

Lecture 1 - Scalar field and its Gradient

Lecture 2 - Line and Surface Integrals

Lecture 3 - Divergence and Curl of Vector Fields

Lecture 4 - Conservative Field, Stoke's Theorem

Lecture 5 - Laplacian

Lecture 6 - Electric Field Potential

Lecture 7 - Gauss's Law, Potential

Lecture 8 - Electric Field and Potential

Lecture 9 - Potential and Potential Energy - I

Lecture 10 - Potential and Potential Energy - II

Lecture 11 - Potential and Potential Energy - III

Lecture 12 - Coefficients of Potential and Capacitance

Lecture 13 - Poission and Laplace Equation

Lecture 14 - Solutions of Laplace Equation - I

Lecture 15 - Solutions of Laplace Equation - II

Lecture 16 - Solutions of Laplace Equation - III

Lecture 17 - Special Techniques - I

Lecture 18 - Special Techniques - II

Lecture 19 - Special Techniques - III

Lecture 20 - Dielectrics - I

Lecture 21 - Dielectrics - II

Lecture 22 - Dielectrics - III

Lecture 23 - Equation of Continuity

Lecture 24 - a) Force between current loops b) Magnetic Vector Potential

Lecture 25 - Magnetic Vector Potential

Lecture 26 - Boundary Conditions

Lecture 27 - Magnetized Material

Lecture 28 - Magentostatics (Continued...), Time Varying Field (Introduction)

Lecture 29 - Faraday's Law and Inductance

Lecture 30 - Maxwell's Equations

Lecture 31 - Maxwell's Equations and Conservation Laws

[Lecture 32 - Conservation Laws](#)

[Lecture 33 - a\) Angular Momentum Conservation b\) Electromagnetic Waves](#)

[Lecture 34 - Electromagnetic Waves](#)

[Lecture 35 - Propagation of Electromagnetic Waves in a metal](#)

[Lecture 36 - Waveguides - I](#)

[Lecture 37 - Waveguides - II](#)

[Lecture 38 - Resonating Cavity](#)

[Lecture 39 - Radiation - I](#)

[Lecture 40 - Radiation - II](#)

NPTEL : Special Theory of Relativity (Physics)

Co-ordinators : Prof. Shiva Prasad

Lecture 1 - Problem with Classical Physics

Lecture 2 - Michelson-Morley Experiment

Lecture 3 - Postulates of Special Theory of Relativity and Galilean Transformation

Lecture 4 - Look out for a New Transformation

Lecture 5 - Lorentz Transformation

Lecture 6 - Length Contraction and Time Dilation

Lecture 7 - Examples of Length Contraction and Time Dilation

Lecture 8 - Velocity Transformation and Examples

Lecture 9 - A Three Event Problem

Lecture 10 - A Problem involving Light and Concept of Casuality

Lecture 11 - Problems involving Casuality and Need to Redefine Momentum

Lecture 12 - Minikowski Space and Four Vectors

Lecture 13 - Proper Time a Four Scalar

Lecture 14 - Velocity Four Vector

Lecture 15 - Momentum Energy Four Vector

Lecture 16 - Relook at Collision Problems

Lecture 17 - Zero Rest Mass Particle and Photon

Lecture 18 - Doppler Effect in Light

Lecture 19 - Example in C-Frame

Lecture 20 - Force in Relativity

Lecture 21 - Force Four-Vector

Lecture 22 - Electric & Magnetic Field Transformation

Lecture 23 - Example of EM Field Transformation

Lecture 24 - Current Density Four Vector and Maxwell Equation

Lecture 1 - Why Quantum Computing?

Lecture 2 - Postulates of Quantum Mechanics - I

Lecture 3 - Postulates of Quantum Mechanics - II

Lecture 4 - Qubit - The smallest unit

Lecture 5 - Qubit - Bloch sphere representation

Lecture 6 - Multiple Qubit States and Quantum Gates

Lecture 7 - Quantum Gates

Lecture 8 - Quantum Circuits

Lecture 9 - No-Cloning Theorem and Quantum Teleportation

Lecture 10 - Super Dense Coding

Lecture 11 - Density Matrix - I

Lecture 12 - Density Matrix - II

Lecture 13 - Bloch Sphere and Density Matrix

Lecture 14 - Measurement Postulates - I

Lecture 15 - Measurement Postulates - II

Lecture 16 - Simple Algorithms-Deutsch Algorithm

Lecture 17 - Deutsch-Josza and Bernstein - Vazirani Algorithms

Lecture 18 - Simon Problem

Lecture 19 - Grover's Search Algorithm - I

Lecture 20 - Grover's Search Algorithm - II

Lecture 21 - Grover's Search Algorithm - III

Lecture 22 - Grover's Search Algorithm - IV

Lecture 23 - Quantum Fourier Transform

Lecture 24 - Period Finding and QFT

Lecture 25 - Implementing QFT

Lecture 26 - Implementing QFT-3 qubits (and more)

Lecture 27 - Shor's Factorization Algorithm

Lecture 28 - Shor's Factorization Algorithm-Implementation

Lecture 29 - Shor's Algorithm-Continued Fraction

Lecture 30 - Quantum Error Correction - I

Lecture 31 - Quantum Error Correction - II Three Qubit Code

[Lecture 32 - Quantum Error Correction - III Shor's 9 Qubit Code - I](#)

[Lecture 33 - Quantum Error Correction - IV Shor's 9 Qubit Code - II](#)

[Lecture 34 - Classical Information Theory](#)

[Lecture 35 - Shannon Entropy](#)

[Lecture 36 - Shannon's Noiseless Coding Theorem](#)

[Lecture 37 - Von Neumann Entropy](#)

[Lecture 38 - EPR and Bell's Inequalities - I](#)

[Lecture 39 - EPR and Bell's Inequalities - II](#)

[Lecture 40 - EPR and Bell's Inequalities - III](#)

[Lecture 41 - Cryptography-RSA Algorithm - I](#)

[Lecture 42 - Cryptography-RSA Algorithm - II](#)

[Lecture 43 - Quantum Cryptography - I](#)

[Lecture 44 - Quantum Cryptography - II](#)

[Lecture 45 - Experimental Aspects of Quantum Computing - I](#)

[Lecture 46 - Experimental Aspects of Quantum Computing - II](#)

Lecture 1 - Introduction

Lecture 2 - Algebraic Preliminaries

Lecture 3 - Basic Group Concepts and Low Order Groups - I

Lecture 4 - Basic Group Concepts and Low Order Groups - II

Lecture 5 - Lagrange's Theorem and Cayley's Theorem - I

Lecture 6 - Lagrange's Theorem and Cayley's Theorem - II

Lecture 7 - Factor Group Conjugacy Classes - I

Lecture 8 - Factor Group Conjugacy Classes - II

Lecture 9 - Cycle Structures and Molecular Notation - I

Lecture 10 - Cycle Structures and Molecular Notation - II

Lecture 11 - Cycle Structures and Classification - I

Lecture 12 - Cycle Structures and Classification - II

Lecture 13 - Point Group Notation and Factor Group - I

Lecture 14 - Point Group Notation and Factor Group - II

Lecture 15 - Representation Theory - I

Lecture 16 - Representation Theory - II

Lecture 17 - Representation Theory - III

Lecture 18 - Representation Theory - IV

Lecture 19 - Schur's Lemma and Orthogonality Theorem - I

Lecture 20 - Schur's Lemma and Orthogonality Theorem - II

Lecture 21 - Orthogonality For Characters - I

Lecture 22 - Orthogonality For Characters - II

Lecture 23 - Character Tables and Molecular Applications - I

Lecture 24 - Character Tables and Molecular Applications - II

Lecture 25 - Preliminaries About The Continuum - I

Lecture 26 - Preliminaries About The Continuum - II

Lecture 27 - Classical Groups - I

Lecture 28 - Classical Groups - II

Lecture 29 - Classical Groups-Topology - I

Lecture 30 - Classical Groups-Topology - II

Lecture 31 - $SO(3)$ And Matrix Exponent - I

[Lecture 32 - SO\(3\) And Matrix Exponent - II](#)

