NPTEL : Electromagnetic Theory (Prof. D.K. Ghosh) (Physics)

Co-ordinators : Prof. D.K. Ghosh

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

NPTEL : NOC:Quantum Information and Computing (Physics)

Co-ordinators : Prof.Dipan Ghosh

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 Circuts

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 - Ven 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

NPTEL : NOC:Theory of Groups for Physics Applications (Physics)

Co-ordinators : Prof. Urjit A. Yajnik

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

NPTEL : NOC:Quantum Mechanics-I (Physics)

Co-ordinators : Prof. Ramadevi

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

Lecture 35 - Solutions to other Coupled Potential Energies - II

Lecture 36 - Tutorial 6 - Part I

Lecture 37 - Tutorial 6 - Part II

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

Lecture 49 - Tutorial 8 - Part II

Lecture 50 - Stern-Gerlach Experiment - I

Lecture 51 - Stern-Gerlach Experiment - II

Lecture 52 - Oscillator Algebra

Lecture 53 - Tutorial 9 - Part I

Lecture 54 - Tutorial 9 - Part II

Lecture 55 - Angular Momentum - I

Lecture 56 - Angular Momentum - II

Lecture 57 - Rotations Groups - I

Lecture 58 - Rotations Groups - II

Lecture 59 - Tutorial 10 - Part I

Lecture 60 - Tutorial 10 - Part II

Lecture 61 - Addition of Angular Momentum - I

Lecture 62 - Addition of Angular Momentum - II

Lecture 63 - Clebsch-Gordan Coe cients - I

Lecture 64 - Clebsch-Gordan Coe cients - II

Lecture 65 - Tutorial 11 - Part I

Lecture 66 - Tutorial 11 - Part II

Lecture 67 - Clebsch-Gordan Coe cients - III

Lecture 68 - Tensor Operators and Wigner-Eckart Theorem - I

Lecture 69 - Tensor Operators and Wigner-Eckart Theorem - II

Lecture 70 - Tensor Operators and Wigner-Eckart Theorem - III

Lecture 71 - Tutorial 12

NPTEL : NOC:Path Integral and Functional Methods in Quantum Field Theory (Physics)

Co-ordinators : Prof. Urjit A. Yajnik

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

Lecture 16 - Effective Potential - IV

Lecture 17 - Asymptotic Theory - I

Lecture 18 - Asymptotic Theory - II

Lecture 19 - Asymptotic Condition Kallen-Lehmann representation - I

Lecture 20 - Asymptotic Condition Kallen-Lehmann representation - II

Lecture 21 - Gauge Invariance - Minimal Coupling

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

NPTEL : NOC:Physics of Biological Systems (Physics)

Co-ordinators : Prof. Mithun Mitra

Lecture 1 - Introduction

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

Lecture 32 - The hierarchical chromatin packing model

Lecture 33 - FISH and DNA looping

Lecture 34 - Nucleosomes as barriers, Hi-C, and contact probabilities

Lecture 35 - Deriving the full force extension curve

Lecture 36 - Random walk models for proteins

Lecture 37 - Hydrophobic polar protein model

Lecture 38 - Diffusion in crowded environments

Lecture 39 - Depletion interactions

Lecture 40 - Examples and implications of depletion interactions

Lecture 41 - Introduction to Biological dynamics

Lecture 42 - Introduction to rate equations

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

Lecture 46 - Growth rate of polymers

Lecture 47 - Dynamic treadmilling in microtubules

Lecture 48 - Introduction to molecular motors

Lecture 49 - Force generation by molecular motors

Lecture 50 - Models of motor motion

Lecture 51 - molecular motors

Lecture 52 - Free energies of motor for stepping

Lecture 53 - Two state models

Lecture 54 - cooperative transport of cargo

Lecture 55 - Cytoskeleton as a motor

Lecture 56 - translocation ratchet

Lecture 57 - Spatial pattern in biology

Lecture 58 - Some common spatial patterns in biology

Lecture 59 - reaction diffusion and spatial pattern

Lecture 60 - Pattern formation in reaction diffusion system with stability

Lecture 61 - Condition for destablization in pattern formation

Lecture 62 - Schnakenberg kinetics

NPTEL : NOC:Group Theory Methods in Physics (Physics)

Co-ordinators : Prof. Ramadevi

Lecture 1 - Introduction - I

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

Lecture 13 - Symmetries of Molecules, Stereographic Projection

Lecture 14 - Examples of Molecular Symmetries and Proof of Cayley Theorem

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

NPTEL : NOC:Neutron Scattering for Condensed Matter Studies (Physics)

Co-ordinators : Prof. Saibal Basu

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,Ãâ€°). Introducing experimental facilities

Lecture 12 - Correlation function to resolution and accessible(Q,Ãâ€°). Introducing experimental facilities

Lecture 13 - Correlation function to resolution and accessible(Q,Ãâ€°). Introducing experimental facilities

Lecture 14 - Correlation function to resolution and accessible(Q,Ãâ€°). 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

Lecture 27 - Application of neutron crystallography

Lecture 28 - Application of neutron crystallography

Lecture 29 - Magnetism in solids

Lecture 30 - Magnetism in solids

Lecture 31 - Magnetic interaction in solids and magnetic neutron diffarction

Lecture 32 - Magnetic interaction in solids and magnetic neutron diffarction

Lecture 33 - Magnetic interaction in solids and magnetic neutron diffarction

Lecture 34 - Magnetic neutron diffraction

Lecture 35 - Magnetic neutron diffraction

Lecture 36 - Neutron diffraction from liquid and amorphous systems

Lecture 37 - Neutron diffraction from liquid and amorphous systems

Lecture 38 - Small Angle Neutron Scattering (SANS) for mesoscopic structure

Lecture 39 - Small Angle Neutron Scattering (SANS) for mesoscopic structure

Lecture 40 - Small Angle Neutron Scattering (SANS) for mesoscopic structure

Lecture 41 - Small Angle Neutron Scattering (SANS) for mesoscopic structure

Lecture 42 - SANS for soft condensed matter

Lecture 43 - SANS for soft condensed matter

Lecture 44 - SANS for polymers, biological systems, nanoparticle aggregates, rocks, Superconducting vortex lattice

Lecture 45 - SANS for polymers, biological systems, nanoparticle aggregates, rocks, Superconducting vortex lattice

Lecture 46 - Neutron reflectometry for thin films

Lecture 47 - Neutron reflectometry for thin films

Lecture 48 - Neutron reflectometry for thin films

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

Lecture 56 - Examples of PNR with and without spin analysis and introduction to off-specular reflectometry

Lecture 57 - Off-specular neutron reflectometry and introduction to inelastic neutron scattering

Lecture 58 - Off-specular neutron reflectometry and introduction to inelastic neutron scattering

Lecture 59 - Off-specular neutron reflectometry and introduction to inelastic neutron scattering

Lecture 60 - Phonon measurements with neutrons

Lecture 61 - Phonon measurements with neutrons

Lecture 62 - Phonon measurements; single crystals

Lecture 63

Lecture 64 - Phonon: Density of States measurements

Lecture 65 - Stochastic dynamics with neutrons

Lecture 66 - Stochastic motion and various types of diffusion

Lecture 67 - Stochastic motion and various types of diffusion

Lecture 68 - Spin echo spectrometer, Summary of the course

Lecture 69 - Spin echo spectrometer, Summary of the course

NPTEL : NOC:Accelerator Physics (Physics)

Co-ordinators : Prof. Rajni Pande, Prof. Amalendu Sharma, Prof. Pitamber Singh

Lecture 1 - Why accelerators

Lecture 2 - Accelerator as a microscope

Lecture 3 - Charging and Discharging of capacitors

Lecture 4 - Charging and Discharging of capacitors (Continued...)

Lecture 5 - Introduction to DC accelerators

Lecture 6 - Cockcroft Walton Accelerator (1929)

Lecture 7 - Van-de-Graaff accelerator and Tandem and Pelletron accelerators

Lecture 8 - Van-de-Graaff accelerator and Tandem and Pelletron accelerators

Lecture 9 - Voltage measurement and stabilisation

Lecture 10 - Voltage measurement and stabilisation

Lecture 11 - Beam energy calibration/measurement

Lecture 12 - Beam energy calibration/measurement

Lecture 13 - Beam focussing using electrostatic and magnetic lenses and beam optics

Lecture 14 - Beam focussing using electrostatic and magnetic lenses and beam optics

Lecture 15 - Beam focussing using electrostatic and magnetic lenses and beam optics

Lecture 16 - Ion Sources

Lecture 17 - Ion Sources

Lecture 18 - Introduction and Basic concepts of linear accelerators

Lecture 19 - Introduction and Basic concepts of linear accelerators

Lecture 20 - RF Acceleration - 1

Lecture 21 - RF Acceleration - 1

Lecture 22 - RF Acceleration - 2

Lecture 23 - RF Acceleration - 2

Lecture 24 - RF Acceleration - 3 - Waveguides and cavities

Lecture 25 - RF Acceleration - 3 - Waveguides and cavities

Lecture 26 - Accelerating structures - Pillbox cavity and DTL

Lecture 27 - Accelerating structures - Pillbox cavity and DTL

Lecture 28 - Accelerating structures - Travelling wave linacs and periodic accelerating structures

Lecture 29 - Accelerating structures - Travelling wave linacs and periodic accelerating structures

Lecture 30 - Superconducting cavities

Lecture 31 - Superconducting cavities

Lecture 32 - Transverse Dynamics - 1

Lecture 33 - Transverse Dynamics - 1

Lecture 34 - Transverse Dynamics - 2

Lecture 35 - Transverse Dynamics - 2

Lecture 36 - Transverse Dynamics - 3

Lecture 37 - Transverse Dynamics - 3

Lecture 38 - Longitudinal Dynamics - 1

Lecture 39 - Longitudinal Dynamics - 1

Lecture 40 - Longitudinal Dynamics - 2

Lecture 41 - Longitudinal Dynamics - 2

Lecture 42 - Radio Frequency Quadrupole

Lecture 43 - Radio Frequency Quadrupole

Lecture 44 - Cyclic accelerators: Some basic principles

Lecture 45 - Cyclic accelerators: Some basic principles

Lecture 46 - About the cyclotron

Lecture 47 - About the cyclotron

Lecture 48 - Microtron

Lecture 49 - Equation of motion, Focusing

Lecture 50 - Equation of motion, Focusing

Lecture 51 - Strong focusing, Edge focusing, AG principle

Lecture 52 - Strong focusing, Edge focusing, AG principle

Lecture 53 - Matrix methods

Lecture 54 - Matrix methods

Lecture 55 - Hill's equation and parameterization - 1

Lecture 56 - Hill's equation and parameterization - 1

Lecture 57 - Hill's equation and parameterization - 2

Lecture 58 - Hill's equation and parameterization - 2

Lecture 59 - Hill's equation and parameterization - 3

Lecture 60 - Hill's equation and parameterization - 3

Lecture 61

Lecture 62

Lecture 63

Lecture 64

Lecture 65

Lecture 66

Lecture 67 - Proton synchrotron for spallation source

Lecture 68 - Proton synchrotron for spallation source

Lecture 69 - Colliders

Lecture 70 - Colliders

Lecture 71 - Laser Plasma accelerators and Accelerator Driven Systems (ADS)

Lecture 72 - Laser Plasma accelerators and Accelerator Driven Systems (ADS)

NPTEL : NOC:An Introduction to Lasers and Laser Systems (Physics)

Co-ordinators : Prof. Dhruba J. Biswas, Prof. J. Padma Nilaya

Lecture 1 - Lasers at a Glance

Lecture 2 - Light Amplifier and the Concept of Cavity

Lecture 3 - Laser: An Integration of a Population Inverted Medium and a Cavity

Lecture 4 - The Invention of Lasers by Maiman

Lecture 5 - Population Inversion vis-Ã -vis Boltzmann Distribution

Lecture 6 - Different Methods of Pumping to Effect Population Inversion

Lecture 7 - Population Inversion vis-Ã -vis No. of Participating Energy Levels in the process of Lasing

Lecture 8 - Behaviour of Light

Lecture 9 - Behaviour of Light (Continued...)

Lecture 10 - Youngs Doble Slit Experiment and Interference of Light

Lecture 11 - Interference of Light and Fabrication of Laser Windows and Mirrors

Lecture 12 - Fabrication of Laser Windows and Mirrors (Continued...)

Lecture 13 - Diffraction of Light

Lecture 14 - Scattering of Light

Lecture 15 - Light Scattering (Continued...) and Polarisation of Light

Lecture 16 - Polarisation of Light (Continued...) and Brewster Angle of Incidence

Lecture 17 - Continuous and Pulsed Operation of Lasers

Lecture 18 - The Maximum Achievable Power from a Pulsed Laser

Lecture 19 - Continuous and Pulsed Pumping of Lasers

Lecture 20 - Continuous and Pulsed Pumping of Lasers (Continued...)

Lecture 21 - Optical Pumping : Coupling of Pump Laser Beam into the Cavity

Lecture 22 - Electrical Pumping

Lecture 23 - Different Kinds of Lasers

Lecture 24 - Atomic Gas Lasers: He-Ne Laser

Lecture 25 - He-Ne Laser (Continued...)

Lecture 26 - Emission Features of He-Ne Laser

Lecture 27 - Ion Lasers: Argon Ion Laser

Lecture 28 - Argon Ion Lasers: Emission Feature

Lecture 29 - Liquid Lasers: Dye Laser

Lecture 30 - Dye Lasers: Working Principle and Emission Features

Lecture 31 - Solid State Lasers: Nd-YAG Laser

Lecture 32 - Pumping of Nd-YAG Lasers

Lecture 33 - Diode Pumped Solid State Lasers and Continuously Tunable Solid State Lasers

Lecture 34 - Excimer Lasers: Importance

Lecture 35 - Excimer Lasers: Working Principle, Rare Gas Halide Lasers

Lecture 36 - Introduction to CO2 lasers and molecular spectroscopy

Lecture 37 - Molecular Spectroscopy: Ro-vibrational Transitions

Lecture 38 - Modes of molecular vibration, Vibrational modes and 4 level lasing scheme in a CO2 laser

Lecture 39 - Mechanism of lasing in a CO2 laser

Lecture 40 - Low pressure, CW Operation of a CO2 laser

Lecture 41 - Limitations of CW-CO2 Lasers and remedy

Lecture 42 - Pulsed Operation of CO2 Lasers; TEA CO2 Lasers and their Temporal Emission Profile

Lecture 43 - TEA CO2 Lasers: Operation, Gain Broadening and Emission Features

Lecture 44 - Gain Broadening and Emission Features (Continued...)

Lecture 45 - Discrete and Continuously Tunable Operation of a CO2 laser

Lecture 46 - Chemical Lasers: Underlying Physics

Lecture 47 - Principle of Operation of HF, DF Chemical Oxygen Iodine Lasers

Lecture 48 - Gas Dynamic Lasers: Principle of Operation

Lecture 49 - Operation of Gas Dynamic CO2 Lasers

Lecture 50 - Fiber Lasers: Its Advantages over Conventional Solid State Lasers

Lecture 51 - Fiber Laser (Continued...)

Lecture 52 - The Acceptance Angle, Pumping of Fiber Lasers and their Operation

Lecture 53 - Scaling up of Output Power of Fiber Laser and Operation of Fiber Amplifiers

Lecture 54 - Semiconductor Lasers: An Introduction and Basics of Semiconductor Physics

Lecture 55 - Metals, Insulators and Semiconductors, Concept of Holes

Lecture 56 - Concept of Holes (Continued...), Intrinsic and Extrinsic Semiconductors

Lecture 57 - n-type and p-type semiconductors, Semiconductor Diodes, Light Emitting Diodes (LED)

Lecture 58 - Diode Laser from the LED

Lecture 59 - Homojunction and Hetrojunction Diode Lasers

Lecture 60 - Edge Emitting Diode Lasers, Surface Emitting Diode Lasers, Diode Bars and Arrays

NPTEL : NOC:The Science of Light Amplification: An Extensive Laser course (Physics)

Co-ordinators : Prof. Paramita Deb

Lecture 1 - Introduction to Lasers and the Electromagnetic Spectrum

Lecture 2 - Stimulated Emission and Spontaneous Emission and Properties of Laser

Lecture 3 - Population Inversion in a Laser medium

Lecture 4 - Laser Oscillations and the Optical Resonator

Lecture 5 - Line Broadening Mechanism - 1

Lecture 6 - Line Broadening Mechanism - 2

Lecture 7 - Laser Resonators - 1

Lecture 8 - Laser Resonators - 2

Lecture 9 - Gas laser examples

Lecture 10 - Gas lasers and Solid State Lasers

Lecture 11 - Solid State Lasers

Lecture 12 - Pulsed Lasers and Optical shutters

Lecture 13 - Modes and Mode Locking

Lecture 14 - The technique of Mode Locking

Lecture 15 - Time Bandwidth product and Ultra short pulse

Lecture 16 - Non-linear phenomenon in optics

Lecture 17 - Self-focusing and Self-phase-modulation

Lecture 18 - Second Harmonic Generation (SHG)

Lecture 19 - Phase matching and SHG

Lecture 20 - Anisotropic medium and SHG

Lecture 21 - Birefringent Crystals and Phase Matching

Lecture 22 - Semiconductor Basics

Lecture 23 - Photon Absorption and Emission in Semiconductors

Lecture 24 - p-n Junction and the Semiconductor Laser

Lecture 25 - Types of Semiconductor Laser

Lecture 26 - Nuclear Fusion

Lecture 27 - Inertial Confinement Fusion

Lecture 28 - Master Oscillator and Power Amplifier Chain

Lecture 29 - Amplifier Chain

Lecture 30 - Chirped Pulse Amplification - 1

Lecture 31 - Chirped Pulse Amplification - 2

Lecture 32 - Ultra-Short-Pulse Oscillator

Lecture 33 - Ultra-Short-Pulse Amplification - 1

Lecture 34 - Ultra-Short-Pulse Amplification - 2

Lecture 35 - Stretching and Compressing a Pulse

Lecture 36 - Stretching and Compressing a Pulse

Lecture 37 - The Auto-Correlation Technique for Temporal Pulse Measurement

Lecture 38 - Frequency Resolved Optical Gating for Temporal Pulse measurement

Lecture 39 - Light Detection And Ranging (LIDAR)

Lecture 40 - Remote Sensing

Lecture 41 - Optical Tweezers

Lecture 42 - Lasers in Spectroscopy

Lecture 43 - Dye Laser

Lecture 44 - Tuning a laser with a grating

Lecture 45 - Details of a grating

Lecture 46 - Multi-Photon Processes

Lecture 47 - Laser Enrichment Method

Lecture 48 - Laser Raman Spectroscopy

Lecture 49 - Polarization Of Electromagnetic Waves

Lecture 50 - Polarizer and Analyzer

Lecture 51 - Interference of Electromagnetic waves - 1

Lecture 52 - Interference Of Electromagnetic waves - 2

Lecture 53 - Interference Patterns - 1

Lecture 54 - Interference Patterns - 2

Lecture 55 - Interference Patterns - 3

Lecture 56 - Fabry - Perot Cavity

Lecture 57 - Holography - 1

Lecture 58 - Holography - 2

Lecture 59 - Holography - 3

Lecture 60 - Holography - 4

NPTEL : Electronics (Physics)

Co-ordinators : Prof. D.C. Dube

Lecture 1 - p-n diode

Lecture 2 - p-n Junction/Diode (Continued...)

Lecture 3 - p-n diode (Continued...)

Lecture 4 - Diode Application

Lecture 5 - Transistors

Lecture 6 - Reverse - bias (Continued...)

Lecture 7 - Transistors (Continued...)

Lecture 8 - Transistors (Continued...)

Lecture 9 - Biasing a transistor unit 2 (Continued...)

Lecture 10 - Biasing of transistor

Lecture 11 - H and R Parameters and their use in small amplifiers

Lecture 12 - Small signal amplifiers analysis using H - Parameters

Lecture 13 - Small signal amplifiers analysis using R - Parameters

Lecture 14 - R - analysis (Continued...)

Lecture 15 - Common Collector(CC) amplifier (Continued...)

Lecture 16 - Feedback in amplifiers, Feedback Configurations and multi stage amplifiers

Lecture 17 - Reduction in non-linear distortion

Lecture 18 - Input/Output impedances in negative feedback amplifiers (Continued...)

Lecture 19 - RC Coupled Amplifiers

Lecture 20 - RC Coupled Amplifiers (Continued...)

Lecture 21 - RC Coupled Amplifiers (Continued...)

