. Indrava Roy**

**NPTEL : NOC:Complex Analysis (Mathematics)**

**Co-ordinators : Prof. Pranav Haridas**

**NPTEL : NOC:Real Analysis - I (Mathematics)**

**Co-ordinators : Prof. Jaikrishnan J**

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

**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

**NPTEL : NOC:Introduction to Galois Theory (Mathematics)**

**Co-ordinators : Prof. Krishna Hanumanthu**

**NPTEL : NOC:Basic Calculus 1 (Mathematics)**

**Co-ordinators : Prof. Arindama Singh**

**NPTEL : NOC:Functional Analysis (Mathematics)**

**Co-ordinators : Prof. Kesavan**

**NPTEL : NOC:Mathematical Methods in Physics 1 (Mathematics)**

**Co-ordinators : Prof. Auditya Sharma**

**NPTEL : NOC:Computational Mathematics with SageMath (Mathematics)**

**Co-ordinators : Prof. Ajit Kumar**

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

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

**Co-ordinators : Prof. Siva Athreya**

**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 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 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

**NPTEL : NOC:Real Analysis - II (Mathematics)**

**Co-ordinators : Prof. Jaikrishnan J**

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

**Co-ordinators : Prof. Kesavan**

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

**NPTEL : NOC:Combinatorics (Mathematics)**

**Co-ordinators : Prof. Narayanan N**

**NPTEL : NOC:Geometry of Vision (Mathematics)**

**Co-ordinators : Prof. Vijay Ravikumar**

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)

**NPTEL : NOC:Algebraic Combinatorics (Mathematics)**

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

**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

**NPTEL : NOC:Operator Theory (Mathematics)**

**Co-ordinators : Prof. G. Ramesh**

**NPTEL : NOC:Measure and Integration (Mathematics)**

**Co-ordinators : Prof. S. Kesavan**

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

**Co-ordinators : Prof. Balasubramaniam Jayaram**

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

**Co-ordinators : Prof. Siva Athreya**

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

**Co-ordinators : Prof. Sourish Das**

**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

**NPTEL : NOC:Introduction to Statistics (Mathematics)**

**Co-ordinators : Prof. Sameen Naqvi**

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

**Co-ordinators : Prof. Ishapathik Das**

**NPTEL : NOC:Algebra 1: Foundations (Mathematics)**

**Co-ordinators : Prof. Jaikrishnan J**

**NPTEL : Discrete Mathematics (Mathematics)**

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

**NPTEL : NOC:Mathematical Methods and its Applications (Mathematics)**

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

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

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

**NPTEL : NOC:Nonlinear Programming (Mathematics)**

**Co-ordinators : S. K. Gupta**

**NPTEL : NOC:Numerical Methods (Mathematics)**

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

**NPTEL : NOC:Numerical Linear Algebra (Mathematics)**

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

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

**Co-ordinators : Prof. Ameeya Kumar Nayak**

**NPTEL : NOC:Multivariable Calculus (Mathematics)**

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

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

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

**NPTEL : NOC:Matrix Analysis with Applications (Mathematics)**

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

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

**Co-ordinators : Prof. Ameeya Kumar Nayak**

**NPTEL : NOC:Dynamical System and Control (Mathematics)**

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

**NPTEL : NOC:Advanced Engineering Mathematics (Mathematics)**

**Co-ordinators : Prof. P.N. Agarwal**

**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

**NPTEL : NOC:Operations Research (Mathematics)**

**Co-ordinators : Prof. Kusumdeep**

**NPTEL : NOC:Essential Mathematics for Machine Learning (Mathematics)**

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

**NPTEL : NOC:Advanced Linear Algebra (Mathematics)**

**Co-ordinators : Prof. Premananda Bera**

**NPTEL : NOC:EXCELing with Mathematical Modeling (Mathematics)**

**Co-ordinators : Prof. Sandip Banerjee**

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

**Co-ordinators : Prof. Vittal Rao**

**NPTEL : Ordinary Differential Equations and Applications (Mathematics)**

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

**NPTEL : NOC:Linear Algebra (Mathematics)**

**Co-ordinators : Prof. Dilip P. Patil**

**NPTEL : NOC:An Introduction to Smooth Manifolds (Mathematics)**

**Co-ordinators : Prof. Harish Seshadri**

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

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

**Co-ordinators : Prof. E. K. Narayanan**

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**

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

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

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

**Co-ordinators : Prof. A. K. Nandakumaran**

**NPTEL : Matrix Theory (Mathematics)**

**Co-ordinators : Prof. Chandra Murthy**

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

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

**Co-ordinators : Prof. E K Narayanan**

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

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

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

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

**NPTEL : NOC:Introduction to Group Theory (Mathematics)**

**Co-ordinators : Prof. R. Venkatesh**

**NPTEL : NOC:Introduction to Lie Algebras (Mathematics)**

**Co-ordinators : Prof. R. Venkatesh**

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

**Co-ordinators : Prof. R. Venkatesh**

**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