[Lecture 33 - Generators, Discussion Of Lie's Theorems - I](#)

[Lecture 34 - Generators, Discussion Of Lie's Theorems - II](#)

[Lecture 35 - Group Algebras; SO\(3\)-SU\(2\) Correspondence - I](#)

[Lecture 36 - Group Algebras; SO\(3\)-SU\(2\) Correspondence - II](#)

[Lecture 37 - SO\(3\), SU\(2\) Representations - I](#)

[Lecture 38 - SO\(3\), SU\(2\) Representations - II](#)

[Lecture 39 - Representation On Function Spaces - I](#)

[Lecture 40 - Representation On Function Spaces - II](#)

[Lecture 41 - Lorentz Boosts, SO\(3,1\) Algebra - I](#)

[Lecture 42 - Lorentz Boosts, SO\(3,1\) Algebra - II](#)

[Lecture 43 - Representation Of Lorentz Group And Clifford Algebra - I](#)

[Lecture 44 - Representation Of Lorentz Group And Clifford Algebra - II](#)

[Lecture 45 - SU\(3\) And Lie's Classification - I](#)

[Lecture 46 - SU\(3\) And Lie's Classification - II](#)

[Lecture 47 - Fundamental Symmetries Of Physics - I](#)

[Lecture 48 - Fundamental Symmetries Of Physics - II](#)

Lecture 1 - Introduction to Quantum Mechanics - I

Lecture 2 - Introduction to Quantum Mechanics - II

Lecture 3 - Review of Particle in Box, Potential Well, Barrier, Harmonic Oscillator - I

Lecture 4 - Review of Particle in Box, Potential Well, Barrier, Harmonic Oscillator - II

Lecture 5 - Tutorial 1 - Part I

Lecture 6 - Tutorial 1 - Part II

Lecture 7 - Bound States - I

Lecture 8 - Bound States - II

Lecture 9 - Conditions and Solutions for one Dimensional Bound States - I

Lecture 10 - Conditions and Solutions for one Dimensional Bound States - II

Lecture 11 - Tutorial 2

Lecture 12 - Linear Vector Space (LVS) - I

Lecture 13 - Linear Vector Space (LVS) - II

Lecture 14 - Linear Vector Space (LVS) - III

Lecture 15 - Basis for Operators and States in LVS - I

Lecture 16 - Basis for Operators and States in LVS - II

Lecture 17 - Tutorial 3 - Part I

Lecture 18 - Tutorial 3 - Part II

Lecture 19 - Function Spaces - I

Lecture 20 - Function Spaces - II

Lecture 21 - Postulates of Quantum Mechanics - I

Lecture 22 - Postulates of Quantum Mechanics - II

Lecture 23 - Tutorial 4 - Part I

Lecture 24 - Tutorial 4 - Part II

Lecture 25 - Classical vs Quantum Mechanics - I

Lecture 26 - Classical vs Quantum Mechanics - II

Lecture 27 - Compatible vs Incompatible Observable - I

Lecture 28 - Compatible vs Incompatible Observable - II

Lecture 29 - Tutorial 5 - Part I

Lecture 30 - Tutorial 5 - Part II

Lecture 31 - Tutorial 5 - Part III

[Lecture 32 - Schrodinger and Heisenberg Pictures - I](#)

[Lecture 33 - Schrodinger and Heisenberg Pictures - II](#)

[Lecture 34 - Solutions to other Coupled Potential Energies - I](#)

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[Lecture 36 - Tutorial 6 - Part I](#)

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[Lecture 38 - Hydrogen Atom and Wave Functions, Angular Momentum Operators, Identical Particles - I](#)

[Lecture 39 - Hydrogen Atom and Wave Functions, Angular Momentum Operators, Identical Particles - II](#)

[Lecture 40 - Identical Particles and Quantum Computer - I](#)

[Lecture 41 - Identical Particles and Quantum Computer - II](#)

[Lecture 42 - Tutorial 7 - Part I](#)

[Lecture 43 - Tutorial 7 - Part II](#)

[Lecture 44 - Harmonic Oscillator - I](#)

[Lecture 45 - Harmonic Oscillator - II](#)

[Lecture 46 - Ladder Operators - I](#)

[Lecture 47 - Ladder Operators - II](#)

[Lecture 48 - Tutorial 8 - Part I](#)

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[Lecture 50 - Stern-Gerlach Experiment - I](#)

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[Lecture 61 - Addition of Angular Momentum - I](#)

[Lecture 62 - Addition of Angular Momentum - II](#)

[Lecture 63 - Clebsch-Gordan Coefficients - I](#)

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[Lecture 65 - Tutorial 11 - Part I](#)

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[Lecture 67 - Clebsch-Gordan Coefficients - III](#)

[Lecture 68 - Tensor Operators and Wigner-Eckart Theorem - I](#)

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[Lecture 71 - Tutorial 12](#)

Lecture 1 - Quantum Theory Fundamental Quantisation - I

Lecture 2 - Quantum Theory Fundamental Quantisation - II

Lecture 3 - Path Integral Formulation - I

Lecture 4 - Path Integral Formulation - II

Lecture 5 - Path Integral Formulation - III

Lecture 6 - Path Integral Formulation - IV

Lecture 7 - Correlation Functions - I

Lecture 8 - Correlation Functions - II

Lecture 9 - Generating Functional, Forced Harmonic Oscillator - I

Lecture 10 - Generating Functional, Forced Harmonic Oscillator - II

Lecture 11 - Generating Function in Field Theory - I

Lecture 12 - Generating Function in Field Theory - II

Lecture 13 - Effective Potential - I

Lecture 14 - Effective Potential - II

Lecture 15 - Effective Potential - III

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Lecture 19 - Asymptotic Condition Kallen-Lehmann representation - I

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Lecture 22 - Gauge Invariance - Geometric Picture

Lecture 23 - Gauge Invariance - Abelian Case

Lecture 24 - Gauge Invariance - Non-abelian case

Lecture 25 - Yang Mills Theory - Coupling to Matter

Lecture 26 - Yang Mills Theory - Physical Content

Lecture 27 - Yang Mills Theory Constraint Dynamics - I

Lecture 28 - Yang Mills Theory Constraint Dynamics - II

Lecture 29 - Gauge Fixing and Faddeev Popov Ghosts - I

Lecture 30 - Gauge Fixing and Faddeev Popov Ghosts - II

Lecture 31 - Topological Vacuum of Yang Mills Theories - I

[Lecture 32 - Topological Vacuum of Yang Mills Theories - II](#)

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Lecture 2 - DNA packing and structure

Lecture 3 - Shape and function

Lecture 4 - Numbers and sizes

Lecture 5 - Spatial scales and System variation

Lecture 6 - Timescales in Biology

Lecture 7 - Random walks and Passive diffusion

Lecture 8 - Random walks to model Biology

Lecture 9 - Derivation of FRAP equations

Lecture 10 - Drift-diffusion equations

Lecture 11 - Solutions of the drift-diffusion equations

Lecture 12 - The cell signaling problem

Lecture 13 - Cell Signalling and Capture Probability of absorbing sphere

Lecture 14 - Capture probability of reflecting sphere

Lecture 15 - Mean capture time

Lecture 16 - Introduction to fluids, viscosity and reynolds number

Lecture 17 - Introduction to the navier stokes equation

Lecture 18 - Understanding reynolds number

Lecture 19 - Life at low reynolds number

Lecture 20 - Various phenomena at low reynolds number

Lecture 21 - Bacterial flagellar motion

Lecture 22 - Rotating flagellum

Lecture 23 - Energy and equilibrium

Lecture 24 - Binding problems

Lecture 25 - Transcription and translation

Lecture 26 - Internal states of macromolecules

Lecture 27 - Protein modification problem

Lecture 28 - Haemoglobin-Oxygen binding problem

Lecture 29 - Freely jointed polymer model

Lecture 30 - Entropic springs and persistence length

Lecture 31 - Freely rotating chain model and radius of gyration

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[Lecture 34 - Nucleosomes as barriers, Hi-C, and contact probabilities](#)