Lecture 22 - FETs ans MOSFET

Lecture 23 - FETs ans MOSFET (Continued...)

Lecture 24 - Depletion - MOSFET

Lecture 25 - Drain and transfer characteristic of E - MOSFET

Lecture 26 - Self Bias (Continued...) Design Procedure

Lecture 27 - FET/MOSFET Amplifiers and their Analysis

Lecture 28 - CMOS Inverter

Lecture 29 - CMOS Inverter (Continued...)

Lecture 30 - Power Amplifier

Lecture 31 - Power Amplifier (Continued...)

Lecture 32 - Power Amplifier (Continued...)

Lecture 33 - Power Amplifier (Continued...)

Lecture 34 - Differential and Operational Amplifier

Lecture 35 - Differential and Operational Amplifier (Continued...) dc and ac analysis

Lecture 36 - Differential and Operational Amplifier dc and ac analysis (Continued...)

Lecture 37 - Operational Amplifiers

Lecture 38 - Operational amplifiers in open loop (Continued...)

Lecture 39 - Summing Amplifiers

Lecture 40 - Frequency response of an intigration

Lecture 41 - Filters

Lecture 42 - Specification of OP Amplifiers

NPTEL : Plasma Physics: Fundamentals and Applications (Physics)

Co-ordinators : Prof. Vijayshri, Prof. V.K. Tripathi

Lecture 1 - Introduction to Plasmas

Lecture 2 - Plasma Response to fields: Fluid Equations

Lecture 3 - DC Conductivity and Negative Differential Conductivity

Lecture 4 - RF Conductivity of Plasma

Lecture 5 - RF Conductivity of Plasma (Continued...)

Lecture 6 - Hall Effect, Cowling Effect and Cyclotron Resonance Heating

Lecture 7 - Electromagnetic Wave Propagation in Plasma

Lecture 8 - Electromagnetic Wave Propagation in Plasma (Continued...)

Lecture 9 - Electromagnetic Wave Propagation Inhomogeneous Plasma

Lecture 10 - Electrostatic Waves in Plasmas

Lecture 11 - Energy Flow with an Electrostatic Wave

Lecture 12 - Two Stream Instability

Lecture 13 - Relativistic electron Beam- Plasma Interaction

Lecture 14 - Cerenkov Free Electron Laser

Lecture 15 - Free Electron Laser

Lecture 16 - Free Electron Laser: Energy gain

Lecture 17 - Free Electron Laser: Wiggler Tapering and Compton Regime Operation

Lecture 18 - Weibel Instability

Lecture 19 - Rayleigh Taylor Instability

Lecture 20 - Single Particle Motion in Static Magnetic and Electric Fields

Lecture 21 - Plasma Physics Grad B and Curvature Drifts

Lecture 22 - Adiabatic Invariance of Magnetic Moment and Mirror confinement

Lecture 23 - Mirror machine

Lecture 24 - Thermonuclear fusion

Lecture 25 - Tokamak

Lecture 26 - Tokamak operation

Lecture 27 - Auxiliary heating and current drive in tokamak

Lecture 28 - Electromagnetic waves propagation in magnetise plasma

Lecture 29 - Longitudinal electromagnetic wave propagation cutoffs, resonances and faraday rotation

Lecture 30 - Electromagnetic propagation at oblique angles to magnetic field in a plasma

Lecture 31 - Low frequency EM waves magnetized plasma

Lecture 32 - Electrostatic waves in magnetized plasma

Lecture 33 - Ion acoustic, ion cyclotron and magneto sonic waves in magnetized plasma

Lecture 34 - VIasov theory of plasma waves

Lecture 35 - Landau damping and growth of waves

Lecture 36 - Landau damping and growth of waves (Continued...)

Lecture 37 - Anomalous resistivity in a plasma

Lecture 38 - Diffusion in plasma

Lecture 39 - Diffusion in magnetized plasma

Lecture 40 - Surface plasma wave

Lecture 41 - Laser interaction with plasmas embedded with clusters

Lecture 42 - Current trends and epilogue

NPTEL : Quantum Electronics (Physics)

Co-ordinators : Prof. K. Thyagarajan

Lecture 1 - Introduction

Lecture 2 - Anisotropic Media

Lecture 3 - Anisotropic Media (Continued...)

Lecture 4 - Anisotropic Media (Continued...)

Lecture 5 - Nonlinear optical effects and nonlinear polarization

Lecture 6 - Non - Linear Optics (Continued...)

Lecture 7 - Non - Linear Optics (Continued...)

Lecture 8 - Non - Linear Optics (Continued...)

Lecture 9 - Non - Linear Optics (Continued...)

Lecture 10 - Non - Linear Optics - Quasi Phase Matching

Lecture 11 - Non - Linear Optics

Lecture 12 - Non Linear Optics (Continued...)

Lecture 13 - Non Linear Optics (Continued...)

Lecture 14 - Non Linear Optics (Continued...)

Lecture 15 - Non Linear Optics (Continued...)

Lecture 16 - Non Linear Optics (Continued...)

Lecture 17 - Non Linear Optics (Continued...)

Lecture 18 - Non Linear Optics (Continued...)

Lecture 19 - Non Linear Optics (Continued...)

Lecture 20 - Third Order Non - Linear Effects

Lecture 21 - Third Order Non - Linear Effects (Continued...)

Lecture 22 - Third Order Non - Linear Effects (Continued...)

Lecture 23 - Third Order Non - Linear Effects (Continued...)

Lecture 24 - Review of Quantum Mechanics

Lecture 25 - Review of Quantum Mechanics (Continued...)

Lecture 26 - Review of Quantum Mechanics (Continued...)

Lecture 27 - Quantization of EM Field

Lecture 28 - Quantization of EM Field (Continued...)

Lecture 29 - Quantization of EM Field (Continued...)

Lecture 30 - Quantum States of EM Field

Lecture 31 - Quantum States of EM Field (Continued...)

Lecture 32 - Quantization of EM Field (Continued...)

Lecture 33 - Quantization of EM Field (Continued...)

Lecture 34 - Quantization of EM Field (Continued...)

Lecture 35 - Quantization of EM Field (Continued...)

Lecture 36 - Quantization of EM Field (Continued...)

Lecture 37 - Beam Splitter

Lecture 38 - Beam Splitter (Continued...)

Lecture 39 - Beam Splitter and Balanced Homodyning

Lecture 40 - Balanced Homodyning

Lecture 41 - Quantum Picture of Parametric Down Conversion

Lecture 42 - Questions

NPTEL : Quantum Mechanics and Applications (Physics)

Co-ordinators : Prof. Ajoy Ghatak

Lecture 1 - Basic Quantum Mechanics I: Wave Particle Duality

Lecture 2 - Basic Quantum Mechanics II: The Schrodinger Equation and The Dirac Delta Function

Lecture 3 - Dirac Delta Function & Fourier Transforms

Lecture 4 - The Free Particle

Lecture 5 - Physical Interpretation of The Wave Function

Lecture 6 - Expectation Values & The Uncertainty Principle

Lecture 7 - The Free Particle (Continued...)

Lecture 8 - Interference Experiment & The Particle in a Box Problem

Lecture 9 - On Eigen Values and Eigen Functions of the 1 Dimensional Schrodinger Equation

Lecture 10 - Linear Harmonic Oscillator

Lecture 11 - Linear Harmonic Oscillator (Continued...1)

Lecture 12 - Linear Harmonic Oscillator (Continued...2)

Lecture 13 - Linear Harmonic Oscillator (Continued...3)

Lecture 14 - Tunneling through a Barrier

Lecture 15 - The 1-Dimensional Potential Wall & Particle in a Box

Lecture 16 - Particle in a Box and Density of States

Lecture 17 - The Angular Momentum Problem

Lecture 18 - The Angular Momentum Problem (Continued...)

Lecture 19 - The Hydrogen Atom Problem

Lecture 20 - The Two Body Problem

Lecture 21 - TheTwo Body Problem: The Hydrogen atom, The Deutron and The Diatomic Molecule

Lecture 22 - Two Body Problem: The Diatomic molecule (Continued...) and the 3 Dimensional Oscillator

Lecture 23 - 3d Oscillator & Dirac's Bra and Ket Algebra

Lecture 24 - Diracâ€™s Bra and Ket Algebra

Lecture 25 - Diracâ€™s Bra and Ket Algebra : The Linear Harmonic Oscillator

Lecture 26 - The Linear Harmonic Oscillator using Bra and Ket Algebra (Continued...)

Lecture 27 - The Linear Harmonic Oscillator: Coherent State and Relationship with the Classical Oscillator

Lecture 28 - Coherent State and Relationship with the Classical Oscillator

Lecture 29 - Angular Momentum Problem using Operator Algebra

Lecture 30 - Angular Momentum Problem (Continued...)

Lecture 31 - Pauli Spin Matrices and The Stern Gerlach Experiment

Lecture 32 - The Larmor Precession and NMR Spherical Harmonics using Operator Algebra

Lecture 33 - Addition of Angular Momentum: Clebsch Gordon Coefficient

Lecture 34 - Clebsch Gordon Coefficients

Lecture 35 - The JWKB Approximation

Lecture 36 - The JWKB Approximation: Use of Connection Formulae to solve Eigen value Problems.

Lecture 37 - The JWKB Approximation: Use of Connection Formulae to calculate Tunneling Probability.

Lecture 38 - The JWKB Approximation: Tunneling Probability Calculations and Applications.

Lecture 39 - The JWKB Approximation: Justification of the Connection Formulae

Lecture 40 - Time Independent Perturbation Theory

Lecture 41 - Time Independent Perturbation Theory (Continued...1)

Lecture 42 - Time Independent Perturbation Theory (Continued...2)

NPTEL : Semiconductor Optoelectronics (Physics)

Co-ordinators : Prof. M.R. Shenoy

Lecture 1 - Context and Scope of the Course

Lecture 2 - Energy Bands in Solids

Lecture 3 - E-K Diagram

Lecture 4 - The Density of States

Lecture 5 - The Density of States (Continued...)

Lecture 6 - The Density of states in a Quantum well Structure

Lecture 7 - Occupation Probability and Carrier Concentration

Lecture 8 - Carrier Concentration and Fermi Level

Lecture 9 - Quasi Fermi Levels

Lecture 10 - Semiconductor Materials

Lecture 11 - Semiconductor Hetrostructures-Lattice-Matched Layers

Lecture 12 - Strained -Layer Epitaxy and Quantum Well Structures

Lecture 13 - Bandgap Engineering

Lecture 14 - Hetrostructure p-n junctions

Lecture 15 - Schottky Junction and Ohmic Contacts

Lecture 16 - Fabrication of Heterostructure Devices

Lecture 17 - Interaction od Photons with Electrons and Holes in a Semiconductor

Lecture 18 - Optical Joint Density of States

Lecture 19 - Rates of Emission and Absorption

Lecture 20 - Amplication by Stimulated Emission

Lecture 21 - The Semiconductor (Laser) Amplifier

Lecture 22 - Absorption Spectrum of Semiconductor

Lecture 23 - Gain and Absorption Spectrum of Quantum Well Structures

Lecture 24 - Electro-absorption Modulator

Lecture 25 - Electro-absorption Modulator - II Device Configuration

Lecture 26 - Mid-Term Revision Question and Discussion

Lecture 27 - Part - III Semiconductor Light Sources

Lecture 28 - Light Emitting Diode-I Device Structure and Parameters

Lecture 29 - Light Emitting Diode-II Device Chracteristics

Lecture 30 - Light Emitting Diode-III Output Characteristics

Lecture 31 - Light Emitting Diode-IV Modulation Bandwidth

Lecture 32 - Light Emitting Diode-V materials and Applications

Lecture 33 - Laser Basics

Lecture 34 - Semiconductor Laser-I Device Structure

Lecture 35 - Semiconductor Laser-II Output Characteristics

Lecture 36 - Semiconductor Laser-III Single Frequency Lasers

Lecture 37 - Vertical Cavity Surface Emitting Laser (VCSEL)

Lecture 38 - Quantum Well Laser

Lecture 39 - Practical Laser Diodes and Handling

Lecture 40 - General Characteristics of Photodetectors

Lecture 41 - Responsivity and Impulse Response

Lecture 42 - Photoconductors

Lecture 43 - Semiconductor Photo-Diodes

Lecture 44 - Semiconductor Photo-Diodes-II : APD

Lecture 45 - Other Photodectors

Lecture 46 - Photonic Integrated Circuits

NPTEL : NOC:Semiconductor Optoelectronics (Physics)

Co-ordinators : Prof. M. R. Shenoy

Lecture 1 - Context, Scope and Contents of the Course

Lecture 2 - Energy Bands in Solids

Lecture 3 - E-k Diagram - The Band Structure

Lecture 4 - The Density of States

Lecture 5 - The Density of States Ï(k), Ï(E)

Lecture 6 - Density of States in a Quantum Well Structure

Lecture 7 - Occupation Probability and Carrier Concentration

Lecture 8 - Carrier Concentration and Fermi Level

Lecture 9 - Quasi Fermi Levels

Lecture 10 - Semiconductor Materials

Lecture 11 - Semiconductor Heterostructures-Lattice-Matched Layers

Lecture 12 - Strained-Layer Epitaxy and Quantum Well Structures

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Lecture 14 - Heterostructure p-n junctions

Lecture 15 - Schottky Junctions and Ohmic Contacts

Lecture 16 - Fabrication of Heterostructure Devices

Lecture 17 - Interaction of Photons with Electrons and Holes in a Semiconductor

Lecture 18 - Optical Joint Density of States, and Probabilities of Emission and Absorption

Lecture 19 - Rates of Emission and Absorption

Lecture 20 - Amplification by Stimulated Emission

Lecture 21 - The Semiconductor (Laser) Amplifier

Lecture 22 - Absorption Spectrum of Semiconductors

Lecture 23 - Gain and Absorption Spectrum of Quantum Well Structures

Lecture 24 - Electro-absorption Modulator-I Principle of Operation

Lecture 25 - Electro-absorption Modulator-II Device Configuration

Lecture 26 - Injuction Electroluminescence

Lecture 27 - Light emitting diode-1 Device structure and parameters

Lecture 28 - Light emitting diode-II Device Characteristics

Lecture 29 - Light emitting diode-III Output Characteristics

Lecture 30 - Light emitting diode-IV Modulation Bandwidth

Lecture 31 - Light emitting diode-V Material and Applications

Lecture 32 - Laser Basics

Lecture 33 - Semiconductor Laser-I Device Structure

Lecture 34 - Semiconductor Laser-II Output Characteristics

Lecture 35 - Semiconductor Laser-III Single Frequency Lasers

Lecture 36 - Vertical cavity Surface Emitting Laser (VCSEL)

Lecture 37 - Quantum Well Laser

Lecture 38 - Practical Laser Diodes and Handling

Lecture 39 - General Characteristics of Photodetectors

Lecture 40 - Responsivity and Impulse Response

Lecture 41 - Photoconductors

Lecture 42 - Semiconductor Photo-Diodes-I: PIN Diode

Lecture 43 - Semiconductor Photo-Diodes-II: APD

Lecture 44 - Other Photodetectors

Lecture 45 - Photonic Integrated Circuits

NPTEL : NOC:Introduction to LASER (Physics)

Co-ordinators : Unknown

Lecture 1 - General Introduction, Scope and Contents

Lecture 2 - Interaction of Radiation with Matter

Lecture 3 - The Einstein Coefficients

Lecture 4 - Atomic Lineshape Function, g(Î½)

Lecture 5 - Amplification by Stimulated Emission

Lecture 6 - Line Broadening Mechanisms - 1

Lecture 7 - Line Broadening Mechanisms - 2

Lecture 8 - Laser Rate Equations: 2-Level System

Lecture 9 - Laser Rate Equations: 3-Level System

Lecture 10 - Laser Rate Equations: 4-Level System

Lecture 11 - Laser Amplifiers

Lecture 12 - Er-Doped Fiber Amplifier

Lecture 13 - Resonance Frequencies

Lecture 14 - Spectral Response of an Optical Resonator

Lecture 15 - Resonator Loss and Cavity Lifetime

Lecture 16 - Spherical Mirror Resonators

Lecture 17 - Resonator Stability Condition

Lecture 18 - Ray Paths in Spherical Mirror Resonators

Lecture 19 - Tranverse Modes of a Spherical Mirror Resonator

Lecture 20 - Gaussian Mode of the Spherical Mirror Resonator

Lecture 21 - Longitudinal Modes of a Spherical Mirror Resonator

Lecture 22 - Laser Oscillations and The Threshold Condition

Lecture 23 - Spectral Hole Burning

Lecture 24 - Variation of Laser Power around Threshold

Lecture 25 - Optimum Output Coupling

Lecture 26 - Laser Output Characteristics

Lecture 27 - Laser Beam Properties

Lecture 28 - Ultimate Linewidth of a Laser

Lecture 29 - Pulsed Lasers

Lecture 30 - Q-Switching

Lecture 31 - Mode Locking

Lecture 32 - Methods of Mode Locking

Lecture 33 - Some Common Lasers

Lecture 34 - Fiber Lasers

Lecture 35 - Semiconductor Lasers

Lecture 36 - Lasers and Laser Amplifiers in Optical Fiber Communication

Lecture 37 - Lasers in Nonlinear Optics

Lecture 38 - Laser Safety

NPTEL : NOC:Nuclear and Particle Physics (Physics)

Co-ordinators : Dr. P. Poulose

Lecture 1 - Introduction

Lecture 2 - Nuclear Properties

Lecture 3 - Properties of Nuclear Force

Lecture 4 - Deuteron

Lecture 5 - Nucleons Scattering

Lecture 6 - Nuclear Models - I

Lecture 7 - Nuclear Models - II

Lecture 8 - Radioactive Decay - General Properties

Lecture 9 - Nuclear Alpha Decay

Lecture 10 - Nuclear Beta decay

Lecture 11 - Beta-decay details

Lecture 12 - Gamma decay

Lecture 13 - Nuclear Scattering - Preliminaries

Lecture 14 - Types of Reactions

Lecture 15 - Particle Accelerators - I

Lecture 16 - Particle Accelerators - II

Lecture 17 - Detectors

Lecture 18 - Elementary Particles - Introduction and Overview

Lecture 19 - Quark Model - I

Lecture 20 - Quark Model - II

Lecture 21 - Quark Model - III

Lecture 22 - Structure of the Hadron - Nucleus

Lecture 23 - Structure of the Hadron - Proton

Lecture 24 - Deep Inelastic Scattering

Lecture 25 - Relativistic Kinematics

Lecture 26 - Klein-Gordon Equation

Lecture 27 - Interaction of charged scalar with EM field

Lecture 28 - Relativistic Electrodynamics

Lecture 29 - Quantum Electrodynamics

Lecture 30 - Interaction between charged scalars

Lecture 31 - Dirac Equation - 1

Lecture 32 - Dirac Equation - 2

Lecture 33 - Interacting charged fermions - 1

Lecture 34 - Interacting charged fermions - 2

Lecture 35 - Interacting charged fermions - 3

Lecture 36 - Scattering Cross Section Revisited - 1

Lecture 37 - Scattering Cross Section Revisited - 2

Lecture 38 - Weak Interactions - 1

Lecture 39 - Weak Interactions - 2

Lecture 40 - Lagrangian Framework

Lecture 41 - Gauge Symmetry - U(1)

Lecture 42 - Electroweak Theory - 1

Lecture 43 - Electroweak Theory - 2

Lecture 44 - SSB and the Higgs Mechanism

NPTEL : NOC:Advanced Condensed Matter Physics (Physics)

Co-ordinators : Dr. Saurabh Basu

Lecture 1 - Propagators - I

Lecture 2 - Propagators - II

Lecture 3 - Second quantization - I

Lecture 4 - Second quantization - II

Lecture 5 - Second quantized Hamiltonian

Lecture 6 - Tight Binding Hamiltonian, Hubbard model

Lecture 7 - Magnetism

Lecture 8 - Singlet and Triplet State: Magnetic Hamiltonian

Lecture 9 - Antiferromagnetism in Hubbard model

Lecture 10 - Green's function and representations in quantum mechanics

Lecture 11 - S matrix and free electron Green's function

Lecture 12 - Wick's theorem and normal ordering

Lecture 13 - Green's function and Feynman diagrams

Lecture 14 - Feynman diagram

Lecture 15 - phonon Green' function and Hartree Fock approaximation

Lecture 16 - Finite temperature Green's function and Matsubara frequencies

Lecture 17 - Dyson's equation and disorder in electronic systems

Lecture 18 - Introduction to electrodynamics, Meissner effect

Lecture 19 - London penetration depth, Type I and II superconductors

Lecture 20 - Cooper's problem, BCS gap equation

Lecture 21 - BCS theory, Transition temperature

Lecture 22 - Ginzburg Landau Theory, Coherence length and penetration depth

Lecture 23 - Quantum Hall Effect

Lecture 24 - Spin Hall effect, 2D topological insulator

Lecture 25 - Bose-Einstein condensation

NPTEL : NOC:Advanced Quantum Mechanics with Applications (Physics)