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[Lecture 36 - Random walk models for proteins](#)

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[Lecture 40 - Examples and implications of depletion interactions](#)

[Lecture 41 - Introduction to Biological dynamics](#)

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[Lecture 43 - Separation of timescales in enzyme kinetics](#)

[Lecture 44 - Structure and treadmilling of actins and microtubules](#)

[Lecture 45 - Average length of polymers in equilibrium](#)

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[Lecture 55 - Cytoskeleton as a motor](#)

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[Lecture 57 - Spatial pattern in biology](#)

[Lecture 58 - Some common spatial patterns in biology](#)

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[Lecture 61 - Condition for destabilization in pattern formation](#)

[Lecture 62 - Schnakenberg kinetics](#)

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Lecture 2 - Introduction - II

Lecture 3 - Normal subgroup, Coset, Conjugate group

Lecture 4 - Factor group, Homomorphism, Isomorphism

Lecture 5 - Factor group, Homomorphism, Isomorphism

Lecture 6 - Conjugacy Classes

Lecture 7 - Permutation Groups

Lecture 8 - Cycle Structure

Lecture 9 - Cycle Structure (Continued...)

Lecture 10 - Young Diagram and Molecular Symmetry

Lecture 11 - Point Groups

Lecture 12 - Symmetries of Molecules, Schoenflies Notation

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Lecture 15 - Matrix Representation of Groups - I

Lecture 16 - Matrix Representation of Groups - II

Lecture 17 - Reducible and Irreducible Representation - I

Lecture 18 - Reducible and Irreducible Representation - II

Lecture 19 - Great Orthogonality Theorem and Character Table - I

Lecture 20 - Great Orthogonality Theorem and Character Table - II

Lecture 21 - Mulliken Notation, Character Table and Basis

Lecture 22 - Tensor Product of Representation

Lecture 23 - Tensor Product and Projection Operator - I

Lecture 24 - Tensor Product and Projection Operator - II

Lecture 25 - Tensor Product and Projection Operator with an example

Lecture 26 - Binary Basis and Observables

Lecture 27 - Selection Rules

Lecture 28 - Selection Rules and Molecular Vibrations

Lecture 29 - Molecular vibration normal modes: Classical Mechanics approach

Lecture 30 - Molecular vibration normal modes: Group Theory approach

Lecture 31 - Molecular vibration modes using projection operator

- Lecture 32 - Vibrational representation of character
- Lecture 33 - Infrared Spectra and Raman Spectra
- Lecture 34 - Introduction to continuous group
- Lecture 35 - Generators of translational and rotational transformation
- Lecture 36 - Generators of Lorentz transformation
- Lecture 37 - Introduction to $O(3)$ and $SO(3)$ group
- Lecture 38 - $SO(n)$ and Lorentz group
- Lecture 39 - Generalised orthogonal group and Lie algebra
- Lecture 40 - Subalgebra of Lie algebra
- Lecture 41 - $gl(2,C)$ and $sl(2,C)$ group
- Lecture 42 - $U(n)$ and $SU(n)$ group
- Lecture 43 - Symplectic group
- Lecture 44 - $SU(2)$ and $SU(3)$ groups
- Lecture 45 - Rank, weight and weight vector
- Lecture 46 - Weight vector, root vector, comparison between $SU(2)$ and $SU(3)$ algebra
- Lecture 47 - Root diagram, simple roots, adjoint representation
- Lecture 48 - $SU(2)$ sub-algebra, Dynkin diagrams
- Lecture 49 - Fundamental weights, Young diagrams, dimension of irreducible representation
- Lecture 50 - Young diagrams and tensor products
- Lecture 51 - Tensor product, Wigner - Eckart theorem
- Lecture 52 - Tensor product of irreducible representation 1: Composite objects from fundamental particles
- Lecture 53 - Tensor product of irreducible representation 2: Decimet and octet diagrams in the Quark Model
- Lecture 54 - Clebsch - Gordan coefficients
- Lecture 55 - 1) Quadrupole moment tensor (Wigner-Eckart theorem) 2) Decimet Baryon wavefunction
- Lecture 56 - Higher dimensional multiplets in the quark model
- Lecture 57 - Symmetry breaking in continuous groups
- Lecture 58 - Dynamical symmetry in hydrogen atom: $SO(4)$ algebra
- Lecture 59 - Hydrogen atom energy spectrum and degeneracy using Runge-Lenz vector

Lecture 1 - Neutrons as Probe of Condensed Matter

Lecture 2 - Sources for thermal neutrons used in neutron scattering

Lecture 3

Lecture 4 - Calculating Neutron Scattering cross-section

Lecture 5

Lecture 6 - Scattering theory and introducing dynamics in the formalism

Lecture 7 - Scattering theory and introducing dynamics in the formalism

Lecture 8 - Scattering theory and introducing dynamics in the formalism

Lecture 9 - Scattering law's correlation with double-Fourier transform of real space correlation function

Lecture 10 - Scattering law's correlation with double-Fourier transform of real space correlation function

Lecture 11 - Correlation function to resolution and accessible($Q, \tilde{A}^\circ$). Introducing experimental facilities

Lecture 12 - Correlation function to resolution and accessible($Q, \tilde{A}^\circ$). Introducing experimental facilities

Lecture 13 - Correlation function to resolution and accessible($Q, \tilde{A}^\circ$). Introducing experimental facilities

Lecture 14 - Correlation function to resolution and accessible($Q, \tilde{A}^\circ$). Introducing experimental facilities

Lecture 15 - Introducing resolution and components of neutron scattering facilities.

Lecture 16 - Introducing resolution and components of neutron scattering facilities.

Lecture 17 - Continue with neutron scattering set up and its components like collimators, filters, detectors etc

Lecture 18 - Continue with neutron scattering set up and its components like collimators, filters, detectors etc

Lecture 19 - Describe the operation of various kinds of neutron detectors

Lecture 20 - Describe the operation of various kinds of neutron detectors

Lecture 21 - Introducing neutron choppers, velocity selectors and polarizers, some important components of beam tailoring devices

Lecture 22 - Introducing neutron choppers, velocity selectors and polarizers, some important components of beam tailoring devices

Lecture 23 - Neutron polarizers and spin-flippers

Lecture 24 - Neutron polarizers and spin-flippers

Lecture 25 - Diffraction at various length scales at a reactor and at a spallation neutron source

Lecture 26 - Diffraction at various length scales at a reactor and at a spallation neutron source

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Lecture 28 - Application of neutron crystallography

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[Lecture 36 - Neutron diffraction from liquid and amorphous systems](#)

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[Lecture 38 - Small Angle Neutron Scattering \(SANS\) for mesoscopic structure](#)

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[Lecture 44 - SANS for polymers, biological systems, nanoparticle aggregates, rocks, Superconducting vortex lattice](#)

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[Lecture 49 - Details formalism to evaluate specular neutron reflectivity and comparison with x-ray reflectometry](#)

[Lecture 50 - Details formalism to evaluate specular neutron reflectivity and comparison with x-ray reflectometry](#)

[Lecture 51 - Neutron reflectometry data analysis and reflectometers at various sources](#)

[Lecture 52 - Neutron reflectometry data analysis and reflectometers at various sources](#)

[Lecture 53 - Neutron reflectometry data analysis and reflectometers at various sources](#)

[Lecture 54 - Examples of PNR with and without spin analysis and introduction to off-specular reflectometry](#)

[Lecture 55 - Examples of PNR with and without spin analysis and introduction to off-specular reflectometry](#)

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[Lecture 59 - Off-specular neutron reflectometry and introduction to inelastic neutron scattering](#)

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[Lecture 61 - Phonon measurements with neutrons](#)

[Lecture 62 - Phonon measurements; single crystals](#)

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[Lecture 64 - Phonon: Density of States measurements](#)

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[Lecture 69 - Spin echo spectrometer, Summary of the course](#)

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Lecture 50 - Equation of motion, Focusing

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Lecture 52 - Strong focusing, Edge focusing, AG principle

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Lecture 55 - Hill's equation and parameterization - 1

Lecture 56 - Hill's equation and parameterization - 1

Lecture 57 - Hill's equation and parameterization - 2

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Lecture 59 - Hill's equation and parameterization - 3

Lecture 60 - Hill's equation and parameterization - 3

Lecture 61

Lecture 62

Lecture 63

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NPTEL : Quantum Electronics (Physics)

Co-ordinators : Prof. K. Thyagarajan

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NPTEL : NOC:Introduction to LASER (Physics)

Co-ordinators : Unknown

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Lecture 2 - Stern Gerlach Experiment, Spin Quantization, Young's Double Slit Experiment

Lecture 3 - The Mathematical Formalism of Quantum Mechanics, Uncertainty Principle

Lecture 4 - The Density Matrix Formalism, Expectation values of Operators

Lecture 5 - Quantum Harmonic Oscillator, Creation and annihilation Operators

Lecture 6 - Coherent States and their Properties

Lecture 7 - Applications of Coherent States, squeezed states

Lecture 8 - Symmetries and Conservation Principles in Quantum Mechanics

Lecture 9 - Rotation Operator and Invariance of Angular Momentum, Parity

Lecture 10 - Spherically Symmetric System and Applications to quantum dots

Lecture 11 - Spin Angular Momentum, Addition of Angular Momentum, Clebsch gordan coefficients

Lecture 12 - Magnetic Hamiltonian, Heisenberg Model

Lecture 13 - Nuclear Magnetic Resonance (NMR)

Lecture 14 - Applications of NMR, time evolution of Magnetic Moments

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Lecture 16 - Qubits,EPR Paradox

Lecture 17 - Quantum Entanglement (QE)

Lecture 18 - Teleportation, Quantum Teleportation for one spin

Lecture 19 - Entangled state for two spins

Lecture 20 - Quantum Gates, Walsh Hadamard Transformation, No cloning theorem

Lecture 21 - Perturbation Theory

Lecture 22 - Stark Effect: First order in ground state

Lecture 23 - Stark Effect: Second order in ground state

Lecture 24 - Variational method, Variation of constants, Upper bound on ground state energy

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Lecture 26 - WKB Approximation, Bohr Sommerfeld quantization condition

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Lecture 3 - Electron Pairing, Basics of BCS Theory

Lecture 4 - BCS ground state, variational calculation, expression for T_c

Lecture 5 - Order parameter, Free energy functional, Ginzburg-Landau (GL) Theory, GL equations

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Lecture 7 - Thermodynamic properties of superconductors, specific heat

Lecture 8 - Experimental determination of Superconducting properties

Lecture 9 - Unconventional Superconductivity, Uemura plot, High- T_c superconductivity, d-wave pairing, ARPES

Lecture 10 - Singlet and triplet states of two $s=1/2$, magnetic Hamiltonian

Lecture 11 - t-J model, discrete symmetry groups, example square lattice

Lecture 12 - Cuprate Superconductors, electron vs hole doped superconductors

Lecture 13 - Non-Fermi Liquid Theory, Adiabatic continuity

Lecture 14 - Quasiparticle lifetime, breakdown of Fermi Liquid Theory in cuprate superconductors

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Lecture 6 - Thermodynamic potentials

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Lecture 10 - Chandrasekhar Limit

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Lecture 21 - Tutorial - III

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Lecture 7 - Dressed States;Introduction to Density Matrix

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Lecture 17 - Cooper Pair Box as TLS;Introduction to Transmission Line

Lecture 18 - Quantization of Transmission Line - I

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Lecture 22 - The Jaynes Cummings Model - II

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NPTEL : NOC:Quantum Hall Effects (Physics)

Co-ordinators : Prof. Saurabh Basu

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Lecture 3 - Introduction to Classical and Quantum Hall Effect

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Lecture 5 - Landau Levels

Lecture 6 - Degenracy of Landau levels

Lecture 7 - Shubnikov de Haas Oscillations

Lecture 8 - Kubo Formula

Lecture 9 - Symmetric gauge

Lecture 10 - Tight binding model, Hofstadter Butterfly

Lecture 11 - Topological Invariant, Chern number

Lecture 12 - Electronic structure of Graphene

Lecture 13 - Low energy Dispersion

Lecture 14 - Dirac Hamiltonian, Hofstadter Butterfly

Lecture 15 - QHE, Landau Levels

Lecture 16 - Properties of Spin angular Momentum, Spin Hall Effect

Lecture 17 - Quantum spin Hall insulator, Kene-Mele Model

Lecture 18 - Kene-Mele Model

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Lecture 20 - Laughlin States, Properties

Lecture 21 - Plasma analogy

Lecture 22 - Composite Fermions, Hierarchy

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Lecture 2 - Review of Quantum Mechanics

Lecture 3 - Mathematical Tools: Density Matrix - Part 1

Lecture 4 - Mathematical Tools: Density Matrix - Part 2

Lecture 5 - Problem solving session - 1

Lecture 6 - Basic Technical Introduction to Quantum Entanglement

Lecture 7 - Schmidt Decomposition Method

Lecture 8 - The EPR Paradox and Bell Inequalities

Lecture 9 - Problem solving session - 2

Lecture 10 - Quantum Measurements

Lecture 11 - Properties of Quantum Entanglement

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Lecture 13 - Problem solving session - 3

Lecture 14 - Quantum Entanglement Measures - II

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Lecture 2 - Topological invariant, Berry phase

Lecture 3 - Second quantization

Lecture 4 - Ten Fold Classification

Lecture 5 - Symmetries and SSH - model

Lecture 6 - SSH - model, Introduction to superconductivity

Lecture 7 - Kitaev model

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Lecture 9 - Quantum Hall Effect

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Lecture 11 - Properties of Landau Levels

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Lecture 14 - Hall quantization and Topological invariant

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Lecture 16 - Symmetries and QHE in Graphene

Lecture 17 - Haldane model

Lecture 18 - Anomalous quantum Hall effect in Haldane model

Lecture 19 - Introduction of spin Hall effect

Lecture 20 - Spin current, quantum spin Hall effect

Lecture 21 - Quantum spin Hall insulator, Kane Mele model

Lecture 22 - Kane Mele model with Rashba spin-orbit coupling, spin Hall conductivity

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Lecture 27 - Topological Consideration of FQHE

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Lecture 2 - Laws of Thermodynamics, Entropy

Lecture 3 - Maxwell's relations, velocity distribution

Lecture 4 - Thermodynamic Potentials

Lecture 5 - Binomial expansion, Random Walk

Lecture 6 - Ensemble Theory, Micro and Macrostates and Liouville's Theorem

Lecture 7 - Ergodic Hypothesis, Phase Space

Lecture 8 - Microcanonical Ensemble and Its Applications

Lecture 9 - Canonical Ensemble, Partition Function, Central Limit Theorem

Lecture 10 - Applications of Canonical Ensemble

Lecture 11 - Bounded System, Negative Temperature, Specific Heat of Solids

Lecture 12 - Virial Theorem, Grand Canonical Distribution

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Lecture 20 - Density Matrix, Exchange Statistics, Bosons and Fermions