Co-ordinators : Dr. Saurabh Basu

Lecture 1 - Introduction, Postulates of Quantum Mechanics

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 - Qunatum 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 Conservational 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

Lecture 15 - Introduction to Quantum Computing

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 Transportation, 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

Lecture 25 - Application of Variational method,Hydrogen,Helium atom,Comparison with perturbation theory

Lecture 26 - WKB Approximation, Bohr Sommerfeld quantization condition

Lecture 27 - Summary of Approximation methods, Time dependent Perturbation Theory

Lecture 28 - Time dependent Perturbation Theory, Fermi's Golden rule, Einstein's A and B coefficients

Lecture 29 - Scattering Theory

Lecture 30 - Linear Response Theory: Derivation of Kubo formula

Lecture 31 - Quantum Dynamics: Two level system

Lecture 32 - Examples

Lecture 33 - Interaction of Radiation with matter, Landau levels

NPTEL : NOC:A Brief Course on Superconductivity (Physics)

Co-ordinators : Dr. Saurabh Basu

Lecture 1 - Historical introduction of superconductivity

Lecture 2 - Meissner effect, Electrodynamics of Superconductors, coherence length and penetration depth

Lecture 3 - Electron Pairing, Basics of BCS Theory

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

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

Lecture 6 - London Equations, Flux quantization

Lecture 7 - Thermodynamic properties of superconductors, specific heat

Lecture 8 - Experimental determination of Superconducting properties

Lecture 9 - Unconventional Superconductivity, Uemura plot, High-Tc 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

Lecture 15 - Josephson junctions, Josephson equations

Lecture 16 - Numerical Differentiation

Lecture 17 - Richardson's extrapolation

NPTEL : NOC:Introduction to Statistical Mechanics (Physics)

Co-ordinators : Prof.Girish S. Setlur

Lecture 1 - Prerequisites and Introduction

Lecture 2 - Combinatorics and Entropy

Lecture 3 - Method of steepest descent

Lecture 4 - Bose and Fermi gases

Lecture 5 - Maxwell Boltzmann distribution

Lecture 6 - Thermodynamic potentials

Lecture 7 - Legendre transformation

Lecture 8 - Specific heats of quantum gases

Lecture 9 - Low and high temperature equations of state

Lecture 10 - Chandrasekhar Limit

Lecture 11 - Radiation thermodynamics

Lecture 12 - Thermodyamics of black holes

Lecture 13 - Van der Waals fluid

Lecture 14 - Landau Diamagnetism

Lecture 15 - Relations between ensembles and Pauli paramagnetism

Lecture 16 - Ferromagnetism

Lecture 17 - Correlations and Mean Field

Lecture 18 - Theories of Specific Heat of Solids

Lecture 19 - Tutorial - I

Lecture 20 - Tutorial - II

Lecture 21 - Tutorial - III

Lecture 22 - Tutorial - IV

Lecture 23 - Tutorial - V

Lecture 24 - RG method Ising model

Lecture 25 - Introduction to Second Quantisation: Harmonic Oscillator

Lecture 26 - Quantum Theory of EM Field - I

Lecture 27 - Quantum Theory of EM Field - II

Lecture 28 - Creation and Annihilation in Fock Space - I

Lecture 29 - Creation and Annihilation in Fock Space - II

Lecture 30 - Green functions in many particle systems

Lecture 31 - Second quantised hamiltonians

Lecture 32 - Current algebra

NPTEL : NOC:Numerical Methods and Simulation Techniques for Scientists and Engineers (Physics)

Co-ordinators : Dr. Saurabh Basu

Lecture 1 - Error analysis and estimates, significant digits, convergence

Lecture 2 - Roots of Non-linear equations, Bisection method

Lecture 3 - Newton Raphson method, Secant method

Lecture 4 - Newton Raphson Method

Lecture 5 - Newton Raphson Method (example), Curve fitting and interpolation of data

Lecture 6 - Newtonâ€™s interpolation formula, statistical interpolation of data

Lecture 7 - Linear and Polynomial regression

Lecture 8 - Numerical differentiation

Lecture 9 - Numerical differentiation, Error analysis

Lecture 10 - Numerical integration, Trapezoidal rule

Lecture 11 - Simpsonâ€™s 1/3rd rule

Lecture 12 - Simpsonâ€™s 1/3rd rule, Gaussian integration

Lecture 13 - Ordinary Differential equations

Lecture 14 - Solution of differential equation, Taylor series and Euler method

Lecture 15 - Heunâ€™s method

Lecture 16 - Runge Kutta method

Lecture 17 - Examples of differential equation: Heat conduction equation

Lecture 18 - Introduction to Monte Carlo technique

Lecture 19 - Details of the Monte Carlo method

Lecture 20 - Importance sampling

Lecture 21 - Applications: Ising model

Lecture 22 - Introduction to Molecular Dynamics

Lecture 23 - Verlet algorithm

Lecture 24 - Applications of Molecular dynamics

NPTEL : NOC:Theoretical Mechanics (Physics)

Co-ordinators : Dr. Charudatt Y. Kadolkar

Lecture 1 - Introduction, Constraints

Lecture 2 - Generalized Coordinates, Configuration Space

Lecture 3 - Principle of Virtual Work

Lecture 4 - D'Alembert's Principle

Lecture 5 - Lagrange's Equations

Lecture 6 - Hamilton's Principle

Lecture 7 - Variational Calculus, Lagrange's Equations

Lecture 8 - Conservation Laws and Symmetries

Lecture 9 - Velocity Dependent Potentials, Non-holonomic Constraints

Lecture 10 - An Example: Hoop on a ramp

Lecture 11 - Phase Space

Lecture 12 - Legendre Transforms

Lecture 13 - Hamilton's Equations

Lecture 14 - Conservation Laws, Routh's procedure

Lecture 15 - An Example:Bead on Spinning Ring

Lecture 16 - Canonical Transformations

Lecture 17 - Symplectic Condition

Lecture 18 - Canonical Invariants, Harmonic Oscillator

Lecture 19 - Poisson Bracket Formulation

Lecture 20 - Infinitesimal Canonical Transformations

Lecture 21 - Symmetry Groups of Mechanical Systems

Lecture 22 - Hamilton Jacobi Theory

Lecture 23 - Action-Angle Variables

Lecture 24 - Separation of Variables and Examples

Lecture 25 - Continuous Systems and Fields

Lecture 26 - The Stress-Energy Tensor

Lecture 27 - Hamiltonian Formulation

NPTEL : NOC:Solar Energy Engineering and Technology (Physics)

Co-ordinators : Prof. Pankaj Kalita

Lecture 1 - Energy Scenarios

Lecture 2 - Overview of solar energy conversion devices and applications

Lecture 3 - Physics of propagation of solar radiation from the sun to the earth

Lecture 4 - Solar radiation and sunshine measuring instruments

Lecture 5 - Geometry, angles and measurement - I

Lecture 6 - Geometry, angles and measurement - II

Lecture 7 - Estimation of radiation under different climatic conditions

Lecture 8 - Estimation of radiation in horizontal and inclined surface

Lecture 9 - Fundamentals of PV cells

Lecture 10 - Semiconductor physics

Lecture 11 - Performance characterization of PV cells

Lecture 12 - Photovoltaic modules and arrays

Lecture 13 - Components of standalone PV system

Lecture 14 - Design of standalone PV system

Lecture 15 - Functioning and components of PV system

Lecture 16 - Design of a grid connected PV system

Lecture 17 - Performance analysis of a grid connected PV system

Lecture 18 - Basics of thermal collectors

Lecture 19 - Basics of heat transfer

Lecture 20 - Solar collector losses and loss estimation

Lecture 21 - Analysis of flat plate collector

Lecture 22 - Influence of various parameters on the performance of LFPC

Lecture 23 - Testing and application of LFPC

Lecture 24 - Basics and performance analysis of solar air heaters

Lecture 25 - Testing and application of solar air heaters

Lecture 26 - Fundamentals of concentrating collectors

Lecture 27 - Concentrating collector technologies and working principle

Lecture 28 - Tutorial: Concentrating Collector

Lecture 29 - Sensible heat, latent heat and thermochemical energy storage

Lecture 30 - Solar pond

Lecture 31 - Tutorial: Solar pond power plant design

Lecture 32 - Emerging technologies

Lecture 33 - Solar energy applications in cooking, desalination, refrigeration and electricity generation

Lecture 34 - Tutorial: COP of VARS and performance analysis of PVT collector

NPTEL : NOC:Quantum Technology and Quantum Phenomena in Macroscopic Systems (Physics)

Co-ordinators : Prof. Amarendra Kumar Sarma

Lecture 1 - Introduction and Basic Quantum Mechanics

Lecture 2 - Problem Solving Session - 1

Lecture 3 - Two-level System - I

Lecture 4 - Bloch Sphere: Supplementary Lectuer - I

Lecture 5 - Two-level Systems - II

Lecture 6 - Two-level Systems - III

Lecture 7 - Dressed States;Introduction to Density Matrix

Lecture 8 - Problem Solving Session - 2

Lecture 9 - Density-matrix formalism

Lecture 10 - Quantum Harmonic Oscillators

Lecture 11 - Quantization of Electromagnetic Radiation

Lecture 12 - Quantization of Standing EM Waves;Quantum States of Radiation Fields - I

Lecture 13 - Problem Solving Session - 3

Lecture 14 - Quantum States of Radiation Fields-II: Squeezed States

Lecture 15 - Problem Solving Session - 4

Lecture 16 - Introduction and Basics of Superconductivity

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

Lecture 18 - Quantization of Transmission Line - I

Lecture 19 - Quantization of Transmission Line - II

Lecture 20 - The Jaynes Cummings Model - I

Lecture 21 - Problem Solving Session - 5

Lecture 22 - The Jaynes Cummings Model - II

Lecture 23 - Josephson Junctions - I

Lecture 24 - Josephson Junctions - II

Lecture 25 - Problem Solving Session - 6

Lecture 26 - Transmon;Introduction to Dissipation in Quantum Systems

Lecture 27 - Quantum Master Equation

Lecture 28 - Pure dephasing and Dissipative Bloch Equations

Lecture 29 - Derivation of Fermi-Golden Rule

Lecture 30 - Introduction to Cavity Optomechanics;Fabry-Perot Cavity

Lecture 31 - Cavity Optomechanics: Basic Physics - I

Lecture 32 - Problem Solving Session - 7

Lecture 33 - Cavity Optomechanics: Basic Physics - II

Lecture 34 - Classical Regime - I

Lecture 35 - Classical Regime - II; Classical Langevin Equation

Lecture 36 - Problem Solving Session - 8

Lecture 37 - Langevin Equation

Lecture 38 - Quantum Langevin Noise

Lecture 39 - Problem Solving Session - 9

Lecture 40 - Input-Output Relation

Lecture 41 - Cavity Quantum Optomechanics

Lecture 42 - Linearized Cavity Optomechanics; Ground state cooling

Lecture 43 - Normal-Mode Splitting

Lecture 44 - Quantum Optomechanics: Squeezed States

NPTEL : NOC:Dynamics of Classical and Quantum Fields (Physics)

Co-ordinators : Prof. Girish S. Setlur

Lecture 1 - Introduction

Lecture 2 - Lagrangian Formalism

Lecture 3 - Hamiltonian Mechanics

Lecture 4 - Flows and Symmetries

Lecture 5 - Examples of Continuum Systems

Lecture 6 - Symmetries and Noether's Theorem

Lecture 7 - Dynamical Symmetries

Lecture 8 - Symmetries in Field Theories

Lecture 9 - The Relativistic Electromagnetic Field

Lecture 10 - Stress-Energy (Energy-Momentum) Tensor

Lecture 11 - Green's Theorem and Green's Functions

Lecture 12 - Diffraction Theory

Lecture 13 - Introduction to Elasticity Theory

Lecture 14 - Solution of the rubber band problem

Lecture 15 - The Stress Function Method

Lecture 16 - Strain Energy

Lecture 17 - The Euler Equation

Lecture 18 - Bernoulli's Principle

Lecture 19 - Matter, Momentum and Energy Transport

Lecture 20 - Stokes' Drag - I

Lecture 21 - Stokes' Drag - II

Lecture 22 - Towards Quantum Fields

Lecture 23 - Right and Left Movers

Lecture 24 - Functional Integration - I

Lecture 25 - Functional Integration - II

Lecture 26 - Perturbation theory

Lecture 27 - Quantum Mechanics using Lagrangians

Lecture 28 - Path Integrals - Formalism

Lecture 29 - Path Integrals - Free particles

Lecture 30 - Path Integrals - Harmonic oscillator

Lecture 31 - Creation and annihilation operators - Excitations

Lecture 32 - Creation and annihilation operators - Photons

Lecture 33 - Creation and annihilation operators - Many-body physics

Lecture 34 - Particle and Hole Green functions

Lecture 35 - Current Algebra

Lecture 36 - Tight Binding Models - I

Lecture 37 - Tight Binding Models - II

Lecture 38 - Order Parameters

Lecture 39 - Schrieffer Wolff Transformation

Lecture 40 - Matsubara Green functions - I

Lecture 41 - Matsubara Green functions - II

Lecture 42 - Self Energy and Spectral Functions

Lecture 43 - S-Matrix Perturbation Theory

Lecture 44 - Keldysh Contour

Lecture 45 - Bosonic Coherent States

Lecture 46 - Fermionic Coherent States

Lecture 47 - Nonlocal particle hole operators - Bosons

Lecture 48 - Nonlocal particle hole operators - Fermions

NPTEL : NOC:Quantum Hall Effects (Physics)

Co-ordinators : Prof. Saurabh Basu

Lecture 1 - Conductance in Nanostructures

Lecture 2 - S-Matrix, Reflection and Transmission

Lecture 3 - Introduction to Classical and Quantum Hall Effect

Lecture 4 - Quantum Hall Effect

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

Lecture 19 - Landau gauge in fractional quantum Hall effect

Lecture 20 - Laughlin States, Properties

Lecture 21 - Plasma analogy

Lecture 22 - Composite Fermions, Hierarchy

NPTEL : NOC:Quantum Entanglement: Fundamentals, Measures and Applications (Physics)

Co-ordinators : Prof. Amarendra Kumar Sarma

Lecture 1 - Introduction

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

Lecture 12 - Quantum Entanglement Measures - I

Lecture 13 - Problem solving session - 3

Lecture 14 - Quantum Entanglement Measures - II

Lecture 15 - Applications of Quantum Entanglement - I

Lecture 16 - Applications of Quantum Entanglement - II

Lecture 17 - Problem solving session - 4

NPTEL : NOC:Topology and Condensed Matter Physics (Physics)

Co-ordinators : Prof. Saurabh Basu

Lecture 1 - Introduction to Topology

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

Lecture 8 - Introduction to Classical and Quantum Hall effect

Lecture 9 - Quantum Hall Effect

Lecture 10 - Landau Levels

Lecture 11 - Properties of Landau Levels

Lecture 12 - Edge modes of Landau levels, Incompressibility of Quantum Hall States

Lecture 13 - Kubo formula

Lecture 14 - Hall quantization and Topological invariant

Lecture 15 - Electronic structure of Graphene

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

Lecture 23 - Symmetric gauge in FQHE

Lecture 24 - Laughlin States

Lecture 25 - Plasma analogy

Lecture 26 - Composite Fermions, Hierarchy picture

Lecture 27 - Topological Consideration of FQHE

Lecture 28 - 3D Topological Insulators

NPTEL : NOC:Statistical Physics of Non-Interacting and Interacting Systems (Physics)

Co-ordinators : Prof. Saurabh Basu

Lecture 1 - Review of Thermodynamics

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 Liouvilles's Theorem

Lecture 7 - Ergodic Hypothesis, Phase Space

Lecture 8 - Microcanonical Ensemble and Its Applications

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

Lecture 10 - Applications of Canonical Ensemble

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

Lecture 12 - Virial Theorem, Grand Canonical Distribution

Lecture 13 - Grand Canonical Distribution, Photon Gas

Lecture 14 - Canonical Ensemble, Parition Function, Central Limit Theorem

Lecture 15 - Applications of Canonical Ensemble

Lecture 16 - Bounded System, Negative Temparature, Specific Heat of Solids

Lecture 17 - Virial Theorem, Grand Canonical Distribution

Lecture 18 - Grand Canonical Distribution, Photon Gas

Lecture 19 - Quantum Statistical Mechanics, Indistinguishability of Particles, Ensembles

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

Lecture 25 - FD Statistics, Properties of Fermi Systems

Lecture 26 - Bethe Ansatz

Lecture 27 - Cluster expansion, Critical Isotherms

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

Lecture 29 - de Haas-van Alphen effect

Lecture 30 - Black Hole Thermodynamics

NPTEL : NOC:Elements of Modern Physics (Physics)

Co-ordinators : Prof. Saurabh Basu

Lecture 1 - Reviews of Classical Physics - Newtons Laws of Motion

Lecture 2 - Lagrangian Mechanics

Lecture 3 - Special Theory of Relativity

Lecture 4 - Postulates of Quantam Mechanics, Old Quantam Theory

Lecture 5 - Hydrogen Spectra, Stern Gerlach, Compton Effect

Lecture 6 - Wavefunction, Operators, Representations in QM

Lecture 7 - Solution of Schroedinger Equation for 1D potentials

Lecture 8 - Harmonic Oscillator, Hydrogen Atom

Lecture 9 - Spin Angular Momentum, Perturbation Theory

Lecture 10 - Degenerate Perturbation Theory, Stark Effect

Lecture 11 - Zeeman Effect

Lecture 12 - Operator Methods for Harmonic Oscillator

Lecture 13 - Variational Theory

Lecture 14 - Time Dependent Perturbation Theory

Lecture 15 - Clebsch-Gordon Coefficients

Lecture 16 - Electrostatics

Lecture 17 - Dielectrics

Lecture 18 - Laplaces Equation, Magnetostatics, Maxwell's Equations

Lecture 19 - Ensembles, Microstates and Macrostates

Lecture 20 - Sackur-Tetrode Equation, Density Matrices

Lecture 21 - Identical Particles

Lecture 22 - Quantum Statistics

Lecture 23 - Crystal Structure, Bragg's Law

Lecture 24 - Lattice Vibrations, Specific Heat

Lecture 25 - Free Electron Theory

Lecture 26 - Magnetism and Magnetic Materials

Lecture 27 - Superconductivity, Meissner Effect, Type I and II Superconductors

Lecture 28 - Nuclear Models

Lecture 29 - Radioactive Decay, Half Life

Lecture 30 - Binding Energy, Shell Model, Liquid drop model

Lecture 31 - Klein-Gordon and Dirac Equations

Lecture 32 - Elementary Particles, Detectors

Lecture 33 - Periodic Table of Elementary Particles, Quark Model

NPTEL : Nuclear Physics: Fundamentals and Applications (Physics)

Co-ordinators : Prof. H.C. Verma

Lecture 1 - Brief Overview of the course

Lecture 2 - Nuclear Size

Lecture 3 - Nuclear Size (Continued...)

Lecture 4 - Nuclear Size (Continued...)

Lecture 5 - Semi empirical Mass Formula

Lecture 6 - Semi empirical Mass Formula (Continued...)

Lecture 7 - Semi empirical Mass Formula (Continued...)

Lecture 8 - Semi empirical Mass Formula (Continued...)

Lecture 9 - Semi empirical Mass Formula (Continued...)

Lecture 10 - How are Neutron stars bound

Lecture 11 - Deuteron

Lecture 12 - Deuteron (Continued...)

Lecture 13 - Deuteron (Continued...)

Lecture 14 - Scattering of nucleons

Lecture 15 - Low energy n-p scattering

Lecture 16 - Theories of nuclear forces

Lecture 17 - Shell model

Lecture 18 - Shell model (Continued...)

Lecture 19 - Shell model (Continued...)

Lecture 20 - Shell model (Continued...)

Lecture 21 - Shell model (Continued...)