Lecture 21 - MB, BE, FD Statistics

Lecture 22 - Bose Statistics, Bose Einstein Condensation

Lecture 23 - Properties of BEC, Phase Transition

Lecture 24 - Experimental Aspects of BEC, Black Body Radiation, Phonons

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Lecture 26 - Bethe Ansatz

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Lecture 28 - Virial Coefficients, Equation of State for real gases

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Lecture 30 - Black Hole Thermodynamics

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Lecture 2 - Lagrangian Mechanics

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Lecture 8 - Harmonic Oscillator, Hydrogen Atom

Lecture 9 - Spin Angular Momentum, Perturbation Theory

Lecture 10 - Degenerate Perturbation Theory, Stark Effect

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Lecture 22 - Quantum Statistics

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Lecture 6 - Helmholtz's Theorem for Electric Field

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Lecture 8 - Divergence of Electric Field & Gauss's Law

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Lecture 12 - Line surface area & volume elements in Spherical Polar Coordinates

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Lecture 15 - Electric field as the gradient of electrostatic potential

Lecture 16 - Laplace's and Poisson's equations for electrostatic potential

Lecture 17 - Electrostatic potential due to a charge distribution - I; a line charge of finite length

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Lecture 19 - Uniqueness of the solution of Laplace's and Poisson's equations

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Lecture 8 - Experimental determination of mean free path

Lecture 9 - Pressure an molecular flux from mean free path

Lecture 10 - Problems on mean free path

Lecture 11 - Transport in fluids: introduction

Lecture 12 - Viscosity: transport of momentum

Lecture 13 - Thermal conductivity: trasnport of thermal energy

Lecture 14 - Diffusion coefficient: transport of mass

Lecture 15 - Molecular effusion: theory and applications

Lecture 16 - Brownian motion: concept, features, theory of fluctuation

Lecture 17 - Brownian motion: mean square displacement and vertical distribution of particles

Lecture 18 - Perrin's experiment on Brownian motion - Part 1

Lecture 19 - Perrin's experiment on Brownian motion - Part 2

Lecture 20 - Problems on Brownian motion, Rotational brownian motion

Lecture 21 - Specific heat of solids: Dulong-Petit law and Einstein theory

Lecture 22 - Limitaion of Einstein theory of specific heat

Lecture 23 - Debye theory of specific heat

Lecture 24 - Behavior of real gasses

Lecture 25 - Van der Waals equation of state

Lecture 26 - Critical parameters from Van der Waal's equation

Lecture 27 - Determination of Van der Waals' constants and Boyle temperature

Lecture 28 - Other equations of state

Lecture 29 - Measurement of temperature: Celcius scale, ideal gas scale, absolute zero

Lecture 30 - The platinum resistance thermometer

Lecture 31 - Basic concepts of classical thermodynamics

[Lecture 32 - Basic concepts of classical thermodynamics \(Continued...\)](#)

[Lecture 33 - First law of thermodynamics](#)

[Lecture 34 - General description of work done and specific heat](#)

[Lecture 35 - General discussion on Heat conduction and elastic properties](#)

[Lecture 36 - Cyclic processes](#)

[Lecture 37 - The reversible heat engine: Carnot cycle](#)

[Lecture 38 - Refrigerator and Carnot Theorem](#)

[Lecture 39 - 2nd law and Clausius theorem](#)

[Lecture 40 - Concept of Entropy and mathematical form of 2nd law](#)

[Lecture 41 - The entropy principle](#)

[Lecture 42 - Efficiency of a cycle from T-S diagram](#)

[Lecture 43 - The Otto cycle](#)

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[Lecture 45 - Entropy and available energy](#)

[Lecture 46 - Thermodynamic relations](#)

[Lecture 47 - Application of thermodynamic relation](#)

[Lecture 48 - The free energy functions](#)

[Lecture 49 - Condition for thermodynamic equilibri](#)

[Lecture 50 - Thermodynamics of chemical reaction](#)

[Lecture 51 - Equilibruim between phases: The Clapeyron equation](#)

[Lecture 52 - 1st order phase transion along liquid-vapor equilibrium](#)

[Lecture 53 - Phase diagram and triple point](#)

[Lecture 54 - The 2nd latent heat equation](#)

[Lecture 55 - Gibbs phase rule and basics of second order phase transion](#)

[Lecture 56 - Basic concepts of radiation](#)

[Lecture 57 - Diffused radiation and Kirchhoff's law](#)

[Lecture 58 - Cavity radiation as a thermodynamic system: Stefan-Boltzmann law](#)

[Lecture 59 - Thermodynamics of cavity radiation](#)

[Lecture 60 - 3rd law of thermodynamics](#)

Lecture 1 - Introduction: Magnetism and superconductivity as macroscopic quantum phenomena

Lecture 2 - Bohr magneton, BvL theorem

Lecture 3 - An electron in a magnetic field, magnetism of isolated atoms

Lecture 4 - Magnetism of isolated atoms (Continued...), Diamagnetism

Lecture 5 - Magnetism of atoms-dia and paramagnetic susceptibilities. Hund's rules, Van Vleck paramagnetism

Lecture 6 - Van Vleck paramagnetism (Continued...), Paramagnetism

Lecture 7 - Curie's law for arbitrary J, adiabatic demagnetization

Lecture 8 - Paramagnetism of conduction electrons - Pauli paramagnetism

Lecture 9 - Ions in a solid: crystal field, orbital quenching, Jahn-Teller effect

Lecture 10 - Jahn-Teller effect (Continued...), Magnetic resonance techniques NMR, ESR

Lecture 11 - Resonance techniques (Continued...), Recapitulation and overview

Lecture 12 - Recapitulation, interacting moments and long range order, dipolar exchange

Lecture 13 - Interacting moments, 2-electron system, origin of exchange and spin Hamiltonian

Lecture 14 - Spin Hamiltonian, Heisenberg model, Exchange interactions: direct

Lecture 15 - GMR, spin model and mean-field theory, Ising model

Lecture 16 - Ising model and its properties

Lecture 17 - Ising model and its properties (Continued...), absence of LRO in d=1, mean-field theory

Lecture 18 - Ising model recap, applications, exact solutions

Lecture 19 - Exact solution of Ising model in d=1, exact results in d=2. Mermin-Wagner theorem

Lecture 20 - Recap - Exact solution of Ising model. Mermin-Wagner theorem on the absence

Lecture 21 - Ferromagnetic Heisenberg model ground state

Lecture 22 - Ferromagnetic Heisenberg model, spin-waves and magnons

Lecture 23 - Antiferromagnetic Heisenberg model, AF magnetic structures

Lecture 24 - AF magnetic structures, susceptibility and excitations

Lecture 25 - Antiferromagnets and frustration, spin glass

Lecture 26 - Superconductivity: discovery, properties

Lecture 27 - Superconductivity: Meissner effect, London Equation

Lecture 28 - Electron-phonon interaction, Cooper problem

Lecture 29 - Cooper problem, setting up the BCS theory

Lecture 30 - BCS wave function, the Superconducting state and calculations of various properties

Lecture 31 - BCS theory (Continued...), energy gap, transition temperature

[Lecture 32 - Consequences of BCS theory, gap vs T, Transition temperature, specific heat, tunnelling](#)

[Lecture 33 - Transition temperature, specific heat, tunnelling](#)

[Lecture 34 - Andreev reflection, Ginzburg-Landau Theory and electrodynamics of superconductors](#)

[Lecture 35 - Ginzburg-Landau theory, coherence length and Type I and II superconductors](#)

[Lecture 36 - Flux lattice, Flux quantization, Josephson junctions](#)

[Lecture 37 - Josephson effect and Josephson junctions](#)

[Lecture 38 - SQUID, Quantum computers and Josephson junction Qubits](#)

[Lecture 39 - High-Temperature Superconductivity: an enduring enigma](#)

[Lecture 40 - Overview and conclusion](#)

Lecture 1 - Vector analysis, Scalar and vector fields, vector identities

Lecture 2 - Vector Analysis (Continued...)