Lecture 22 - Collective models

Lecture 23 - Vibrational and Rotational levels

Lecture 24 - Radioactivity, Alpha Decay

Lecture 25 - Alpha decay (Continued...)

Lecture 26 - Beta decay

Lecture 27 - Beta decay (Continued...)

Lecture 28 - Beta decay (Continued...)

Lecture 29 - Gamma decay

Lecture 30 - Nuclear Reactions

Lecture 31 - Nuclear reaction (Continued...)

Lecture 32 - Nuclear reaction (Continued...)

Lecture 33 - Nuclear Fission basics

Lecture 34 - Nuclear fission of uranium

Lecture 35 - Nuclear Fission Reactor

Lecture 36 - Nuclear Energy Programme of India

Lecture 37 - Nuclear Fusion

Lecture 38 - Nuclear fusion (Continued...)

Lecture 39 - Thermonuclear fusion reactors

Lecture 40 - Fusion reactions in Stars and stellar neutrinos

Lecture 41 - Nucleosynthesis of elements in Stars

Lecture 42 - Mossbauer Spectroscopy

Lecture 43 - RBS, PIXE, NAA, Summary

NPTEL : NOC:Introduction to Electromagnetism (Physics)

Co-ordinators : Prof. Manoj K Harbola

Lecture 1 - Coloumb's Law

Lecture 2 - Coloumb's Force due to several Point charges

Lecture 3 - Force due to distribution of Charges

Lecture 4 - What is an Electric Field?

Lecture 5 - Electric Field due to a Charged Distribution

Lecture 6 - Helmholtz's Theorem for Electric Field

Lecture 7 - Divergence of a Field

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

Lecture 9 - Curl Of a Field - I

Lecture 10 - Curl of a Field - II & Stokes' Theorem

Lecture 11 - Line surface area & volume elements in Cartesian & Cylindrical Coordinates

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

Lecture 13 - Examples of application of the divergence and stokes' theorems

Lecture 14 - Electrostatic Potential

Lecture 15 - Electric field as the gradient of electrostatic potential

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

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

Lecture 18 - Elecrostatic potential due to a charge distribution - II;a ring and a spherical shell of charge

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

Lecture 20 - Method of images I: point charge in front of a grounded metallic plane - I

Lecture 21 - Method of imagesII: point charge in front of a grounded metallic plane and grounded metal sphere

Lecture 22 - Laplaces equations in some other physical phenomena

Lecture 23 - Energy of a charge distribution - I

Lecture 24 - Energy of a charge distribution - II An example

Lecture 25 - Energy of a charge distribution - III Energy density in terms of electric field

Lecture 26 - Electric field and potential in a conductor

Lecture 27 - Reciprocity theorem for conductors - I

Lecture 28 - Reciprocity theorem for conductors - II

Lecture 29 - Electric polarization and bound charges - I

Lecture 30 - Electric polarization and bound charges - II

Lecture 31 - Electric Displacement

Lecture 32 - Elecrostatics in presence of Dielectric Materials - I

Lecture 33 - Elecrostatics in presence of Dielectric Materials - II

Lecture 34 - Introduction to Magnetostatics; The BiO-Savart law

Lecture 35 - Divergence and curl of Magnetic Field

Lecture 36 - Amperes law for Magnetic Fields

Lecture 37 - Vector Potential for Magnetic Fields

Lecture 38 - Calculation of Vector Potential for a given magnetic field

Lecture 39 - Equation for the Vector Potentialin terms of current density

Lecture 40 - Vector potential from Current Densities - I

Lecture 41 - Vector potential from Current Densities - II

Lecture 42 - Magnetic Materials - I

Lecture 43 - Magnetic Materials - II Bound Current Densities

Lecture 44 - The Auxiliary Field - H

Lecture 45 - Solving for Magnetic Field of a magnet - I

Lecture 46 - Solving for Magnetic Field of a magnet in presence of Magnetic Materials

Lecture 47 - Faradays Law

Lecture 48 - Induced Electric field due to changing Magnetic Field

Lecture 49 - Demonstrations on faradays law, Lenzs law and Nonconservative nature of Induced electric field

Lecture 50 - Energy stord in a magnetic Field-I

Lecture 51 - Energy stord in a magnetic Field-I;solved examples

Lecture 52 - Displacement Current

Lecture 53 - Quasistatic approximation

Lecture 54 - Energy transport by electromagnetic fields; The Poynting Vector

Lecture 55 - The Poynting Vector;solved examples

Lecture 56 - Linear Momentum and Angular Momentum carried by Electromagnetic Fields

Lecture 57

Lecture 58

Lecture 59

Lecture 60

Lecture 61

Lecture 62

Lecture 63

Lecture 64

Lecture 65

Lecture 66 - Solution Assignment 1 - Problems 1 to 3

Lecture 67 - Solution Assignment 1 - Problems 4 to 9

Lecture 68 - Solution Assignment 2 - Problems 1 to 4

Lecture 69 - Solution Assignment 2 - Problems 5 to 11

Lecture 70 - Solution Assignment 3 - Problems 1 to 5

Lecture 71 - Solution Assignment 3 - Problems 6 to 10

Lecture 72 - Solution Assignment 4- Problems 1 to 5

Lecture 73 - Solution Assignment 4- Problems 6 to 10

Lecture 74 - Solution Assignment 5- Problems 6 to 11

Lecture 75 - Solution Assignment 5- Problems 1to 5

Lecture 76 - Solution Assignment 6- Problems 1 to 4

Lecture 77 - Solution Assignment 6- Problems 5 to 8

Lecture 78 - Solution Problem Set 7

NPTEL : NOC:Engineering Mechanics (Physics)

Co-ordinators : Prof. Manoj K Harbola

Lecture 1 - Introduction to Vectors

Lecture 2 - Addition and subtraction of vectors

Lecture 3 - Multiplying vectors

Lecture 4 - Introduction to vectors: solved examples - I

Lecture 5 - Transformation of vectors under rotation

Lecture 6 - Vector products and their geometric interpretation

Lecture 7 - Vector Product: Kronecker Delta and Levi-Civita symbols - I

Lecture 8 - Vector Product: Kronecker Delta and Levi-Civita symbols - II

Lecture 9 - Introduction to vectors: solved examples - II

Lecture 10 - Equilibrium of rigid bodies Â– Forces and torques

Lecture 11 - Calculating torques and couple moments - I

Lecture 12 - Calculating torques and couple moments - II

Lecture 13 - Finding a force and a couple equivalent to an applied force

Lecture 14 - Different elements and associated forces and torques - I

Lecture 15 - Different elements and associated forces and torques - II

Lecture 16 - Solved examples; equilibrium of bodies Â– I

Lecture 17 - Solved examples; equilibrium of bodies Â– II

Lecture 18 - Forces in different geometric configuration

Lecture 19 - Plane trusses I - building a truss and condition for it to be statically determinate

Lecture 20 - Plane trusses II - calculating forces in a simple truss and different types of trusses

Lecture 21 - Plane trusses III - calculating forces in a simple truss by method of joints

Lecture 22 - Plane trusses IV- Solved examples for calculating forces in a simple truss by method of joints

Lecture 23 - Plane trusses V - Solved examples for calculating forces in a simple truss by method of joints

Lecture 24 - Plane trusses VI - method of sections for calculating forces in a simple truss

Lecture 25 - Dry friction I - introduction with an example

Lecture 26 - Dry friction II - a solved example

Lecture 27 - Dry friction III - Dry thrust bearing and belt friction with demonstration

Lecture 28 - Dry friction IV - Screw friction and rolling friction

Lecture 29 - Dry friction V - Solved examples

Lecture 30 - Properties of plane surfaces I - First moment and centroid of an area

Lecture 31 - Properties of plane surfaces II - Centroid of an area made by joining several plane surfaces

Lecture 32 - Properties of plane surfaces III - Centroid of a distributed force and its relation with centre of gravity

Lecture 33 - Properties of plane surfaces IV - solved examples of calculation of first moment and centroid of distributed forces

Lecture 34 - Properties of plane surfaces V- Second moment and product of an area and radius of gyration

Lecture 35 - Properties of plane surfaces VI - Parallel axis transfer theorem for second moment and product of an area

Lecture 36 - Properties of plane surfaces VII - transformation of second moment and product of an area under rotation of coordinate axes

Lecture 37 - Properties of plane surfaces VIII - second moment and product of an area, solved examples

Lecture 38 - Method of virtual work I - degrees of freedom, constraints and constraint forces

Lecture 39 - Method of virtual work II - virtual displacement, virtual work and equilibrium condition in terms of virtual work

Lecture 40 - Method of virtual work III - solved examples

Lecture 41 - Motion of a particle in a plane in terms of planar polar coordinates

Lecture 42 - Planar polar coordinates: solved examples

Lecture 43 - Description of motion in cylindrical and spherical coordinate systems

Lecture 44 - Using planar polar, cylindrical and spherical coordinate systems: solved examples

Lecture 45 - Motion with constraints, constraint forces and free body diagram

Lecture 46 - Motion with constraints Â– solved examples

Lecture 47 - Motion with dry friction Â– solved examples

Lecture 48 - Motion with drag Â– solved examples

Lecture 49 - Equation of motion in terms of linear momentum and the principle of conservation of linear momentum

Lecture 50 - Linear momentum and centre of mass

Lecture 51 - Momentum transfer, impulse and force due to a stream of particles hitting an object

Lecture 52 - Momentum and the variable mass problem

Lecture 53 - Linear momentum Â– solved examples

Lecture 54 - Work and energy I - work energy theorem; conservative and non-conservative force fields

Lecture 55 - Work and energy II - Definition of potential energy for conservative forces; total mechanical energy and the principle of conservation of energy

Lecture 56 - Work and energy III - Two solved examples using conservation principles

Lecture 57 - Work and energy IV Â– Further discussion on potential energy

Lecture 58 - Work and energy V - Solved examples

Lecture 59 - Work and energy VI Â– Applying conservation principles to solve a collision problem

Lecture 60 - Work and energy VII - Solved examples

Lecture 61 - Rigid body motion I - degrees of freedom and number of variables required to describe motion of a rigid body

Lecture 62 - Rigid body motion II - Equation of motion for a single particle in terms of angular momentum and torque; motion of a conical pendulum

Lecture 63 - Rigid body motion III - Conservation of angular momentum; angular momentum for a collection of particles

Lecture 64 - Rigid body motion IV - applying angular momentum conservation, a solved example

Lecture 65 - Rigid body motion V (fixed axis rotation) - some demonstrations of conservation of angular momentum about fixed axis

Lecture 66 - Rigid body motion VI (fixed axis rotation) - Some more demonstrations and related problems

Lecture 67 - Rigid body motion VII (fixed axis rotation) - Kinetic energy and moment of inertia for fixed axis rotation and some solved examples

Lecture 68 - Rigid body motion VIII (fixed axis rotation) - solved examples for calculating moment of inertia and conservation of angular momentum

Lecture 69 - Rigid body motion IX (fixed axis rotation) - solved examples

Lecture 70 - Rigid body motion X - rotation and translation with axis moving parallel to itself

Lecture 71 - Rigid body motion XI - solved examples for rotation and translation with axis moving parallel to itself

Lecture 72 - Rigid-body dynamics XII - Some demonstrations on general motion of rigid bodies

Lecture 73 - Rigid-body dynamics XIII - Infinitesimal angles as vector quantities and change of a vector when rotated by an infinitesimal angle

Lecture 74 - Rigid-body dynamics XIV - Angular velocity and the rate of change of a rotating vector; relating change in angular velocity to an applied torque

Lecture 75 - Rigid-body dynamics XV - Relationship between angular momentum and angular velocity Â– the moment of inertia tensor and the principal axes

Lecture 76 - Rigid-body dynamics XVI - Solved examples

Lecture 77 - Rigid body motion XVII Â– A review of the relation between angular momentum and angular velocity, moment of inertia tensor and the principal axes Edit Lesson

Lecture 78 - Rigid body motion XVIII- Solved examples for calculating rate of change of angular momentum and torque when angular velocity and angular momentum are not parallel

Lecture 79 - Rigid body dynamics XIX - understanding demonstrations shown earlier using equation of motion

Lecture 80 - Rigid body dynamics XX - understanding demonstrations shown earlier using equation of motion (Euler equations)

Lecture 81 - Rigid body dynamics XXI - Euler equations, solved examples

Lecture 82 - Simple harmonic motion I - expanding potential energy about the equilibrium point and the corresponding force

Lecture 83 - Simple harmonic motion II - solving the equation of motion with given initial conditions

Lecture 84 - Simple harmonic motion III - solved examples

Lecture 85 - Simple harmonic motion IV - representing simple harmonic motion on a phasor diagram; energy of an oscillator

Lecture 86 - Simple harmonic motion V - solved examples

Lecture 87 - Simple harmonic motion VI - solving the equation of motion with constant friction in the system

Lecture 88 - Simple harmonic motion VII - harmonic oscillator with velocity-dependent damping (heavy damping)

Lecture 89 - Simple harmonic motion VIII - harmonic oscillator with velocity-dependent damping (critical damping)

Lecture 90 - Simple harmonic motion IX - solved examples

Lecture 91 - Simple harmonic motion X - harmonic oscillator with velocity-dependent damping (light damping)

Lecture 92 - Simple harmonic motion XI - solved examples

Lecture 93 - Simple harmonic motion XII - oscillations of an un-damped harmonic oscillator subjected to an oscillatory force

Lecture 94 - Simple harmonic motion XIII - oscillations of a forced damped harmonic oscillator - I

Lecture 95 - Simple harmonic oscillator XIV - oscillations of a forced damped harmonic oscillator - II

Lecture 96 - Simple harmonic oscillator XV - Energy and power in a forced damped harmonic oscillator

Lecture 97 - Simple harmonic oscillator XVI - Solved examples

Lecture 98 - Equation of motion in a uniformly accelerating frame

Lecture 99 - Motion described in a uniformly accelerating frame; solved examples - I

Lecture 100 - Motion described in a uniformly accelerating frame; solved examples - II

NPTEL : NOC:Computational Science and Engineering Using Python (Physics)

Co-ordinators : Prof. Mahendra Verma

Lecture 1 - Lecture 1 - About Computers

Lecture 2 - Lecture 2 - Python: Variables and Assignments

Lecture 3 - Lecture 3 - Python: Numpy arrays

Lecture 4 - Lecture 4 - Python: Control structures

Lecture 5 - Lecture 5A - Python packages; Programming

Lecture 6 - Lecture 5B - Some suggestions on programming

Lecture 7 - Lecture 6 - Plotting in Python

Lecture 8 - Lecture 7 - Errors and Nondimensionalization

Lecture 9 - Lecture 8 - Data I/O and Mayavi

Lecture 10 - Lecture 9 - Lagrange interpolation

Lecture 11 - Lecture 10 - Interpolation II: 2D, splines

Lecture 12 - Lecture 11 - Integration I: Newton-Cotes

Lecture 13 - Lecture 12 - Integration II: Gaussian quadrature

Lecture 14 - Lecture 13 - Gaussian quadrature continued

Lecture 15 - Lecture 14 - Numerical Differentiation

Lecture 16 - Lecture 15 - ODE solvers

Lecture 17 - Lecture 16 - ODE solvers continued

Lecture 18 - Lecture 17 - Fourier transform

Lecture 19 - Lecture 18 - PDE solver: Diffusion equation in spectral method

Lecture 20 - Lecture 19A - PDE solver: Diffusion equation using finite difference

Lecture 21 - Lecture 19B - PDE solver: Wave equation using finite difference

Lecture 22 - Lecture 20 - Linear algebra: Ax = b solver

Lecture 23 - Lecture 21 - Summary

NPTEL : NOC:Introductory Quantum Mechanics (Physics)

Co-ordinators : Prof. Manoj K Harbola

Lecture 1 - Black Body Radiation I - Relevant Definitions and Black Body as cavity

Lecture 2 - Black Body Radiation II - Intensity of radiation in terms of energy density

Lecture 3 - Black Body Radiation III - Spectral energy density and radiation pressure inside a black body radiation

Lecture 4 - Black Body Radiation IV - Stephen's Boltzman law

Lecture 5 - Black Body Radiation V - Wein's Displacement law and analysis for spectral density

Lecture 6 - Black Body Radiation VI - Wein's distribution law and rayleigh - Jeans distribution law

Lecture 7 - Black Body Radiation VII - Quantum Hypothesis and plank's distribution Formula

Lecture 8 - Radiation as a collection of particles called photons

Lecture 9 - Quantum Hypothesis and specific heat of soilds

Lecture 10 - Bohr's Model of hydrogen spectrum

Lecture 11 - Wilson Sommerfeld quantum condition I - Harmonic oscillator and particle in a box

Lecture 12 - Wilson Sommerfeld quantum condition II - Particle moving in a coulomb potential in a plane and related quantum numbers

Lecture 13 - Wilson Sommerfeld quantum condition III - Particle moving in a coulomb potential in 3D and related quantum numbers

Lecture 14 - Quantum conditions and atomic structure, electron spin and Pauli exclusion principle

Lecture 15 - Interaction of atoms with radiation : Eienstien's A and B coefficients

Lecture 16 - Stimulated emmision and amplification of light in a LASER

Lecture 17 - Brief description of a LASER

Lecture 18 - Introduction to the correspondence principle

Lecture 19 - General nature of the correspondence principle

Lecture 20 - Selection rules (for transitions) through the correspondence principle

Lecture 21 - Applications of the correspondence principle : Einstiens A coefficient for the harmonic oscillator and the selection rules for atomic transitions

Lecture 22 - Heisenberg's formulations of quantum mechanics : expressing kinetic variables as matrices

Lecture 23 - Heisenberg's formulation of quantum mechanics : the quantum condition

Lecture 24 - Heisenberg's formulation of the quantum mechanics : Application to harmonic oscillator

Lecture 25 - Brief introduction to matrix mechanics and the quantum condition in matrix form

Lecture 26 - Introduction to waves and wave equation

Lecture 27 - Sationary waves eigen values and eigen functions

Lecture 28 - Matter waves and their experimental detection

Lecture 29 - Represenating a moving paticle by a wave packet

Lecture 30 - Stationary-state Schrodinger equation and its solution for a particle in a box

Lecture 31 - Solution of the stationary-state Schrodinger equation for a simple harmonic oscillator

Lecture 32 - Equivalance of Heisenberg and the Schrodinger formulations : Mathematical preliminaries

Lecture 33 - Equivalance of Heisenberg and Schrodinger formulations : The x and p operators and the quantum condition

Lecture 34 - Born interpretation of the wavefunction and expectation values of x and p operators

Lecture 35 - Uncertainty principle and its simple applications

Lecture 36 - Time dependent Schrodinger equation the probability current density and the continuity equation for the probability density

Lecture 37 - Ehrenfest theorem for the expectation values of x and p operators

Lecture 38 - Solution of Schrodinger equation for a particle in one and two delta function potentials

Lecture 39 - Solution of Schrodinger equation for a particle in a finite well

Lecture 40 - Numerical solution of a one dimensional Schrodinger equation for bound states - I

Lecture 41 - Numerical solution of a one dimensional Schrodinger equation for bound states - II

Lecture 42 - Reflection and transmission of particles across a potential barrier

Lecture 43 - Quantum-tunneling and its examples

Lecture 44 - Solution of the Schrodinger for free paticles and periodic boundary conditions

Lecture 45 - Electrons in a metal : Density of states and Fermi energy

Lecture 46 - Schrodinger equation for particles in spherically symmetric potential, angular momentum operator

Lecture 47 - Angular momentum operator and its eigenfunctions

Lecture 48 - Equation for radial component of the wavefunction in spherically symmteric potentials and general properties of its solution

Lecture 49 - Solution for radial component of the wavefunction for the hydrogen atom

Lecture 50 - Numerical solution for the radial component of wavefunction for spherically symmetric potentials

Lecture 51 - Solution of the Schrodinger equation for one dimensional periodic potential : Bloch's theorem

Lecture 52 - Kroning-Penny model and energy bands

Lecture 53 - Kroning-Penny model with periodic Dirac delta function and energy bands

Lecture 54 - Discussion on bands

Lecture 55 - Summary of the course

NPTEL : NOC:Introduction to Solid State Physics (Physics)

Co-ordinators : Prof. Satyajit Banerjee

Lecture 1 - Introduction to Drude's theory of electrons in a metal - Part 1

Lecture 2 - Introduction to Drude's theory of electrons in a metal - Part 2

Lecture 3 - Postulates of Drude's theory

Lecture 4 - Calculating electrical conductivity of metal using Drude's theory of electrons in metal - Part 1