Lecture 3 - Use of Levi-Civita Symbol, Coordinate system

Lecture 4 - Coordinate system, Orthogonal Transformation

Lecture 5 - Spherical Coordinate system, Line, surface and volume element

Lecture 6 - Line, surface and volume element (Continued...)

Lecture 7 - Line, surface and volume integral

Lecture 8 - Differential calculus, Gradient

Lecture 9 - Gradient operator, Concept of divergence

Lecture 10 - Divergence operator, Divergence Theorem

Lecture 11 - Curl operator, Stokes Theorem

Lecture 12 - Gradient, Divergence and Curl (A recap), Vector identities

Lecture 13 - Curvilinear coordinate system

Lecture 14 - Curvilinear coordinate system (Continued...)

Lecture 15 - Curvilinear coordinate system (Continued...)

Lecture 16 - Delta Function

Lecture 17 - Delta Function (Continued...)

Lecture 18 - Helmholtz's Theorem

Lecture 19 - Helmholtz's Theorem(Recap), Tutorial

Lecture 20 - Tutorial (Continued...)

Lecture 21 - Concept of charge, Charge density

Lecture 22 - Coulomb's Law

Lecture 23 - Coulomb's Law (Continued...), Charge distribution

Lecture 24 - Charge distribution problem, Gauss's Law

Lecture 25 - Topics More on Gauss's Law

Lecture 26 - Application of Gauss's Law

Lecture 27 - Electrostatic potential

Lecture 28 - Electrostatic potential (Continued...)

Lecture 29 - Electrostatic energy

Lecture 30 - Electrostatic energy (Continued...)

Lecture 31 - Electrostatic energy calculation

[Lecture 32 - Electrostatic dipole](#)

[Lecture 33 - Electric dipole \(Continued...\)](#)

[Lecture 34 - Multipole expansion](#)

[Lecture 35 - Monopole and Dipole moment](#)

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[Lecture 37 - Dipole and Quadrupole moment \(Continued...\)](#)

[Lecture 38 - Conductor](#)

[Lecture 39 - Conductor \(Continued...\)](#)

[Lecture 40 - Boundary condition](#)

[Lecture 41 - Electrostatic pressure, Capacitor](#)

[Lecture 42 - Energy of the Capacitor, Dielectric](#)

[Lecture 43 - Dielectric \(Continued...\)](#)

[Lecture 44 - Displacement Vector](#)

[Lecture 45 - Electrostatic boundary value problem](#)

[Lecture 46 - Electrostatic boundary value problem \(Continued...\)](#)

[Lecture 47 - Electrostatic boundary value problem \(Continued...\), Image method](#)

[Lecture 48 - Image method \(Continued...\)](#)

[Lecture 49 - Charge particle in magnetic field](#)

[Lecture 50 - Biot-Savart Law](#)

[Lecture 51 - Application of Biot-Savart Law](#)

[Lecture 52 - Ampere's Law](#)

[Lecture 53 - Application of Ampere's Law](#)

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[Lecture 55 - Magnetic vector potential \(Continued...\)](#)

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[Lecture 58 - Torque and potential energy of magnetic dipole, Magnetization](#)

[Lecture 59 - Bound Current](#)

[Lecture 60 - Magnetic materials](#)

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[Lecture 62 - Self and mutual inductance](#)

[Lecture 63 - Wave equation, Maxwell's Equation](#)

[Lecture 64 - Maxwells Equation \(Continued...\)](#)

[Lecture 65 - Maxwells Equation: a complete overview](#)

[Lecture 66 - Maxwells Equation: a complete overview \(Continued...\)](#)

[Lecture 67 - Lorentz Gauge, Maxwell's wave equation](#)

[Lecture 68 - Maxwell's wave equation \(Continued...\)](#)

[Lecture 69 - Maxwell's Equation in matter](#)

[Lecture 70 - Maxwell's Equation in matter \(Continued...\)](#)

[Lecture 71 - Tutorial 2 \(Electrostatic\)](#)

[Lecture 72 - Tutorial 3 \(Magnetostatic\)](#)

[Lecture 73 - Tutorial 4 \(Magnetostatic and EM Wave\)](#)

Lecture 1 - Introduction to solid state materials - From conventional to functional

Lecture 2 - Ceramics and Composites - I

Lecture 3 - Ceramics and Composites - II

Lecture 4 - Polymers

Lecture 5 - Introduction to Nanomaterials and functionality

Lecture 6 - Synthesis protocols - I

Lecture 7 - Synthesis protocols - II

Lecture 8 - Synthesis protocols - III

Lecture 9 - Crystal structure - I

Lecture 10 - Crystal structure - II

Lecture 11 - Crystal structure - III

Lecture 12 - Crystal imperfections

Lecture 13 - Alloys and Melts

Lecture 14 - Theory of Solids

Lecture 15 - Nearly free electron model

Lecture 16 - Bonds in molecules and solids

Lecture 17 - Transformations kinetics and reaction rates

Lecture 18 - Thermodynamics

Lecture 19 - Phase and phase transitions

Lecture 20 - Diffusion and various properties

Lecture 21 - Mechanical properties of solids

Lecture 22 - Thermal Properties of Solids

Lecture 23 - Negative and Zero Expansion Ceramics

Lecture 24 - Heat Capacity

Lecture 25 - Thermogravimetric (TGA) analysis

Lecture 26 - Introduction to magnetism and Magnetic properties of solids

Lecture 27 - From magnetic to multiferroic materials

Lecture 28 - Magnetic materials and their applications

Lecture 29 - Magnetism at nanoscale

Lecture 30 - GMR materials

Lecture 31 - CMR materials

[Lecture 32 - Ferrofluids](#)

[Lecture 33 - Spintronics and devices](#)

[Lecture 34 - Introduction to the basic properties of liquids and melts](#)

[Lecture 35 - Heat capacity and diffusion of liquids and melts](#)

[Lecture 36 - Viscosity, electric and thermal conduction of liquids and melts](#)

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[Lecture 39 - Introduction to energy storage devices and basics of supercapacitors](#)

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[Lecture 46 - X-ray Diffraction \(XRD\)](#)

[Lecture 47 - Fourier Transform Infrared Spectroscopy](#)

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[Lecture 49 - Scanning and Transmission Electron Microscopy](#)

[Lecture 50 - Summary](#)

Lecture 1 - Introduction to waves, 1D wave equation and its solutions

Lecture 2 - 1D Light waves

Lecture 3 - Characteristics of light waves - amplitude, absolute phase, wavelength and frequency

Lecture 4 - Phase, Phase velocity and Phase delay

Lecture 5 - Complex notation for the description light waves and superposition

Lecture 6 - Maxwell's equations to the 3D wave equation and its solutions

Lecture 7 - Recap of Week 1

Lecture 8 - 3D wave equation and plane waves

Lecture 9 - Complex notation for Electric fields, Superposition and interference

Lecture 10 - Fabry-Perot interferometer and its transmittance

Lecture 11 - Physical interpretation of FP transmittance

Lecture 12 - Recap of Fabry-Perot modes

Lecture 13 - Free spectral range of a Fabry-Perot etalon

Lecture 14 - Resonator modes and optical pulses - insight

Lecture 15 - Table - Top Coherent and Incoherent Imaging

Lecture 16 - Recap of Etalon free spectral range

Lecture 17 - Line width and finesse of an etalon

Lecture 18 - Actual resonator modes

Lecture 19 - Resonator configurations and stability

Lecture 20 - Recap of optical resonators

Lecture 21 - Introduction of light pulses

Lecture 22 - Complex amplitude, Gaussian pulse

Lecture 23 - Recap of light pulses

Lecture 24 - Introduction of Fourier Transforms

Lecture 25 - Tutorial 1

Lecture 26 - Motivating Fourier Transforms

Lecture 27 - Fourier Transform Properties

Lecture 28 - Frequency domain electric field

Lecture 29 - Recap of Fourier transform properties

Lecture 30 - Frequency domain description of pulses

Lecture 31 - Spectral Phase

[Lecture 32 - Recap of spectral phase](#)

[Lecture 33 - Instantaneous Frequency and group delay](#)

[Lecture 34 - Phase wrapping, blanking, and Taylor series expansion](#)

[Lecture 35 - Recap of instantaneous frequency, phase wrapping, and phase blanking](#)

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[Lecture 39 - Absolute Phase \(revisited\)](#)

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[Lecture 49 - Quadratic chirp pulses](#)

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[Lecture 56 - Time-bandwidth product](#)

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[Lecture 59 - Effect of matter on light](#)

[Lecture 60 - Recap of Lorentz oscillator, Polarization tensor](#)

[Lecture 61 - Dynamics of electrons in the Lorentz oscillator](#)

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[Lecture 65 - Origin of nonlinear optical effects](#)

[Lecture 66 - Wave equation in an inert gas](#)

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[Lecture 69 - Atoms in the presence of fields](#)

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[Lecture 71 - Attosecond pulse generation and metrology](#)

[Lecture 72 - Nonlinear optics review](#)

[Lecture 73 - Nonlinear response of matter to light](#)

[Lecture 74 - Sum and difference frequency generation](#)

[Lecture 75 - Recap of sum and difference frequency generation, second harmonic generation](#)

[Lecture 76 - Generalized nonlinear effects, conservation laws in SHG](#)

[Lecture 77 - Phase matching in SHG, polarization dependent refractive index](#)

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Concept of wave, Wave Equation

Lecture 4 - Plane wave, Spherical wave

Lecture 5 - Maxwell's wave equation, Poynting Vector

Lecture 6 - Superposition of waves

Lecture 7 - Superposition of wave (Complex method)

Lecture 8 - Random and coherent source, standing wave formation

Lecture 9 - Group and Phase velocity

Lecture 10 - Material Dispersion

Lecture 11 - Material Dispersion (Continued...)

Lecture 12 - Concept of Coherence

Lecture 13 - Concept of Coherence (Continued...)

Lecture 14 - Concept of Coherence (Continued...)

Lecture 15 - Concept of Coherence (Continued...)

Lecture 16 - Two beam interference

Lecture 17 - Young's double slit experiment

Lecture 18 - Young's double slit experiment (Continued...)

Lecture 19 - Interference by division of amplitude

Lecture 20 - Interference by division of amplitude (Continued...)

Lecture 21 - Newton's Ring

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

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

Lecture 24 - Optical Interferometers

Lecture 25 - Michelson Interferometer

Lecture 26 - Multiple beam interference

Lecture 27 - Fabry-Perot Interferometer

Lecture 28 - Fabry-Perot Interferometer (Continued...)

Lecture 29 - Resolving power of Fabry-Perot interferometer

Lecture 30 - Diffraction of Light

Lecture 31 - Huygen's Theory

[Lecture 32 - Fraunhofer Diffraction](#)

[Lecture 33 - Single-slit Diffraction](#)

[Lecture 34 - Single-slit Diffraction \(Continued...\)](#)

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[Lecture 36 - Multi-slit Diffraction](#)

[Lecture 37 - Multi-Slit Diffraction \(Continued...\)](#)

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[Lecture 39 - Grating spectra \(Continued...\)](#)

[Lecture 40 - Resolving power of grating](#)

[Lecture 41 - Fraunhofer diffraction for a circular aperture](#)

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[Lecture 46 - Zone Plate](#)

[Lecture 47 - Fresnel's diffraction from an aperture](#)

[Lecture 48 - Fresnel's diffraction for a circular aperture](#)

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[Lecture 50 - Fresnel's diffraction for a rectangular aperture \(Continued...\)](#)

[Lecture 51 - Fresnel's diffraction for semi-infinite opaque screen](#)

[Lecture 52 - Polarization of light \(Basic concept\)](#)

[Lecture 53 - Circularly polarized light](#)

[Lecture 54 - Matrix treatment of polarization](#)

[Lecture 55 - Jones Matrix for polarization](#)

[Lecture 56 - Jones Matrix for polarization \(Continued...\)](#)

[Lecture 57 - Jones Matrix for polarization \(Continued...\)](#)

[Lecture 58 - Jones Matrix for polarization \(Continued...\)](#)

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[Lecture 65 - Analyzing Polarised Light](#)

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Lecture 1 - Introductory lecture about this course

Lecture 2 - Quantum Mechanics and Symmetry of the Hydrogen Atom

Lecture 3 - Hydrogen atom: Rotational and Dynamical Symmetry of the $1/r$ Potential

Lecture 4 - Hydrogen atom: Dynamical Symmetry of the $1/r$ Potential

Lecture 5 - Degeneracy of the Hydrogen Atom: $SO(4)$

Lecture 6 - Wavefunctions of the Hydrogen Atom

Lecture 7 - Angular Momentum in Quantum Mechanics

Lecture 8 - Angular Momentum in Quantum Mechanics: half-odd-integer and integer quantum numbers: $SU(2)$ & $SO(3)$

Lecture 9 - Angular Momentum in Quantum Mechanics: Addition Theorem for Spherical Harmonics - Coupling of Angular Momenta

Lecture 10 - Angular Momentum in Quantum Mechanics Dimensionality of the Direct-Product (Composite) Vector Space CGC recursion relations

Lecture 11 - Angular Momentum in Quantum Mechanics CGC matrix, Wigner D Rotation Matrix, Irreducible Tensor Operators

Lecture 12 - Angular Momentum in Quantum Mechanics - more on ITO, and the Wigner-Eckart Theorem

Lecture 13 - Angular Momentum in Quantum Mechanics Wigner-Eckart Theorem - 2

Lecture 14 - Relativistic Quantum Mechanics of the Hydrogen Atom - 1

Lecture 15 - Relativistic Quantum Mechanics of the Hydrogen Atom - 2

Lecture 16 - Relativistic Quantum Mechanics of the Hydrogen Atom - PAULI Equation - Foldy - Wouthysen Transformations - 1

Lecture 17 - Relativistic Quantum Mechanics of the Hydrogen Atom - Foldy - Wouthysen Transformations - 2

Lecture 18 - Relativistic Quantum Mechanics of the Hydrogen Atom - Foldy - Wouthysen Transformations - 3

Lecture 19 - Relativistic Quantum Mechanics of the Hydrogen Atom - Spherical Symmetry of the Coulomb Potential

Lecture 20 - Hartree-Fock Self-Consistent Field formalism - 1

Lecture 21 - Hartree-Fock Self-Consistent Field formalism - 2

Lecture 22 - Hartree-Fock Self-Consistent Field formalism - 3

Lecture 23 - Hartree-Fock Self-Consistent Field formalism - 4

Lecture 24 - Hartree-Fock Self-Consistent Field formalism - 5

Lecture 25 - Perturbative treatment of relativistic effectsâ€| Schrodinger's and Dirac QM