Lecture 5 - Calculating the electrical conductivity of metal using Drude's Model - Part 2

Lecture 6 - Introduction to Hall effect in Metals - Part 1

Lecture 7 - Introduction to Hall effect in metals - Part 2

Lecture 8 - Introduction to Hall effect in metals - Part 3

Lecture 9 - Understanding thermal conductivity of a metal using Drude's model - Part 1

Lecture 10 - Understanding thermal conductivity of a metal using Drude's model - Part 2

Lecture 11 - Introduction to Sommerfeld's Theory of electrons in a metal - Part 1

Lecture 12 - Introduction to Sommerfeld's Theory of electrons in a metal - Part 2

Lecture 13 - Introduction to Sommerfeld's Theory of electrons in a metal - Part 3

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19 - Electronic Contribution to the Specific heat of a Solid - Part 1

Lecture 20 - Electronic Contribution to the Specific heat of a Solid - Part 2

Lecture 21 - Electronic Contribution to the Specific heat of a Solid - Part 3

Lecture 22 - Electronic Contribution to the Specific heat of a Solid - Part 4

Lecture 23 - Understanding Thermal conductivity of Metals

Lecture 24 - Introduction to Magnetism in Metal - Part 1

Lecture 25 - Introduction to Magnetism in Metal - Part 2

Lecture 26

Lecture 27 - Introduction to crystals and bonding in crystals

Lecture 28 - Understanding crystal structure using Bravais Lattice

Lecture 29 - Bravais Lattice Types - Part 1

Lecture 30 - Bravais Lattice Types - Part 2

Lecture 31 - Introduction to different crystal types - Part 1

Lecture 32 - Introduction to different crystal types - Part 2

Lecture 33 - Indexing crystal planes

Lecture 34 - Scattering of X rays from crystals - Part 1

Lecture 35 - Scattering of X rays from crystals - Part 2

Lecture 36 - Reciprocal lattice vectors - Part 1

Lecture 37 - Reciprocal lattice vectors - Part 2

Lecture 38 - Reciprocal lattice vectors and Laue's condition for diffraction of waves in crystals - Part 1

Lecture 39 - Reciprocal lattice vectors and Laue's condition for diffraction of waves in crystals - Part 2

Lecture 40 - Reciprocal lattice vectors, Laue's condition and Bragg's law for diffraction of waves by a crystal

Lecture 41 - Wave equation in a continuous medium and generalization to a discrete medium

Lecture 42 - Derivation of wave equation for motion of atoms in a crystal

Lecture 43 - Solution of the wave equation for a crystal and the relation between frequency Ãâ€° and wavevector k

Lecture 44 - Group velocity of waves and speed of sound in a crystal

Lecture 45 - Waves in a crystal considering interaction among atoms beyond their nearest neighbours

Lecture 46 - Normal modes in a crystal : Phonons and their momenta and energy

Lecture 47 - Experimental determination of Phonon dispersion curves

Lecture 48 - Lattice with two atom basis: Optical Phonons

Lecture 49 - Displacement of the atoms for the acoustic and optical Phonons

Lecture 50 - Density of states of phonons

Lecture 51 - Calculating the density of states of Phonons: The Einstein's and the Debye's Models

Lecture 52 - Average energy of Phonons at Temperature T

Lecture 53 - Debye's Model of specific heat of crystals

Lecture 54 - Anharmonic effects in crystals: thermal expansion and Umkclapp processes

Lecture 55 - Going beyond free electron model: Periodic crystal potential and Bloch's theorem for the wavefunction

Lecture 56 - Applying perturbation theory to free electron wavefunctions and nearly free electron model

Lecture 57 - Applying perturbation theory to free electron wavefunctions and creation of energy gap at zone boundaries

Lecture 58 - Mixing of plane waves to get Bloch Wavefunction - I

Lecture 59 - Mixing of plane waves to get Bloch Wavefunction - II

Lecture 60 - Equivalence of wave vectors k and k+G and reduced zone scheme

Lecture 61 - Applying periodic boundary condition to Bloch wavefunction and counting the number of states

Lecture 62 - Band theory of metals, insulators and semiconductors

Lecture 63 - Kronig- Penney model

Lecture 64 - Bloch wavefunction as a linear combination of atomic orbitals: Tight Binding Model- I

Lecture 65 - Tight Binding Model - II

Lecture 66 - Semiclassical dynamics of a particle in a band and Bloch oscillations

Lecture 67 - Experimental observations of Bloch oscillations

Lecture 68 - Concept of hole as a current carrier in semiconductors - I

Lecture 69 - Concept of hole as a current carrier in semiconductors - II

Lecture 70 - Calculating carrier density in semiconductors - I

Lecture 71 - Calculating carrier density in semiconductors - II

Lecture 72 - Donor and acceptor energy levels in a semiconductor

Lecture 73 - charge carrier density in n-type and p-type semiconductors

Lecture 74 - Electrical conductivity and hall coefficient in semiconductors

Lecture 75 - Paramagnetism in solids I - Magnetic moment and Lande g factor for atoms

Lecture 76 - Paramagnetism in solids II - temperature dependence of paramagnetic susceptibility and Curie's Law

Lecture 77 - Hund's rule for calculating the total angular momentum J, orbital angular momentum L and spin angular momentum S for an atom

Lecture 78 - Examples of performing paramagnetic susceptibility calculations

Lecture 79 - Diamagnetism in Solids

Lecture 80 - Understanding quenching of orbital angular momentum in transition metal ions

Lecture 81 - Ferromagnetism in solids

Lecture 82 - Introduction to Meissner state of superconductors and levitation

Lecture 83 - Superconducting materials and Type-I and Type-II superconductors

Lecture 84 - London's equation for superconductors

Lecture 85 - Application of London's equation, behavior

Lecture 86 - A qualitative introduction to BCS theory of superconductivity

Lecture 87 - Josephson's effect in superconductors and tunneling current across barriers

NPTEL : NOC:Physics of Turbulence (Physics)

Co-ordinators : Prof. Mahendra Verma

Lecture 1 - The turbulence problem

Lecture 2 - Basic hydrodynamics - Governing equations

Lecture 3 - Basic hydrodynamics - Vorticity

Lecture 4 - Basic hydrodynamics - Quadratic quantities

Lecture 5 - Basic hydrodynamics - Example problems

Lecture 6 - Fourier space representation - Definitions

Lecture 7 - Fourier space representation - Flow equations

Lecture 8 - Fourier space representation - Kinetic energy

Lecture 9 - Fourier space representation - Vorticity, Kinetic Helicity, and Enstrophy

Lecture 10 - Fourier space representation - Examples

Lecture 11 - Fourier space representation - Examples (Continued...)

Lecture 12 - Craya-Herring Basis: Definitions

Lecture 13 - Craya-Herring Basis: Equations of Motion for a Triad

Lecture 14 - Craya-Herring Basis: Equations of Motion for an Anticlockwise Triad

Lecture 15 - Thermal Instability

Lecture 16 - Thermal Instabilities (Continued...)

Lecture 17 - Rotating Convection: Instability and Patterns

Lecture 18 - Magnetoconvection: Instability and Patterns

Lecture 19 - Nonlinear Saturation: Lorenz Equation

Lecture 20 - Patterns, Chaos, and Turbulence

Lecture 21 - Energy Transfers: Mode-to-mode Energy Transfers

Lecture 22 - Energy Transfers: Mode-to-mode Energy Transfers (Continued...)

Lecture 23 - Energy Transfers: Examples

Lecture 24 - Energy Transfers: Spectral Energy Flux and Shell-to-Shell Energy Transfer

Lecture 25 - Energy Transfers: Fluid Simulations using Spectral Method

Lecture 26 - Energy Transfers: Fluid Simulations - Dealiasing

Lecture 27 - Kolmogorov's Theory: Energy Spectrum and Flux

Lecture 28 - Kolmogorov's Theory: Insights and its Verification with Direct Numerical Simulation

Lecture 29 - Kolmogorov's Theory: Spectrum and Flux in inertial-dissipation range

Lecture 30 - Kolmogorov's four-fifth law: Isotropic Tensor and Correlations

Lecture 31 - Kolmogorov's four-fifth law: Derivation

Lecture 32 - Kolmogorov's four-fifth law: Derivation (Final steps)

Lecture 33 - Enstrophy Spectrum and Flux

Lecture 34 - Two-dimensional Turbulence

Lecture 35 - Helical turbulence

Lecture 36 - Flow with a scalar

Lecture 37 - Passive scalar turbulence

Lecture 38 - Stably stratified turbulence

Lecture 39 - Turbulent thermal convection

Lecture 40 - Flow with a vector

Lecture 41 - MHD Turbulence: Formalism

Lecture 42 - MHD Turbulence: Energy Transfers

Lecture 43 - MHD Turbulence: Turbulence Models

Lecture 44 - MHD Turbulence: Dynamo

NPTEL : NOC:Introduction to Astrophysical Fluids (Physics)

Co-ordinators : Prof. Supratik Banerjee

Lecture 1 - General introduction

Lecture 2 - Phase space and Liouville's theorem

Lecture 3 - Collisionless Boltzmann equation

Lecture 4 - Boltzmann equation for collisional system - I

Lecture 5 - Boltzmann equation for collisional system - II

Lecture 6 - Equilibrium distribution function - I

Lecture 7 - Equilibrium distribution function - II

Lecture 8 - Derivation of moment equations - I

Lecture 9 - Derivation of moment equations - II

Lecture 10 - Application of moment equations in collisionless systems

Lecture 11 - Derivation of ideal fluid equations

Lecture 12 - Macroscopic forces on an ideal fluid

Lecture 13 - Properties of ideal fluid

Lecture 14 - Kevin's vorticity theorem

Lecture 15 - Conservative form and invariants in ideal fluids

Lecture 16 - Steady flow, streamlines and stream function

Lecture 17 - Departure from Maxwellian distribution

Lecture 18 - Derivation of real fluid equations

Lecture 19 - Hydrostatics: Model of solar corona

Lecture 20 - Stellar/solar wind

Lecture 21 - Accretion disks - I

Lecture 22 - A small digression: Newtonian fluids

Lecture 23 - Accretion disk - II

Lecture 24 - Weak perturbation in a compressible fluid: sound wave

Lecture 25 - Effect of nonlinearity: shocks

Lecture 26 - Supernova explosion and spherical blast waves - I

Lecture 27 - Supernova explosion and spherical blast waves - II

Lecture 28 - de Laval nozzle and extragalactic jets

Lecture 29 - Convective instability and Swarzschild stability criterian

Lecture 30 - Rayleigh Benard convection - I

Lecture 31 - Rayleigh Benard convection - II

Lecture 32 - Jeans instability

Lecture 33 - Waves and instabilities in a two-fluid interface - I

Lecture 34 - Waves and instabilities in a two-fluid interface - II

Lecture 35 - Oscillations of stars

Lecture 36 - Oscillation of stars (Continued...)

Lecture 37 - Rotation in astrofluids and Rayleigh criterion

Lecture 38 - Fluid dynamics in a rotating frame of reference

Lecture 39 - Vorticity theorem in rotating frame and Taylor-Proudman theorem

Lecture 40 - Effect of rotation on a self gravitating mass

Lecture 41 - Effect of rotation in stars

Lecture 42 - Introduction to Plasmas

Lecture 43 - Description of Plasma

Lecture 44 - Kinetic to fluid picture of plasmas

Lecture 45 - MHD fluids: magnetic pressure, magnetic tension and plasma beta

Lecture 46 - Inviscid invariants in MHD

Lecture 47 - Inviscid invariants in MHD (Continued...)

Lecture 48 - Elsasser variables in MHD

Lecture 49 - Linear wave modes in MHD

Lecture 50 - MHD in space plasmas

Lecture 51 - Introduction to turbulence in fluids

Lecture 52 - Richardson-Kolmogorov phenomenology of turbulence

Lecture 53 - Turbulent diffusion

Lecture 54 - Turbulent viscosity

Lecture 55 - Turbulence in MHD fluids

Lecture 56 - Introduction to astrophysical dynamos

Lecture 57 - Anti-dynamo theorem and turbulent dynamos

NPTEL : NOC:Introduction to Electromagnetic Theory (Hindi) (Physics)

Co-ordinators : Prof. Manoj Harbola

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

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Lecture 37

Lecture 38

Lecture 39

Lecture 40

Lecture 41

Lecture 42

Lecture 43

Lecture 44

Lecture 45

Lecture 46

Lecture 47

Lecture 48

Lecture 49

Lecture 50

Lecture 51

Lecture 52

Lecture 53

NPTEL : NOC:Scientific Computing Using Python (Physics)

Co-ordinators : Prof. Mahendra K. Verma

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

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Lecture 22

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Lecture 62

Lecture 63

Lecture 64

Lecture 65

Lecture 66

Lecture 67

Lecture 68

Lecture 69

Lecture 70

Lecture 71

NPTEL : NOC:Tapestry of Field theory: Classical and Quantum, Equilibrium and Nonequilibrium Perspectives (Physics)

Co-ordinators : Prof. Mahendra K. Verma

Lecture 1 - Introduction to Field Theory and Course

Lecture 2 - Integration using Complex Analysis

Lecture 3 - Cauchy Principal Value Theorem

Lecture 4 - Fourier Transform

Lecture 5 - Green's Function and Examples

Lecture 6 - Green's Function in Fourier Space

Lecture 7 - Fourier Transform, Time Frequency

Lecture 8 - Green's Function for Helmholtz Equation and Wave Equation

Lecture 9 - Green's Function for Diffusion and Schrodinger Equation

Lecture 10 - Dimensional Analysis

Lecture 11 - Functionals - Part 1

Lecture 12 - Lagrangian Formalism - Part 2

Lecture 13 - Relativistic Fields

Lecture 14 - Hamiltonian Formalism

Lecture 15 - Principle of Least Action

Lecture 16 - Relativistic Fields and Hamiltonian Formalism

Lecture 17 - Noether's Theorem and Symmetries

Lecture 18 - Review of Quantum Mechanics

Lecture 19 - Second Quantization

Lecture 20 - Field Operators

Lecture 21 - Fock Space and Vaccum Energy

Lecture 22 - Quantization of Bosons and Fermions

Lecture 23 - Examples

Lecture 24 - Free Fermi Gas

Lecture 25 - Propagators and Perturbations

Lecture 26 - Relativistic Quantum Field Theory

Lecture 27 - Feynman Propagator

Lecture 28 - Review of Statistical Mechanics (Partition Function)

Lecture 29 - Feynman Path Integral

Lecture 30 - Diagrammatic Field Theory (Wick's Theorem)

Lecture 31 - Wick's Theorem (Continued...)

Lecture 32 - Diagrammatic Perturbation Theory

Lecture 33 - Green's Function and Correlation Function

Lecture 34 - Feynman Diagrams

Lecture 35 - Phase Transition and Landau Theory

Lecture 36 - Failure of Landau's Theory

Lecture 37 - Scale Invariance

Lecture 38 - Renormalization Group - Preliminary

Lecture 39 - RG Steps

Lecture 40 - Pertubative Calculations

Lecture 41 - RG Fixed Points

Lecture 42 - Relevent and Irrelevant Variables

Lecture 43 - Behaviour Near Critical Points

Lecture 44 - Computing Critical Exponents

Lecture 45 - Mass and Charge Renormalization, Running Coupling const: Î¦4 Theory

Lecture 46 - Charge and Mass Renormalization: QED and QCD

Lecture 47 - Breaking a Continuous Symmetry (Goldstone Mode)

Lecture 48 - Covariant Electrodynamics (Gauge Interactions)

Lecture 49 - Higgs Mechanism

Lecture 50 - Introduction to Non-Equilibrium Field Theory (Langevin Equation)

Lecture 51 - Fluctuation Dissipation Theorem

Lecture 52 - Kolgomorov's Theory of Turbulence

Lecture 53 - Equilibrium and Non Equilibrium Solution of Navier Stokes

Lecture 54 - Energy Flux in Navier Stokes Equation

Lecture 55 - RG Analysis of Field Theory of Turbulence

Lecture 56 - Renormalized Viscosity and Discussion

Lecture 57 - Renormalization of the Coupling Constant for the Shell Model

Lecture 58 - Flux Computation for the Shell Model of Turbulence

Lecture 59 - Renormalization Group Analysis of Navier Stokes Equation

Lecture 60 - Flux Computation for the Navier Stokes Equation

Lecture 61 - Functional Form of a Dynamical Equation

Lecture 62 - Surface Growth Phenomena: Introduction

Lecture 63 - Surface Growth Phenomena: EW Equation

Lecture 64 - Surface Growth Phenomena: KPZ Equation

Lecture 65 - Surface Growth Phenomena: KPZ Equation (Continued...)

Lecture 66 - RG Procedure for KPZ Equation

Lecture 67 - Noise Renormalization

Lecture 68 - Fixed Point Solution

Lecture 69 - Weak Turbulence Theory using Examples

Lecture 70 - Weak Turbulence Applications (Rotating Turbulence, Internal and Surface Gravity Waves)

Lecture 71 - Nonlinear Schodinger Equation

Lecture 72 - Field Theory of Passive Scalar Turbulence

Lecture 73 - Course Summary

NPTEL : NOC:Coherence and Quantum Entanglement (Physics)

Co-ordinators : Prof. Anand Kumar Jha

Lecture 1 - Main differences between classical and quantum mechanics

Lecture 2 - Introduction to Coherence and Stochastic Processes

Lecture 3 - The Joint Probability Function used in Classical Optics: The Correlation Functions

Lecture 4 - Second-order Coherence Theory (Temporal)

Lecture 5 - Quantifying the Temporal Correlations

Lecture 6 - Second-order Coherence Theory (Spatial); Spatial Correlations

Lecture 7 - Quantifying the Spatial Correlations

Lecture 8 - Second-order Coherence Theory (Angular); Angular Correlations

Lecture 9 - Second-order Coherence Theory (Polarization)

Lecture 10 - Degree of Polarization

Lecture 11 - Coherent Mode Representation of Optical Fields

Lecture 12 - Review of Quantum Mechanics

Lecture 13 - Quantum Mechanical Correlation Functions

Lecture 14 - Basics of Nonlinear Optics

Lecture 15 - Two-Photon State Produced by Parametric Down-Conversion

Lecture 16 - Coherence and Quantum Entanglement

Lecture 17 - Temporal Two-Photon Interference

Lecture 18 - Some example of Two-Photon Interference Effects

Lecture 19 - Spatial Two-Photon Interference

Lecture 20 - Quantum Measurements

Lecture 21 - Can the Quantum Mechanical Description of Physical Reality be Considered Complete ?

Lecture 22 - Hidden Variable Interpretation of Quantum Mechanics

Lecture 23 - Bell Inequalities

Lecture 24 - Entanglement Verification

Lecture 25 - Entanglement Quantification and Connection Between Coherence and Entanglement

Lecture 26 - 84 Quantum Cryptography

Lecture 27 - Quantum Teleportation

NPTEL : NOC:Classical Motion of a Single Particle (Physics)

Co-ordinators : Prof. Supratik Banerjee

Lecture 1 - Introduction and Newton's laws of motion

Lecture 2 - From dynamics to Kinematics

Lecture 3 - Equations of dynamics and constants of motion

Lecture 4 - Constants of motion (Continued...), Wrok-energy theorem and conservative forces

Lecture 5 - Dynamics under constants and central forces

Lecture 6 - Derivation of gradient form from zero curl condition

Lecture 7 - Concept of equilibrium

Lecture 8 - Terminal velocity, stable and unstable equilibria

Lecture 9 - Stable and unstable equilibria in more than one dimensions

Lecture 10 - Motion in one-dimensional potential

Lecture 11 - Solving equations of motion in one dimension

Lecture 12 - Calculation of Work Done in a Force Field

Lecture 13 - Central forces, Velocity and Acceleration in Plane Polar Coordinates

Lecture 14 - Dynamics and Trajectories Under a Central Force

Lecture 15 - Equation For Trajectories Under a Central Force (Continued...) : Binet Equation

Lecture 16 - Trajectory of a Particle Under Attractive Inverse-Square Force Law

Lecture 17 - Energy Diagram in an Effective One-Dimensional Motion

Lecture 18 - Two Interesting Problems On the motion Under Central Forces

Lecture 19 - Motion Under an Attractive Inverse-Square Force

Lecture 20 - Motion Under an Attractive Inverse-Square Force (Continued...)