Lecture 26 - Perturbative treatment of relativistic effectsâ€| Schrodinger's and Dirac QM

Lecture 27 - Probing the atom - Collisions and Spectroscopy - boundary conditions - 1

Lecture 28 - Atomic Probes - Collisions and Spectroscopy - boundary conditions - 2

Lecture 29 - Atomic Probes - Collisions and Spectroscopy - Scattering phase shifts and boundary conditions

Lecture 30 - Atomic Probes - Time reversal symmetry - applications in atomic collisions and photoionization processes

[Lecture 31 - Atomic Photoionization cross sections, angular distributions of photoelectrons - 1](#)

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[Lecture 35 - Atomic Photoionization cross sections, angular distributions of photoelectrons Cooper Zare Formula](#)

[Lecture 36 - Stark- Zeeman Spectroscopy - Stark effect](#)

[Lecture 37 - Stark- Zeeman Spectroscopy - Stark effect on \$n=2\$ excited state of the H atom Zeeman effect](#)

[Lecture 38 - Stark- Zeeman Spectroscopy - Normal, Anomalous Zeeman effect; Paschen- Back effect](#)

[Lecture 39 - Stark- Zeeman Spectroscopy - Anomalous Zeeman effect](#)

[Lecture 40 - Zeeman effect Fine structure, Hyperfine structure - Elemental, rudimentary introduction to Laser Cooling, BEC, Atomic Clock / Attosecond metrology](#)

Lecture 1 - What is Classical Field Theory?

Lecture 2 - Symmetries and Invariances - I

Lecture 3 - Symmetries and Invariances - II

Lecture 4 - Group Theory in Physics - I

Lecture 5 - Group Theory in Physics - II

Lecture 6 - Finite Groups - I

Lecture 7 - Finite Groups - II

Lecture 8 - Basics of CFT - I

Lecture 9 - Basics of CFT - II

Lecture 10 - Basics of CFT - III

Lecture 11 - Green Functions - I

Lecture 12 - Green Functions - II

Lecture 13 - Noether's Theorem - I

Lecture 14 - Noether's Theorem - II

Lecture 15 - Kink Soliton

Lecture 16 - Hidden Symmetry

Lecture 17 - Local Symmetries

Lecture 18 - The Abelian Higgs model

Lecture 19 - Lie Algebras - I

Lecture 20 - Lie Algebras - II

Lecture 21 - Magnetic Vortices - I

Lecture 22 - Magnetic Vortices - II

Lecture 23 - Non-abelian gauge theories - I

Lecture 24 - Non-abelian gauge theories - II

Lecture 25 - Irreps of Lie algebras - I

Lecture 26 - Irreps of Lie algebras - II

Lecture 27 - The Standard Model - I

Lecture 28 - The Standard Model - II

Lecture 29 - Irreps of the Lorentz/Poincare algebras

Lecture 30 - The Dirac monopole

Lecture 31 - The 't Hooft-Polyakov monopole

[Lecture 32 - Revisiting Derrick's Theorem](#)

[Lecture 33 - The Julia-Zee dyon](#)

[Lecture 34 - Instantons - I](#)

[Lecture 35 - Instantons - II](#)

[Lecture 36 - Instantons - III](#)

[Lecture 37 - Instantons - IV](#)

[Lecture 38 - Dualities](#)

[Lecture 39 - Geometrization of Field Theory](#)

NPTEL : Topics in Nonlinear Dynamics (Physics)

Co-ordinators : Prof. V. Balakrishnan

Lecture 1 - Overview

Lecture 2 - Critical points of a dynamical system

Lecture 3 - Two-dimensional flows

Lecture 4 - Stable and unstable manifolds

Lecture 5 - Hamiltonian dynamics - Part I

Lecture 6 - Hamiltonian dynamics - Part II

Lecture 7 - Hamiltonian dynamics - Part III

Lecture 8 - Hamiltonian dynamics - Part IV

Lecture 9 - Hamiltonian dynamics - Part V

Lecture 10 - Elementary bifurcations

Lecture 11 - Limit cycles

Lecture 12 - Poincaré index

Lecture 13 - Illustrative examples

Lecture 14 - Quiz 1. Questions and answers

Lecture 15 - Bead on a rotating hoop

Lecture 16 - Types of dynamical behaviour

Lecture 17 - Discrete time dynamics - Part I

Lecture 18 - Discrete time dynamics - Part II

Lecture 19 - Discrete time dynamics - Part III

Lecture 20 - Discrete time dynamics - Part IV

Lecture 21 - Coarse-grained dynamics in phase space - Part I

Lecture 22 - Coarse-grained dynamics in phase space - Part II & Stochastic dynamics - Part I

Lecture 23 - Stochastic dynamics - Part II

Lecture 24 - Stochastic dynamics - Part III

Lecture 25 - Coarse-grained dynamics in phase space - Part IV & Stochastic dynamics - Part IV

Lecture 26 - Discrete time dynamics - Part V

Lecture 27 - Quiz 2. Questions and answers

Lecture 28 - Stochastic dynamics - Part V

Lecture 29 - Stochastic dynamics - Part VI

Lecture 1 - Principles of Condensed Matter Physics

Lecture 2 - Symmetry in Perfect Solids

Lecture 3 - Symmetry in Perfect Solids (Continued...)

Lecture 4 - Symmetry in Perfect Solids - Worked Examples

Lecture 5 - Diffraction Methods For Crystal Structures

Lecture 6 - Diffraction Methods For Crystal Structures (Continued...)

Lecture 7 - Diffraction Methods For Crystal Structures - Worked Examples

Lecture 8 - Physical Properties of Crystals

Lecture 9 - Physical Properties of Crystals (Continued...)

Lecture 10 - Physical Properties of Crystals - Worked Examples

Lecture 11 - Cohesion in Solids

Lecture 12 - Cohesion in Solids - Worked Examples

Lecture 13 - The Free Electron Theory of Metals

Lecture 14 - The Free Electron Theory of Metals - Worked Examples

Lecture 15 - The Free Electron Theory of Metals - Electrical Conductivity

Lecture 16 - The Free Electron Theory of Metals - Electrical Conductivity - Worked Examples

Lecture 17 - Thermal Conductivity of Metals

Lecture 18 - Thermal Conductivity of Metals - Worked Examples

Lecture 19 - The Concept of Phonons

Lecture 20 - Debye Theory of Specific Heat, Lattice Vibrations

Lecture 21 - Debye Theory of Specific Heat, Lattice Vibrations - Worked Examples

Lecture 22 - Lattice Vibrations (Continued) Phonon thermal conductivity

Lecture 23 - Lattice Vibrations (Continued) Phonon Thermal Conductivity - Worked Examples

Lecture 24 - Anharmonicity and Thermal Expansion

Lecture 25 - Dielectric (Insulating) Solids

Lecture 26 - Dispersion and Absorption of Electromagnetic Waves in Dielectric Media, Ferro-and Antiferroelectrics

Lecture 27 - Optical Properties of Metals; Ionic Polarization in Alkali Halides; Piezoelectricity

Lecture 28 - Dielectric Solids - Worked Examples

Lecture 29 - Dia - and Paramagnetism

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Co-ordinators : Dr. Prasanta Tripathy

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Co-ordinators : Prof. S. Lakshmi Bala

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NPTEL : Nuclear Reactors and Safety - An Introduction (Physics)

Co-ordinators : Dr.G.Vaidyanathan

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NPTEL : Physical Applications of Stochastic Processes (Physics)

Co-ordinators : Prof. V. Balakrishnan

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- Lecture 19 - Power spectrum of noise
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- Lecture 22 - Dichotomous diffusion
- Lecture 23 - First passage time (Part 1)
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Lecture 11 - Vectors in 3-Dimensional space (Continued...)

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