Lecture 21 - Trajectories Under Attractive Inverse-Square Force, Laws of Kepler

Lecture 22 - Laplace Runge-Lenz Vector

Lecture 23 - Simple harmonic oscillators

Lecture 24 - Two examples of simple harmonic oscillation

Lecture 25 - Forced harmonic oscillator

Lecture 26 - Forced harmonic oscillator at resonance

Lecture 27 - Damped harmonic oscillator

Lecture 28 - Nature of motion under a harmonic potential

Lecture 29 - Comparison among three types of damped oscillation

Lecture 30 - Forced harmonic oscillator with damping

Lecture 31 - A problem on damped harmonic oscillator

Lecture 32 - Beats

Lecture 33 - Motion of a particle in electric and magnetic fields

Lecture 34 - E X B drift

Lecture 35 - Inertial frames of reference, Galilean transformation

Lecture 36 - Non-inertial frames of reference, pseudo forces

Lecture 37 - Motion of a particle in a rotating frame of reference

Lecture 38 - Motion of a particle relative to an observer on earth

Lecture 39 - Motion of a particle under various constraints

Lecture 40 - Principle of Virtual work, D'Alembert's principle

Lecture 41 - Lagrange's equation of first kind

Lecture 42 - Solving problems using Lagrange's equation of first kind

Lecture 43 - Generalized Coordinates and Generalized Velocities

Lecture 44 - Knetic Energy and Acceleration in Terms of Generalized Coordinates

Lecture 45 - Generalized Momentum and Generalized Force; Derivation of Euler-Lagrange Equation

Lecture 46 - Euler Lagrange Equation, Cyclic Coordinates and Other Properties

Lecture 47 - Properties of Euler-Lagrange equations (Continued...)

Lecture 48 - Lagrangian of various oscillating systems

Lecture 49 - Problem solving using Euler-Lagrange equations

Lecture 50 - Concept of Phase Space

Lecture 51 - Phase space trajectories and fixed points

Lecture 52 - Stability of fixed points

Lecture 53 - Different types of fixed points

Lecture 54 - Fixed points and their stability for mechanical systems

Lecture 55 - Linear two-dimensional phase space dynamics

Lecture 56 - Linear two-dimensional phase space dynamics (Continued...)

Lecture 57 - Concept of limit cycles

Lecture 58 - Lorenz equations and introduction to chaos

NPTEL : Astrophysics and Cosmology (Physics)

Co-ordinators : Prof. S. Bharadwaj

Lecture 1 - Introduction

Lecture 2 - Keplers Law

Lecture 3 - The Solar System

Lecture 4 - The Solar System (Continued...)

Lecture 5 - Binary Systems

Lecture 6 - Binary Systems (Continued...)

Lecture 7 - Tidal Forces and the Earth Moon System

Lecture 8 - Fluid Mechanics

Lecture 9 - Hydrostatics and the Solar Wind

Lecture 10 - Radiative Transfer

Lecture 11 - Radiative Transfer (Continued...)

Lecture 12 - Thermal Radiation

Lecture 13 - Thermal Radiation and the Sun

Lecture 14 - Virial Theorem and Its Application to Stars

Lecture 15 - Stars: Magnitudes and the H-R Diagram

Lecture 16 - Stellar Physics - I

Lecture 17 - Stellar Physics - II

Lecture 18 - Stellar Physics - III

Lecture 19 - Stellar Physics - IV

Lecture 20 - Stellar Physics - V

Lecture 21 - White Dwarfs

Lecture 22 - White Dwarfs and Neutron Stars

Lecture 23 - Galaxies

Lecture 24 - Galaxies and the Expanding Universe

Lecture 25 - The Expanding Universe

Lecture 26 - Dynamics of the Expanding Universe

Lecture 27 - Dynamics of the Expanding Universe (Continued...)

Lecture 28 - The Expanding Universe and the Cosmological Metric

Lecture 29 - The Cosmological Space - Time

Lecture 30 - Distances

Lecture 31 - Distances (Continued...)

Lecture 32 - Distances and the Hubble Parameter

Lecture 33 - Distances, the Hubble Parameter and Dark Energy (Continued...)

Lecture 34 - CMBR and Thermal History

Lecture 35 - CMBR and Thermal History (Continued...1)

Lecture 36 - CMBR and Thermal History (Continued...2)

Lecture 37 - Thermal History, Expansion Rate and Neutrino Mass

Lecture 38 - Thermal History: Neutrino Mass, Nucleosynthesis

Lecture 39 - Big Bang Nucleosynthesis

Lecture 40 - Big Bang Nucleosynthesis (Continued...)

NPTEL : NOC:Mathematics Methods in Physics - I (Physics)

Co-ordinators : Prof. Samudra Roy

Lecture 1 - Set, Group, Field, Ring

Lecture 2 - Vector Space

Lecture 3 - Span, Linear combination of vectors

Lecture 4 - Linearly dependent and independent vector, Basis

Lecture 5 - Dual Space

Lecture 6 - Inner Product

Lecture 7 - Schwarz Inequality

Lecture 8 - Inner product space, Gram-Schmidt Ortho-normalization

Lecture 9 - Projection operator

Lecture 10 - Transformation of Basis

Lecture 11 - Transformation of Basis (Continued...)

Lecture 12 - Unitary transformation, Similarity Transformation

Lecture 13 - Eigen Value, Eigen Vectors

Lecture 14 - Normal Matrix

Lecture 15 - Diagonalization of a Matrix

Lecture 16 - Hermitian Matrix

Lecture 17 - Rank of a Matrix

Lecture 18 - Cayley - Hamilton Theorem, Function space

Lecture 19 - Metric Space, Linearly dependent - independent functions

Lecture 20 - Linearly dependent â€“independent functions (Continued...), Inner Product of functions

Lecture 21 - Orthogonal functions

Lecture 22 - Delta Function, Completeness

Lecture 23 - Fourier

Lecture 24 - Fourier Series (Continued...)

Lecture 25 - Parseval Theorem, Fourier Transform

Lecture 26 - Parseval Relation, Convolution Theorem

Lecture 27 - Polynomial space, Legendre Polynomial

Lecture 28 - Monomial Basis, Factorial Basis, Legendre Basis

Lecture 29 - Complex Numbers

Lecture 30 - Geometrical interpretation of complex numbers

Lecture 31 - de Moivreâ€™s Theorem

Lecture 32 - Roots of a complex number

Lecture 33 - Set of complex no, Stereographic projection

Lecture 34 - Complex Function, Concept of Limit

Lecture 35 - Derivative of Complex Function, Cauchy-Riemann Equation

Lecture 36 - Analytic Function

Lecture 37 - Harmonic Conjugate

Lecture 38 - Polar form of Cauchy-Riemann Equation

Lecture 39 - Multi-valued function and Branches

Lecture 40 - Complex Line Integration, Contour, Regions

Lecture 41 - Complex Line Integration (Continued...)

Lecture 42 - Cauchy-Goursat Theorem

Lecture 43 - Application of Cauchy-Goursat Theorem

Lecture 44 - Cauchyâ€™s Integral Formula

Lecture 45 - Cauchyâ€™s Integral Formula (Continued...)

Lecture 46 - Series and Sequence

Lecture 47 - Series and Sequence (Continued...)

Lecture 48 - Circle and radius of convergence

Lecture 49 - Taylor Series

Lecture 50 - Classification of singularity

Lecture 51 - Laurent Series, Singularity

Lecture 52 - Laurent series expansion

Lecture 53 - Laurent series expansion (Continued...), Concept of Residue

Lecture 54 - Classification of Residue

Lecture 55 - Calculation of Residue for quotient from

Lecture 56 - Cauchyâ€™s Residue Theorem

Lecture 57 - Cauchyâ€™s Residue Theorem (Continued...)

Lecture 58 - Real Integration using Cauchyâ€™s Residue Theorem

Lecture 59 - Real Integration using Cauchyâ€™s Residue Theorem (Continued...)

Lecture 60 - Real Integration using Cauchyâ€™s Residue Theorem (Continued...)

NPTEL : NOC:Classical Mechanics - from Newtonian to Lagrangian Formulation (Physics)

Co-ordinators : Prof. Debamalya Banerjee

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6 - Systems with variable mass - 3

Lecture 7 - Systems with variable mass - 4

Lecture 8 - Central force - 1

Lecture 9 - Central force - 2

Lecture 10 - Central force - 3

Lecture 11 - Central force - 4

Lecture 12 - Central force - 5

Lecture 13 - Central force - 6

Lecture 14 - Central force - 7

Lecture 15 - Central force - 8

Lecture 16 - Central force - 9

Lecture 17 - Central force - 10

Lecture 18 - Central force - 11

Lecture 19 - Central force - 12

Lecture 20 - Central force - 13

Lecture 21 - Central force - 14

Lecture 22 - Central force - 15

Lecture 23 - Mooring Co-ordinate Systems - 1

Lecture 24 - Mooring Co-ordinate Systems - 2

Lecture 25 - Mooring Co-ordinate Systems - 3

Lecture 26 - Mooring Co-ordinate Systems - 4

Lecture 27 - Rigid body dynamics - 1

Lecture 28 - Rigid body dynamics - 2

Lecture 29 - Rigid body dynamics - 3

Lecture 30 - Rigid body dynamics - 4

Lecture 31 - Rigid body dynamics - 5

Lecture 32 - Rigid body dynamics - 6

Lecture 33 - Rigid body dynamics - 7

Lecture 34 - Rigid body dynamics - 8

Lecture 35 - Rigid body dynamics - 9

Lecture 36 - Rigid body dynamics - 10

Lecture 37 - Rigid body dynamics - 11

Lecture 38 - Rigid body dynamics - 12

Lecture 39 - Rigid body dynamics - 13

Lecture 40 - Rigid body dynamics - 14

Lecture 41 - Rigid body dynamics - 15

Lecture 42 - Rigid body dynamics - 16

Lecture 43 - Lagrangian Formulation - 1

Lecture 44 - Lagrangian Formulation - 2

Lecture 45 - Lagrangian Formulation - 3

Lecture 46 - Lagrangian Formulation - 4

Lecture 47 - Lagrangian Formulation - 5

Lecture 48 - Lagrangian Formulation - 6

Lecture 49 - Lagrangian Formulation - 7

Lecture 50 - Lagrangian Formulation - 8

Lecture 51 - Lagrangian Formulation - 9

Lecture 52 - Lagrangian Formulation - 10

Lecture 53 - Small oscillation - 1

Lecture 54 - Small oscillation - 2

Lecture 55 - Small oscillation - 3

Lecture 56 - Small oscillation - 4

Lecture 57 - Small oscillation - 5

Lecture 58 - Small oscillation - 6

Lecture 59 - Small oscillation - 7

Lecture 60 - Small oscillation - 8

NPTEL : NOC:Solid State Physics (Physics)

Co-ordinators : Prof. Amal Kumar Das

Lecture 1 - Atom to Solid Structure

Lecture 2 - Atom to Solid Structure (Continued...)

Lecture 3 - Structure of Solid

Lecture 4 - Structure of Solid (Continued...)

Lecture 5 - Crystal Structure

Lecture 6 - Crystal Structure (Continued...)

Lecture 7 - Crystal Structure (Continued...)

Lecture 8 - Crystal Structure (Continued...)

Lecture 9 - Crystal Structure (Continued...)

Lecture 10 - Crystal Structure (Continued...)

Lecture 11 - Crystal Structure (Continued...)

Lecture 12 - Crystal Structure (Continued...)

Lecture 13 - Crystal Structure (Continued...)

Lecture 14 - Crystal Structure (Continued...)

Lecture 15 - Crystal Structure (Continued...)

Lecture 16 - Crystal Structure (Continued...)

Lecture 17 - Crystal Structure (Continued...)

Lecture 18 - X-ray Diffraction from Crystal

Lecture 19 - X-ray Diffraction from Crystal (Continued...)

Lecture 20 - X-ray Diffraction from Crystal (Continued...)

Lecture 21 - X-ray Diffraction from Crystal (Continued...)

Lecture 22 - X-ray Diffraction from Crystal (Continued...)

Lecture 23 - X-ray Diffraction from Crystal (Continued...)

Lecture 24 - X-ray Diffraction from Crystal (Continued...)

Lecture 25 - Reciprocal Lattice

Lecture 26 - Reciprocal Lattice (Continued...)

Lecture 27 - Reciprocal Lattice (Continued...)

Lecture 28 - Reciprocal Lattice (Continued...)

Lecture 29 - Reciprocal Lattice (Continued...)

Lecture 30 - Intensity of Bragg Diffraction

Lecture 31 - Intensity of Bragg Diffraction (Continued...)

Lecture 32 - Electrical Properties of Metal

Lecture 33 - Electrical Properties of Metal (Continued...)

Lecture 34 - Electrical Properties of Metal (Continued...)

Lecture 35 - Electrical Properties of Metal (Continued...)

Lecture 36 - Electrical Properties of Metal (Continued...)

Lecture 37 - Electrical Properties of Metal (Continued...)

Lecture 38 - Electrical Properties of Metal (Continued...)

Lecture 39 - Electrical Properties of Metal (Continued...)

Lecture 40 - Band Theory of Solids

Lecture 41 - Band Theory of Solids (Continued...)

Lecture 42 - Band Theory of Solids (Continued...)

Lecture 43 - Band Theory of Solids (Continued...)

Lecture 44 - Band Theory of Solids (Continued...)

Lecture 45 - Band Theory of Solids (Continued...)

Lecture 46 - Band Theory of Solids (Continued...)

Lecture 47 - Physics of Semiconductor

Lecture 48 - Physics of Semiconductor (Continued...)

Lecture 49 - Physics of Semiconductor

Lecture 50 - Electrical Conduction

Lecture 51 - Electrical Conduction

Lecture 52

Lecture 53

Lecture 54 - Thermal Properties of Solid (Continued...)

Lecture 55 - Thermal Properties of Solid (Continued...)

Lecture 56 - Thermal Properties of Solid (Continued...)

Lecture 57 - Thermal Properties of Solid (Continued...)

Lecture 58 - Magnetic Property of Solid

Lecture 59 - Magnetic Property of Solid (Continued...)

Lecture 60 - Magnetic Property of Solid (Continued...)

Lecture 61 - Magnetic Property of Solid (Continued...)

Lecture 62 - Magnetic Property of Solid (Continued...)

Lecture 63 - Magnetic Property of Solid (Continued...)

Lecture 64 - Magnetic Property of Solid (Continued...)

Lecture 65 - Magnetic Property of Solid (Continued...)

Lecture 66 - Magnetic Property of Solid (Continued...)

Lecture 67 - Magnetic Property of Solid (Continued...)

Lecture 68 - Magnetic Property of Solid (Continued...)

Lecture 69 - Magnetic Property of Solid (Continued...)

Lecture 70 - Magnetic Property of Solid (Continued...)

Lecture 71 - Magnetic Property of Solids (Continued...)

Lecture 72 - Dielectric Properties of Solid

Lecture 73 - Dielectric Properties of Solid (Continued...)

Lecture 74 - Dielectric Properties of Solid (Continued...)

Lecture 75 - Superconductivity

NPTEL : NOC:Atomic and Molecular Physics (Physics)

Co-ordinators : Prof. Amal Kumar Das

Lecture 1 - Experimental observations and theoretical development in discovery of constituents of an atom

Lecture 2 - Experimental observations and theoretical development in discovery of constituents of an atom (Continued...)

Lecture 3 - Experimental observations and theoretical development in discovery of constituents of an atom (Continued...)

Lecture 4 - Experimental observations and theoretical development in discovery of constituents of an atom (Continued...:

Lecture 5 - Experimental observations and theoretical development in discovery of constituents of an atom (Continued...)

Lecture 6 - Structure of an atom

Lecture 7 - Structure of an atom

Lecture 8 - Structure of an atom (Continued...)

Lecture 9 - Atomic structure of an atom

Lecture 10 - Atomic structure of an atom

Lecture 11 - Structure of an atom

Lecture 12 - Atomic structure of an atom

Lecture 13 - Atomic structure of an atom

Lecture 14 - Structure of an atom

Lecture 15 - Structure of an atom

Lecture 16 - Structure of an atom

Lecture 17 - Structure of an atom

Lecture 18 - Structure of an atom

Lecture 19 - Structure of an atom

Lecture 20 - Structure of an atom

Lecture 21 - Atomic spectra

Lecture 22 - Atomic spectra

Lecture 23 - Multielectron atoms

Lecture 24 - Multielectron atoms (Continued...)

Lecture 25 - Multielectron atoms (Continued...)

Lecture 26 - Multielectron atoms (Continued...)

Lecture 27 - Quantum mechanical treatment

Lecture 28 - Quantum mechanical treatment (Continued...)

Lecture 29 - Quantum mechanical treatment of H-like atom

Lecture 30 - Quantum mechanical treatment of H-like atom (Continued...)

Lecture 31 - Quantum mechanical treatment of Hydrogen like atom

Lecture 32 - Quantum mechanical treatment of Hydrogen like atom (Continued...)

Lecture 33 - Quantum mechanical treatment of hydrogen like atom (Continued...)

Lecture 34 - Quantum mechanical treatment of hydrogen like atom (Continued...)

Lecture 35 - Quantum mechanical treatment of hydrogen like atom (Continued...)

Lecture 36 - Quantum Mechanical treatment of Hydrogen like atom (Continued...)

Lecture 37 - Quantum Mechanical treatment of Hydrogen like atom (Continued...)

Lecture 38 - Hydrogen like atom in magnetic field

Lecture 39 - Hydrogen like atom in magnetic field (Continued...)

Lecture 40 - Hydrogen like atom in electric field

Lecture 41 - Physics of molecules

Lecture 42 - Rotation of a molecule

Lecture 43 - Rotation of a molecule (Continued...)

Lecture 44 - Rotation of a molecule (Continued...)

Lecture 45 - Rotation of a molecule (Continued...)

Lecture 46 - Vibration of a molecule

Lecture 47 - Vibration of a molecule (Continued...)

Lecture 48 - Vibration of a molecule (Continued...)

Lecture 49 - Vibration of a molecule (Continued...)

Lecture 50 - Vibration of a molecule (Continued...)

Lecture 51 - Electronic spectra of a molecule

Lecture 52 - Electronic spectra of a molecule (Continued...)

Lecture 53 - Electronic structure of molecules

Lecture 54 - Electronic structure of molecules (Continued...)

Lecture 55 - Electronic structure of a molecule

Lecture 56 - Atomic and Molecular Spectroscopy

Lecture 57 - Raman Spectroscopy

Lecture 58 - Raman Spectroscopy (Continued...)

Lecture 59 - Raman Spectroscopy (Continued...)

Lecture 60 - Resonance spectroscopy

NPTEL : NOC:Modern Optics (Physics)

Co-ordinators : Prof. Partha Roy Choudhuri

Lecture 1 - Maxwells equations and electromagnetic waves

Lecture 2 - Maxwells equations and electromagnetic waves (Continued...)

Lecture 3 - Maxwells equations and electromagnetic waves (Continued...)

Lecture 4 - Maxwells equations and electromagnetic waves (Continued...)

Lecture 5 - Maxwells equations and electromagnetic waves (Continued...)

Lecture 6 - Maxwells equations and electromagnetic waves (Continued...)

Lecture 7 - Maxwells equations and electromagnetic waves (Continued...)

Lecture 8 - Wave propagation in anisotropic media

Lecture 9 - Wave propagation in anisotropic media (Continued...)

Lecture 10 - Wave propagation in anisotropic media (Continued...)

Lecture 11 - Wave propagation in anisotropic media (Continued...)

Lecture 12 - Wave propagation in anisotropic media (Continued...)

Lecture 13 - Wave propagation in layered structures

Lecture 14 - Wave propagation in layered structures (Continued...)

Lecture 15 - Wave propagation in layered structures (Continued...)

Lecture 16 - Wave propagation in layered structures (Continued...)

Lecture 17 - Wave propagation in layered structures (Continued...)

Lecture 18 - Waves in guided structures and modes

Lecture 19 - Waves in guided structures and modes (Continued...)

Lecture 20 - Waves in guided structures and modes (Continued...)

Lecture 21 - Waves in guided structures and modes (Continued...)

Lecture 22 - Waves in guided structures and modes (Continued...)

Lecture 23 - Waves in guided structures and modes (Continued...)

Lecture 24 - Coupling of waves and optical couplers

Lecture 25 - Coupling of waves and optical couplers (Continued...)

Lecture 26 - Coupling of waves and optical couplers (Continued...)

Lecture 27 - Coupling of waves and optical couplers (Continued...)

Lecture 28 - Coupling of waves and optical couplers (Continued...)

Lecture 29 - Electro-optic Effect

Lecture 30 - Electro-optic Effect (Continued...)

Lecture 31 - Electro-optic Effect (Continued...)

Lecture 32 - Electro-optic Effect (Continued...)

Lecture 33 - Electro-optic Effect (Continued...)

Lecture 34 - Electro-optic Modulators and Devices

Lecture 35 - Electro-optic Modulators and Devices (Continued...)

Lecture 36 - Electro-optic Modulators and Devices (Continued...)

Lecture 37 - Electro-optic Modulators and Devices (Continued...)

Lecture 38 - Electro-optic Modulators and Devices (Continued...)

Lecture 39 - Electro-optic Modulators and Devices (Continued...)

Lecture 40 - Electro-optic Modulators and Devices (Continued...)

Lecture 41 - Acousto-optic Effect

Lecture 42 - Acousto-optic Effect (Continued...)

Lecture 43 - Acousto-optic Effect (Continued...)

Lecture 44 - Acousto-optic Effect (Continued...)

Lecture 45 - Acousto-optic Effect (Continued...)

Lecture 46 - Acousto-optic Effect (Continued...)

Lecture 47 - Acousto-optic Effect (Continued...)

Lecture 48 - Acousto-optic Effect (Continued...)

Lecture 49 - Acousto-optic Effect (Continued...)

Lecture 50 - Acousto-optic Effect (Continued...)

Lecture 51 - Acousto-optic Effect (Continued...)

Lecture 52 - Acousto-optic Effect (Continued...)

Lecture 53 - Acousto-optic Effect (Continued...)

Lecture 54 - Acousto-optic Modulators and Devices

Lecture 55 - Acousto-optic Modulators and Devices (Continued...)

Lecture 56 - Acousto-optic Modulators and Devices (Continued...)

Lecture 57 - Acousto-optic Modulators and Devices (Continued...)

Lecture 58 - Magneto-optic Effect

Lecture 59 - Magneto-optic Effect (Continued...)

NPTEL : NOC:Introduction to Non-linear Optics and its Applications (Physics)

Co-ordinators : Prof. Samudra Roy

Lecture 1 - Basic Linear Optics

Lecture 2 - Basic Linear Optics (Continued...)

Lecture 3 - Basic Linear Optics (Continued...)

Lecture 4 - Basic Linear Optics (Continued...)

Lecture 5 - Basic Linear Optics (Continued...)

Lecture 6 - Basic Linear Optics (Continued...)

Lecture 7 - Basic Linear Optics (Continued...)

Lecture 8 - Basic Linear Optics (Continued...)

Lecture 9 - Basic Linear Optics (Continued...)

Lecture 10 - Nonlinear Optics : An Introduction

Lecture 11 - Classical origin of optical nonlinearity

Lecture 12 - Millerâ€™s Rule

Lecture 13 - Second Harmonic Generation (SHG)

Lecture 14 - Optical Rectification, Linear electro-optic effect

Lecture 15 - Sum and Difference frequency generation

Lecture 16 - Nonlinear Maxwellâ€™s equation

Lecture 17 - Theory of SHG

Lecture 18 - Phase matching

Lecture 19 - Phase matching of SHG, Gain band width calculation

Lecture 20 - Manley-Rowe Relation, Energy conservation in SHG,

Lecture 21 - Birefringence phase-matching (BPM),Type I and Type II phase matching

Lecture 22 - Type II phase matching, Symmetry in nonlinear susceptibility

Lecture 23 - Kleinmanâ€™s Symmetry, Neumannâ€™s Principle

Lecture 24 - Neumannâ€™s Principle (Continued...) Centrosymmetric system

Lecture 25 - Matrix form : SHG, SFG, DFG , SHG in KDP Crystal

Lecture 26 - SHG in KDP crystal, Calculation of deff

Lecture 27 - SHG in LiNbO3

Lecture 28 - Quasi phase matching (QPM)

Lecture 29 - Quasi phase matching (QPM) (Continued...), Periodic d function

Lecture 30 - 1st, 2nd, 3rd order QPM, SHG under depleted pump

Lecture 31 - Realistic calculation of SHG, 3 wave interaction

Lecture 32 - 3 wave interaction, Equation for pump, signal and idler wave, Non-collinear phase matching

Lecture 33 - Manley-Rowe Relation (3 wave mixing), Parametric down conversion

Lecture 34 - Parametric down conversion (Continued...), Optical Parametric Amplification (OPA)

Lecture 35 - Optical Parametric Amplification (OPA), Difference frequency generation under OPA

Lecture 36 - Sum frequency generation under OPA

Lecture 37 - OPA under non-phase matching condition, Expression of gain

Lecture 38 - Optical parametric Oscillator (OPO), Singly resonant oscillator

Lecture 39 - Doubly Resonant Oscillator (DRO)

Lecture 40 - Doubly Resonant Oscillator (DRO) (Continued...)

Lecture 41 - 3rd order nonlinear effect

Lecture 42 - Optical Kerr effect and Self-focusing, Symmetry in 3rd order susceptibility

Lecture 43 - Symmetry in 3rd order susceptibility (Continued...), Self Phase Modulation (SPM)

Lecture 44 - Self Phase Modulation (Continued...), Frequency Shift

Lecture 45 - Third Harmonic Generation(3HG), Energy conservation

Lecture 46 - Third Harmonic Generation (Continued...)

Lecture 47 - Third Harmonic Generation (Continued...), Cross Phase Modulation (XPM)

Lecture 48 - Cross Phase Modulation (Continued...), Nonlinear Absorption

Lecture 49 - Four Wave Mixing

Lecture 50 - Four Wave mixing (Continued...)

Lecture 51 - Parametric Amplification under FWM

Lecture 52 - Parametric Amplification under FWM (Continued...)

Lecture 53 - Optical Phase Conjugation

Lecture 54 - Raman Scattering

Lecture 55 - Stimulated Raman Scattering

Lecture 56 - Raman Amplification

Lecture 57 - Raman Amplification (Continued...)

Lecture 58 - Linear pulse propagation

Lecture 59 - Nonlinear Pulse propagation

Lecture 60 - Optical Soliton

NPTEL : NOC:Upstream LNG Technology (Physics)

Co-ordinators : Prof. Pavitra Sandilya

Lecture 1 - Introduction

Lecture 2 - Concentration

Lecture 3 - Sources and Process Overview of Natural Gas

Lecture 4 - Pure Component Phase Behavior

Lecture 5 - Mixture Phase Behavior

Lecture 6 - Phase Behaviour of Natural Gas

Lecture 7 - Dew Point and Bubble Point Calculations

Lecture 8 - Vapor Liquid Equilibrium

Lecture 9 - Problems on Vapor Pressure, Gibb's Phase Rule, Dew Point Bubble Point Temperatures

Lecture 10 - Thermophysical Properties of Natural Gas - I

Lecture 11 - Thermophysical Properties of Natural Gas - II

Lecture 12 - Thermodynamic and Chemical Properties

Lecture 13 - Combustion Properties

Lecture 14 - Flow in Natural Gas Systems

Lecture 15 - Flow Measurement In Natural Gas - I

Lecture 16 - Flow Measurement In Natural Gas - II

Lecture 17 - Temperature and Quality Measurement in Natural Gas Systems

Lecture 18 - Pressure measurement in natural gas systems

Lecture 19 - Tutorial on the estimation of thermophysical properties

Lecture 20 - Tutorial on the combustion and thermodynamic properties of natural gas

Lecture 21 - Tutorial on fluid mechanics

Lecture 22 - Tutorial on flow and pressure measurement in natural gas systems

Lecture 23 - Tutorial on temperature and quality measurement in natural gas

Lecture 24 - Heat transfer in natural gas systems

Lecture 25 - Tutorial on heat transfer in natural gas systems

Lecture 26 - Heat exchangers in natural gas systems

Lecture 27 - Analysis of heat exchangers in natural gas systems

Lecture 28 - Tutorial on heat exchanger analysis

Lecture 29 - Equillibrium vapour-liquid separation

Lecture 30 - Equillibrium in multicomponent systems

Lecture 31 - Separation by distillation

Lecture 32 - Design of distillation column

Lecture 33 - Equillibrium fluid solid separation

Lecture 34 - Membrane separation in natural gas systems

Lecture 35 - Estimation of water content in natural gas

Lecture 36 - Multistage single component equillibrium separation

Lecture 37 - Tutorial on vapour liquid separation

Lecture 38 - Tutorial on ideal binary distillation

Lecture 39 - Tutorial on equillibrium gas- solid separation

Lecture 40 - Tutorial on membrane gas separation

Lecture 41 - Dehydration of natural gas

Lecture 42 - Natural gas Processing - hydrate removal

Lecture 43 - Acid gas removal in natural gas system - I

Lecture 44 - Acid gas removal in natural gas system - II

Lecture 45 - Nitrogen removal in natural gas system - I

Lecture 46 - Nitrogen removal in natural gas system - II

Lecture 47 - Compression in natural gas systems

Lecture 48 - Compressors used in natural gas systems

Lecture 49 - Tutorial on hydrate removal

Lecture 50 - Multicomponent distillation column design: Approximate method

Lecture 51 - Sulfur recovery in natural gas systems - I

Lecture 52 - Tutorial on compression

Lecture 53 - Pigging

Lecture 54 - Sulfur recovery in natural gas systems - II

Lecture 55 - Trace components in natural gas

Lecture 56 - Helium recovery, upgradation and purification

Lecture 57 - Fundamentals of absorption and stripping for natural gas processing

Lecture 58 - Tutorial on absorption and stripping

Lecture 59 - Gas liquid separation in natural gas systems - I

Lecture 60 - Gas liquid separation in natural gas systems - II

Lecture 61 - Tutorial on equillibrium in multicomponent systems

Lecture 62 - Tutorial on multicomponent distillation - I

Lecture 63 - Tutorial on multicomponent distillation - II

Lecture 64 - Pumps in natural gas systems - I

Lecture 65 - Pumps in natural gas systems - II

Lecture 66 - Pumps in natural gas systems - III

Lecture 67 - Tutorial on pumps - I

Lecture 68 - Tutorial on pumps - II

Lecture 69 - Cryogenic refrigeration and liquefaction in natural gas systems - I

Lecture 70 - Cryogenic refrigeration and liquefaction in natural gas systems - II

Lecture 71 - Tutorial on refrigeration - I

Lecture 72 - Tutorial on refrigeration - II

Lecture 73 - Cryogenic refrigeration and liquefaction in natural gas systems - III

Lecture 74 - Cryogenic refrigeration and liquefaction in natural gas systems - IV

Lecture 75 - Cryogenic refrigeration and liquefaction in natural gas systems - V

Lecture 76 - Tutorial on refrigeration - III

Lecture 77 - Tutorial on refrigeration and liquefaction - IV

Lecture 78 - Tutorial on refrigeration and liquefaction - V

Lecture 79 - Hydrocarbon recovery in natural gas system - I

Lecture 80 - Hydrocarbon recovery in natural gas system - II

Lecture 81 - Hydrocarbon recovery in natural gas system - III

Lecture 82 - Tutorial on hydrocarbon recovery in natural gas

Lecture 83 - Piping in natural gas systems - I

Lecture 84 - Piping in natural gas systems - II

Lecture 85 - Tutorial on piping in natural gas systems - I

Lecture 86 - Tutorial on piping in natural gas systems - II

NPTEL : NOC:Experimental Physics-I (Physics)

Co-ordinators : Prof. Amal Kumar Das

Lecture 1 - Introduction

Lecture 2 - Basic tools and apparatus

Lecture 3 - Basic tools and apparatus (Continued...)

Lecture 4 - Basic tools and apparatus (Continued...)

Lecture 5 - Basic tools and apparatus (Continued...)

Lecture 6 - Basic tools and apparatus (Continued...)

Lecture 7 - Basic components

Lecture 8 - Basic apparatus

Lecture 9 - Basic apparatus (Continued...)

Lecture 10 - Basic analysis

Lecture 11 - Basics analysis (Continued...)

Lecture 12 - Basics analysis (Continued...)

Lecture 13 - Basics analysis (Continued...)

Lecture 14 - Basics analysis (Continued...)

Lecture 15 - Basics analysis (Continued...)

Lecture 16 - Basics analysis (Continued...)

Lecture 17 - Basics analysis (Continued...)

Lecture 18 - Basics analysis (Continued...)

Lecture 19 - Basics analysis (Continued...)

Lecture 20 - Determination of Young's modulus

Lecture 21 - Demonstration on the experiment of Young's modulus of mettalic bar and data collection

Lecture 22 - Calculate the value of young's modulus of given metallic bar form the recorded datas

Lecture 23 - Experimental demonstration to calculate the spring constant of a given spring

Lecture 24 - Calculate the value of calculate the spring constant of a given spring form the recorded datas

Lecture 25 - Theory regarding Moment of inertia of a flywheel

Lecture 26 - Experimental demonstration to calculate the moment of inertia of a given flywheel

Lecture 27 - How to calculate the value of moment of inertia of a flywheelform the recorded data

Lecture 28 - Theory regarding surface tension of the liquid

Lecture 29 - Demonstration on the experiment of surface tension and data collection

Lecture 30 - How to calculate the value of surface tension of water from the recorded data

Lecture 31 - Theory regarding viscosity of liquid

Lecture 32 - Demonstration on the experiment of viscosity

Lecture 33 - Data analysis of recorded data on viscosity

Lecture 34 - Forced Oscillations Pohls pendulum

Lecture 35 - Coupled Pendulum

Lecture 36 - Demonstration on the experiment of compound pendulum

Lecture 37 - Theory regarding compound pendulum has been discussed

Lecture 38 - Experimental demonstration on the standing Waves on a String has been shown clearly how to determine the linear mass density of the string.

Lecture 39 - Linear expansion of metal

Lecture 40 - Expt. to study linear expansion

Lecture 41 - Determine the coefficient of thermal conductivity of a bad conductor

Lecture 42 - Determination of electrical equivalent of heat

Lecture 43 - Determination of specific heat of the given solid metals using Dulong-Petit's law

Lecture 44 - Determination of the calibration curve of a given (Type K chromelÃ¢â‚¬â€œalumel) thermocouple and hence determination of Seebeck coefficient

Lecture 45 - Theorey and Demonstartion Platinum Resistance thermometer

Lecture 46 - Experiment on Platinum Resistance thermometer

Lecture 47 - To study the current-voltage relationship of an L-R circuit

Lecture 48 - To study the variation in current and voltage in a series LCR circuit

Lecture 49 - Sensitivity of Blastic Galvanometer

Lecture 50 - Expt. for Sensitivity of Blastic Galvanometer

Lecture 51 - Theory on RC Circuit

Lecture 52 - Expt. on RC Circuit

Lecture 53 - Theory regarding the magnetic field along the axis of a circular coil

Lecture 54 - Experiment regarding the magnetic field along the axis of a circular coil

Lecture 55 - Study the induced e.m.f of inductance coil

Lecture 56 - Mutual inductance

Lecture 57 - Theory regarding permeability of air

Lecture 58 - Experiment to determination the permeability of air

Lecture 59 - Devices around us

Lecture 60 - Devices around us (Continued...)

NPTEL : NOC:Experimental Physics-II (Physics)

Co-ordinators : Prof. Amal Kumar Das

Lecture 1 - Introduction

Lecture 2 - Summary of Experimental Physics - I

Lecture 3 - Summary of Experimental Physics - I (Continued...)

Lecture 4 - Summary of Experimental Physics - I (Continued...)

Lecture 5 - Summary of Experimental Physics - I (Continued...)

Lecture 6 - Basic analysis

Lecture 7 - Basic analysis (Continued...)

Lecture 8 - Basic components

Lecture 9 - Basic components (Continued...)

Lecture 10 - Basic components (Continued...)

Lecture 11 - Basic idea on mirros and lenses and their applications

Lecture 12 - Determination of focal length of concave mirror

Lecture 13 - Determination of focal length of concave mirror (Continued...)

Lecture 14 - Determination of focal length of convex mirror

Lecture 15 - Determination of focal length of convex lens

Lecture 16 - Determination of focal length of concave lens

Lecture 17 - Determination of focal length of convex lens by diplacement method

Lecture 18 - Applications of mirrors and lenses

Lecture 19 - Determination of refractive index of liquid using travelling microscope

Lecture 20 - Basic discussion on spectrometer and prism

Lecture 21 - Basic discussion on spectrometer and prism (Continued...)

Lecture 22 - Basic discussion on spectrometer and prism (Continued...)

Lecture 23 - Schuster's method

Lecture 24 - Discussion on angle of the prism, angular dispersion and dispersive power of given prism

Lecture 25 - Determination of the angle of prism

Lecture 26 - Determination of the angle of minimum deviation for a given prism and hence to determine the refractive index of the given prism

Lecture 27 - Discussion on the angle of incidence and corresponding deviation of light through a prism and determination of the angle of minimum deviation for a given prism from the plot of the angle of incidence versus deviation.

Lecture 28 - Determination of the angle of minimum deviation from (i-D) plot for a given prism and hence to determine the refractive index of the given prism.

Lecture 29 - Determination of the calibration plot of deviation versus wavelength for a given prism and hence determination of the wavelength of the unknown light source using the calibration plot

Lecture 30 - Determination of the dispersive power, Cauchy constant and resolving power of a given prism.

Lecture 31 - Interference Phenomena

Lecture 32 - Interference Phenomena (Continued...)

Lecture 33 - Interference Phenomena (Continued...)

Lecture 34 - Bi-prism

Lecture 35 - Bi-prism (Continued...)

Lecture 36 - Interference phenomena by Newton ring (Theory)

Lecture 37 - Interference phenomena by Newton ring (Experiment)

Lecture 38 - Michelson interferometer (Theory)

Lecture 39 - Michelson interferometer (Experiment)

Lecture 40 - Theory of diffraction

Lecture 41 - Theory of diffraction (Continued...)

Lecture 42 - Theory of diffraction (Continued...)

Lecture 43 - Single slit diffraction

Lecture 44 - Double slit diffraction

Lecture 45 - Plane transmission grating

Lecture 46 - Plane transmission grating (Continued...)

Lecture 47 - Theory of polarization

Lecture 48 - Theory of polarization (Continued...)

Lecture 49 - Experiment for Verification of Malus law

Lecture 50 - Experiment for brewester

Lecture 51 - Experiment for Brewester angle

Lecture 52 - Experiment on e-ray and o-ray

Lecture 53 - Polarimeter

Lecture 54 - Zone-plate Theory

Lecture 55 - Zone-plate Experiment

Lecture 56 - Theory of Photoelectric Effect

Lecture 57 - Experiment on Photoelectric Effect

Lecture 58 - Thomson experiment to determine the specific charge of an electron (e/m)

Lecture 59 - Frank-Hertz Experiment

Lecture 60 - Experiment on Rydberg constant

Lecture 61 - Experiment on Rydberg constant (Continued...)

NPTEL : NOC:Experimental Physics-III (Physics)

Co-ordinators : Prof. Amal Kumar Das

Lecture 1 - Basic Tools and Instruments in the Laboratory

Lecture 2 - Basic Tools and Instruments in the Laboratory (Continued...)

Lecture 3 - Cathode Ray Oscilloscope (CRO)

Lecture 4 - Cathode Ray Oscilloscope (CRO) (Continued...)

Lecture 5 - Electro Magnet and Constant Current Power Supply

Lecture 6 - Electro Magnet and Constant Current Power Supply (Continued...)

Lecture 7 - Electro Magnet and Constant Current Power Supply (Continued...)

Lecture 8 - Gaussmeter/Teslameter

Lecture 9 - Gaussmeter/Teslameter (Continued...)

Lecture 10 - Lock in Amplifier

Lecture 11 - Lock in Amplifier (Continued...)

Lecture 12 - Measurement of magneto resistance

Lecture 13 - Magneto resistance for Semiconductor

Lecture 14 - Hall Effect

Lecture 15 - Hall Effect as a function of magnetic Field

Lecture 16 - Hall Effect as a function of temperature

Lecture 17 - To study the variation of resistivity of metal and semiconductor at low temperature region (Continued...)

Lecture 18 - To study the variation of resistivity of metal and semiconductor at low temperature region (Continued...)

Lecture 19 - Measurement of magnetisation of ferromagnetic material

Lecture 20 - Measurement of magnetisation of ferromagnetic material (Continued...)

Lecture 21 - Susceptibility of paramagnetic substance by Quincke's tube method

Lecture 22 - Experiment of Quincke's Tube Method

Lecture 23 - Susceptibility of paramagnetic substance by Gouy's method

Lecture 24 - Dielectric constant of solid

Lecture 25 - Dielectric constant of non-conducting liquid

Lecture 26 - P-E Loop of Ferroelectric Material

Lecture 27 - Measurement of Ionic Conductivity

Lecture 28 - Measurement of Ionic Conductivity (Continued...)

Lecture 29 - Electron Spin Resonance (ESR)

Lecture 30 - Electron Spin Resonance (ESR) Experiment

Lecture 31 - Superconductivity

Lecture 32 - Superconductivity (Continued...)

Lecture 33 - Superconductivity (Continued...)

Lecture 34 - Nuclear g-factor

Lecture 35 - Nuclear g-factor (Continued...)

Lecture 36 - P-N Junction

Lecture 37 - P-N Junction (Continued...)

Lecture 38 - P-N Junction (Continued...)

Lecture 39 - Zeeman Effect

Lecture 40 - Zeeman Effect (Continued...)

Lecture 41 - Zeeman Effect (Continued...)

Lecture 42 - Sodium Yellow Doublet

Lecture 43 - Sodium Yellow Doublet (Continued...)

Lecture 44 - Study of Absorption Spectrum of Iodine Vapour

Lecture 45 - Study of Absorption Spectrum of Iodine Vapour (Continued...)

Lecture 46 - Study of Absorption Spectrum of Iodine Vapour (Continued...)

Lecture 47 - Determination of Wavelength of Spectral Lines using Constant Deviation Spectrometer

Lecture 48 - Determination of Wavelength of Spectral Lines using Constant Deviation Spectrometer (Continued...)

Lecture 49 - Photoelastic Property of Materials

Lecture 50 - Photoelastic Property of Materials (Continued...)

Lecture 51 - Photoelastic Property of Materials (Continued...)

Lecture 52 - Faraday Effect

Lecture 53 - Faraday Effect (Continued...)

Lecture 54 - Electron Diffraction

Lecture 55 - Electron Diffraction (Continued...)

Lecture 56 - Determination of Velocity of Light in Free Space

Lecture 57 - Determination of Velocity of Light in Free Space (Continued...)

Lecture 58 - X-Ray Diffraction and Crystal Structure

Lecture 59 - X-Ray Diffraction and Crystal Structure (Continued...)

Lecture 60 - X-Ray Diffraction and Crystal Structure (Continued...)

Lecture 61 - X-Ray Diffraction and Crystal Structure (Continued...)

Lecture 62

NPTEL : NOC:Electronic Theory of Solids (Physics)

Co-ordinators : Prof. Arghya Taraphder

Lecture 1 - Free electrons: Drude Theory

Lecture 2 - Weidemann Franz Law

Lecture 3 - Drude Model continued: Hall Effect

Lecture 4 - Schrodinger Equation: Boundary Conditions

Lecture 5 - Density of States

Lecture 6 - Properties of Degenerate Fermi Gas

Lecture 7 - Statistics Fermi-Dirac distribution and Maxwell-Boltzmann Distribution: comparison and Specific Heat

Lecture 8 - Sommerfeld Expansion and Band Formation: Temperature dependent densities, Chemical Potential, Specific Heat

Lecture 9 - Bonding and Band Formation: N=2 solid Molecular Orbitals, Linear combinations of Atomic Orbitals (LCAO)

Lecture 10 - Variational Method: Molecular Orbitals, Bonding and anti-bonding Orbitals

Lecture 11 - Bonding and Band Formation (LCAO)

Lecture 12 - Bonding and Band Formation (LCAO) (Continued...)

Lecture 13 - Bloch's Theorem

Lecture 14 - Proof of Bloch's Theorem

Lecture 15 - N atoms Solid

Lecture 16 - Brillouin Zones

Lecture 17 - Tight binding: lattice with a basis

Lecture 18 - Fermi Surfaces

Lecture 19 - Lattice with basis:Energy Spectrum

Lecture 20 - Energy spectrum (Continued...)

Lecture 21 - Graphene and Fermi Surfaces

Lecture 22 - Fermi Surfaces Instabilities

Lecture 23 - Low Dimensional Systems

Lecture 24 - Integer Quantum Hall Effect (IQHE)

Lecture 25 - Integer Quantum Hall Effect (Continued...)

Lecture 26 - Electron in a Strong Magnetic Field and IQHE

Lecture 27 - Spintronics: Introduction and Applications

Lecture 28 - Magnetism

Lecture 29 - Magnetism: Quantum Theory

Lecture 30 - Hund's Rule

Lecture 31 - Curie's Law and Van Vleck Paramagnetism

Lecture 32 - Curie's law for any J, Susceptibility

Lecture 33 - Susceptibility and Thermal Properties

Lecture 34 - Adiabatic Demagnetisation

Lecture 35 - Pauli Paramagnetism

Lecture 36 - Paramagnetism of metals

Lecture 37 - Exchange interaction for 2 electrons

Lecture 38 - Exchange interactions of different types

Lecture 39 - Magnetic Order

Lecture 40 - Magnetic Order of different types and Heisenberg model

Lecture 41 - Ising Model

Lecture 42 - Mean Field Theory

Lecture 43 - Spontaneous magnetisation and 1D Ising Model

Lecture 44 - Symmetries of Ising model, Exact Solution

Lecture 45 - Ferromagnetic Heisenberg Model

Lecture 46 - Ground State and Magnons/Excitations

Lecture 47 - Superconductivity

Lecture 48 - London Equation

Lecture 49 - Meisner Effect from London Equation

Lecture 50 - Cooper problem

Lecture 51 - Instability of the Fermi Surface

Lecture 52 - BCS Theory Introduction

Lecture 53 - BCS Theory, Excitation Spectrum

Lecture 54 - BCS

Lecture 55 - Tunneling and Ginzberg Landau Theory

Lecture 56 - Electrodynamics of Superconductivity

Lecture 57 - Type II superconductors

Lecture 58 - Josephson junction

Lecture 59 - Vortices, SQUID, Quantum Supremacy and Qubits

Lecture 60 - Topological state of matter, XY Model, Topological Insulators

NPTEL : NOC:Physics of Linear and Nonlinear Optical Waveguides (Physics)

Co-ordinators : Prof. Samudra Roy

Lecture 1 - Wave Equation, Maxwellâ€™s equation, Plane wave

Lecture 2 - EM wave in vacuum, Poynting vector, Maxwellâ€™s equation in Dielectric Medium

Lecture 3 - Poynting Vector, Maxwellâ€™s equation in dielectric medium (Continued...)

Lecture 4 - Total Internal reflection, Evanescent wave

Lecture 5 - Step-index fiber (SIF), Light guidance in SIF

Lecture 6 - Light guidance in SIF (Skew Ray), V-Parameter, Discrete Ray

Lecture 7 - Cutoff wavelength, Fiber characteristics

Lecture 8 - Fiber Loss, dB units, Dispersion

Lecture 9 - Dispersion, Ray Path constant

Lecture 10 - Ray path constant, Ray equation

Lecture 11 - Ray equation (Continued...)

Lecture 12 - Ray transit time

Lecture 13 - Ray transit time (Continued...)

Lecture 14 - Material dispersion

Lecture 15 - Material dispersion (Continued...)

Lecture 16 - Material Dispersion (Continued...), Dispersion Coefficient

Lecture 17 - Pulse Broadening

Lecture 18 - Pulse Propagation in Dispersive Medium

Lecture 19 - Pulse Propagation in Dispersive Medium (Continued...)

Lecture 20 - Concept of Modes

Lecture 21 - TE and TM Modes

Lecture 22 - TE and TM Modes (Continued...)

Lecture 23 - Modes in Slab waveguide

Lecture 24 - Modes in Slab waveguide (Continued...)

Lecture 25 - Modes in Slab waveguide (Continued...)

Lecture 26 - Modes in Slab Waveguide (Continued...)

Lecture 27 - Waveguide Dispersion

Lecture 28 - Physical Understanding of Modes

Lecture 29 - Power Associated with a Modes

Lecture 30 - Modes in an Optical Fiber

Lecture 31 - Modes in an optical fiber (Continued...)

Lecture 32 - Modes in an optical fiber (Continued...)

Lecture 33 - LPlm mode structure

Lecture 34 - Optical fiber mode morphology (Continued...)

Lecture 35 - Effective area of mode, Fiber optics components

Lecture 36 - Directional Coupler

Lecture 37 - Coupled Mode Theory

Lecture 38 - Coupled Mode Theory (Continued...)

Lecture 39 - 3 dB power splitter

Lecture 40 - Working principle of WDM coupler

Lecture 41 - Fiber Bragg Grating

Lecture 42 - Fiber Bragg Grating (Continued...)

Lecture 43 - Reflectivity Calculation

Lecture 44 - Reflectivity Calculation (Continued...)

Lecture 45 - Reflectivity calculation of FBG (Continued...)

Lecture 46 - Reflectivity calculation of FBG (Continued...)

Lecture 47 - Reflectivity calculation of FBG (Continued...)

Lecture 48 - Bandwidth of reflectivity

Lecture 49 - Basic nonlinear optics

Lecture 50 - Frequency mixing, Optical Kerr effect

Lecture 51 - Optical Kerr effect (Continued...)

Lecture 52 - Self Phase Modulation

Lecture 53 - Self Phase Modulation (Continued...)

Lecture 54 - Self Phase Modulation (Continued...)

Lecture 55 - Pulse propagation in nonlinear waveguide

Lecture 56 - Pulse propagation in nonlinear waveguide (Continued...)

Lecture 57 - Pulse propagation in nonlinear dispersive waveguide

Lecture 58 - Pulse propagation in nonlinear dispersive waveguide (Continued...)

Lecture 59 - Concept of optical soliton

Lecture 60 - Concept of optical soliton (Continued...)

NPTEL : NOC:Physics of Renewable Energy Systems (Physics)

Co-ordinators : Prof. Amreesh Chandra

Lecture 1 - Introduction and relevance of the course

Lecture 2 - Energy sources

Lecture 3 - Solar Radiation

Lecture 4 - Solar Photovoltaic Systems

Lecture 5 - Origin of Band Structure and Energy Band Gap

Lecture 6 - Basics of Semiconductors

Lecture 7 - Construction of Solar Cells

Lecture 8 - Characterization of Solar Cells and Future Direction

Lecture 9 - Solar Heaters

Lecture 10 - Introduction to Wind Energy

Lecture 11 - Continuity Equation and its applications

Lecture 12 - Betz Criteria for extracting wind power

Lecture 13 - Wind turbines and their operation

Lecture 14 - Materials Aspects and future direction

Lecture 15 - Introduction to Hydroelectric Power

Lecture 16 - Hydroelectric Power Station and Turbines

Lecture 17 - Wave power and converters

Lecture 18 - Introduction to Tidal Power

Lecture 19 - Tidal Power and Geothermal Energy

Lecture 20 - Introduction to Energy Storage Systems

Lecture 21 - Thermal Energy Storage

Lecture 22 - Basics of Mechanical Energy Storage

Lecture 23 - Pumped Hydroelectric to Flywheels (Mechanical Energy Storage Systems)

Lecture 24 - Introduction to Li-ion battery

Lecture 25 - Characteristics and Parameters of Li-ion batteries

Lecture 26 - Cathode Materials for Li-ion batteries

Lecture 27 - Anode Materials for Li-ion batteries

Lecture 28 - Electrolytes and Separators for Li-batteries

Lecture 29 - From battery to supercapacitors

Lecture 30 - Construction, development and classification of Supercapacitors

Lecture 31 - Electric double layer capacitors (EDLCs)

Lecture 32 - Pseudocapacitors

Lecture 33 - Electrochemical Techniques for Supercapacitors and Batteries

Lecture 34 - From material to a supercapacitor device

Lecture 35 - Effect of temperature on supercapacitor performance

Lecture 36 - Effect of external magnetic field and frequency on supercapacitors

Lecture 37 - Introduction to Fuel Cells

Lecture 38 - Explanation of Fuel cell systems

Lecture 39 - Microbial Fuel Cells

Lecture 40 - Nanotechnology and Nanomaterials for Energy Applications

Lecture 41 - Synthesis of nanomaterials

Lecture 42 - Carbon- and metal-oxide based nanomaterials

Lecture 43 - Nanocatalysts

Lecture 44 - Characterization techniques for solid materials

Lecture 45 - X-ray diffraction method

Lecture 46 - UV-Visible Spectroscopy

Lecture 47 - Fourier Transform Infrared Spectroscopy

Lecture 48 - SEM, TEM and XPS

Lecture 49 - Particle size and zeta potential analysis

Lecture 50 - BET analysis

Lecture 51 - Electrochemical Impedance Spectroscopy

NPTEL : NOC:Thermal Physics (Physics)

Co-ordinators : Prof. Debamalya Banerjee

Lecture 1 - Foundation of kinetic theory of gasses

Lecture 2 - Maxwell's law for speed distribution of gas molecules

Lecture 3 - Average speeds in an ideal gas assembly

Lecture 4 - Principle of equipartition of energy

Lecture 5 - Maxwell's law for energy distribution of gas molecules

Lecture 6 - The mean free path of a gas assembly

Lecture 7 - Expression for mean free path

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 - Refrigarator 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

Lecture 44 - The Diesel cycle

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

NPTEL : NOC:Concepts in Magnetism and Superconductivity (Physics)

Co-ordinators : Prof. A Taraphder

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

NPTEL : NOC:Foundations of Classical Electrodynamics (Physics)

Co-ordinators : Prof. Samudra Roy

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

Lecture 36 - Quadrupole moment

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

Lecture 54 - Magnetic vector potential

Lecture 55 - Magnetic vector potential (Continued...)

Lecture 56 - Magnetic dipole moment

Lecture 57 - Magnetic dipole moment (Continued...)

Lecture 58 - Torque and potential energy of magnetic dipole, Magnetization

Lecture 59 - Bound Current

Lecture 60 - Magnetic materials

Lecture 61 - Electromagnetic Induction

Lecture 62 - Self and mutual inductance

Lecture 63 - Wave equation, Maxwellâ€™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 (Coninued...)

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)

NPTEL : NOC:Physics of Functional Materials and Devices (Physics)

Co-ordinators : Prof. Amreesh Chandra

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 - Nearlly free electron model

Lecture 16 - Bonds in molecules and solids

Lecture 17 - Transformations kinetics and reaction rates

Lecture 18 - Themodynamics

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

Lecture 37 - Sensors

Lecture 38 - Electrochemical Sensors

Lecture 39 - Introduction to energy storage devices and basics of supercapacitors

Lecture 40 - Supercapacitors - II

Lecture 41 - Magnetic supercapacitors

Lecture 42 - Battery - I

Lecture 43 - Battery - II

Lecture 44 - Solar Cells - I

Lecture 45 - Solar Cells - II

Lecture 46 - X-ray Diffraction (XRD)

Lecture 47 - Fourier Transform Infrared Spectroscopy

Lecture 48 - UV- Vis Spectroscopy

Lecture 49 - Scanning and Transmission Electron Microscopy

Lecture 50 - Summary

NPTEL : NOC:Fundamentals of Attosecond Science and Technology (FAST) (Physics)

Co-ordinators : Prof. Sivarama Krishnan

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, wavelenght 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 inteferometer and it 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 Tayor series expansion

Lecture 35 - Recap of instantaneous frequency, phase wrapping, and phase blanking

Lecture 36 - Frequency domain phase expansion, group delay dispersion

Lecture 37 - Absolute Phase

Lecture 38 - Recap of concepts + discussion

Lecture 39 - Absolute Phase (revisited)

Lecture 40 - Carrier envelope phase, frequency comb

Lecture 41 - Discussion

Lecture 42 - Recap of concepts

Lecture 43 - First order phase

Lecture 44 - Second order phase

Lecture 45 - Recap of first order and second order phase

Lecture 46 - Chirped pulse: Instantaneous frequency and Fourier transform

Lecture 47 - Group delay, nonlinearly chirped pulse

Lecture 48 - Recap of chirped pulses

Lecture 49 - Quadratic chirp pulses

Lecture 50 - Higher order spectral phase

Lecture 51 - Recap and discussion on higher order phase

Lecture 52 - Relative importance of intensity and phase

Lecture 53 - Pulse propagation through a medium

Lecture 54 - Recap of pulse propagation and pulse length

Lecture 55 - Discussion of RMS pulse width and uncertainty principle

Lecture 56 - Time-bandwidth product

Lecture 57 - Recap of previous module

Lecture 58 - Introduction of Lorentz Oscillator Model

Lecture 59 - Effect of matter on light

Lecture 60 - Recap of Lorentz oscillator, Polarization tensor

Lecture 61 - Dynamics of electrons in the Lorentz oscillator

Lecture 62 - Solving the inhomogeneous wave equation

Lecture 63 - Inhomogeneous wave equation, absorption coefficient, refractive index

Lecture 64 - Nonlinear response of matter

Lecture 65 - Origin of nonlinear optical effects

Lecture 66 - Wave equation in an inert gas

Lecture 67 - Perturbation theory and second harmonics

Lecture 68 - Numerical simulation strategy

Lecture 69 - Atoms in the presence of fields

Lecture 70 - Ionization models

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

NPTEL : NOC:Wave Optics (Physics)

Co-ordinators : Prof. Samudra Roy

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 sourse, 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 - Youngâ€™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 - Newtonâ€™s Ring (Continued...)

Lecture 23 - Newtonâ€™s Ring (Continued...)

Lecture 24 - Optical Interferometers

Lecture 25 - Michelson Interferometer

Lecture 26 - Multiple beam interference

Lecture 27 - Febry-Perot Interferometer

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

Lecture 29 - Resolving power of Fabry-Perot interferometer

Lecture 30 - Diffraction of Light

Lecture 31 - Huygenâ€™s Theory

Lecture 32 - Fraunhofer Diffraction

Lecture 33 - Single-slit Diffraction

Lecture 34 - Single-slit Diffraction (Continued...)

Lecture 35 - Doubleâ€“Slit Diffraction

Lecture 36 - Multiâ€“Slit Diffraction

Lecture 37 - Multi-Slit Diffraction (Continued...)

Lecture 38 - Grating spectra

Lecture 39 - Grating spectra (Continued...)

Lecture 40 - Resolving power of grating

Lecture 41 - Fraunhofer diffraction for a circular aperture

Lecture 42 - Fraunhofer diffraction for a rectangular aperture

Lecture 43 - Fresnel Diffraction

Lecture 44 - Fresnelâ€™s half period zone

Lecture 45 - Fresnelâ€™s half period zone (Continued...)

Lecture 46 - Zone Plate

Lecture 47 - Fresnelâ€™s diffraction from an aperture

Lecture 48 - Fresnelâ€™s diffraction for a circular aperture

Lecture 49 - Fresnelâ€™s diffraction for a rectangular aperture

Lecture 50 - Fresnelâ€™s diffraction for a rectangular aperture (Continued...)

Lecture 51 - Fresnelâ€™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...)

Lecture 59 - Jones matrix for polarization (Continued...)

Lecture 60 - Production of polarized light

Lecture 61 - Production of polarized light (Continued...)

Lecture 62 - Birefrigent Crystal

Lecture 63 - Birefrigent Crystal (Continued...)

Lecture 64 - Index Ellipsoid

Lecture 65 - Analyzing Polarised Light

Lecture 66 - Babinet Compensator

NPTEL : Special Topics in Atomic Physics (Physics)

Co-ordinators : Prof. P.C. Deshmukh

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

Lecture 32 - Atomic Photoionization cross sections, angular distributions of photoelectrons - 2

Lecture 33 - Atomic Photoionization cross sections, angular distributions of photoelectrons - 3

Lecture 34 - Atomic Photoionization cross sections, angular distributions of photoelectrons - 4

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

NPTEL : Classical Field Theory (Physics)

Co-ordinators : Prof. Suresh Govindarajan

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 mononpole

Lecture 31 - The 't Hooft-Polaykov monopole

Lecture 32 - Revisiting Derrickâ€™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 - PoincarÂ´e 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

NPTEL : Condensed Matter Physics (Physics)

Co-ordinators : Prof. G. Rangarajan

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

Lecture 30 - Paramagnetism of Transition Metal and Rare Earth Ions

Lecture 31 - Quenching of Orbital Angular Momentum; Ferromagnetism

Lecture 32 - Exchange Interactions, Magnetic Order, Neutron Diffraction

Lecture 33 - Hysteresis and Magnetic Domains; Spin Waves and Magnons

Lecture 34 - Magnetic Resonance

Lecture 35 - Magnetism and Magnetic Resonance - Worked Examples

Lecture 36 - Magnetism - Worked Examples (Continued...)

Lecture 37 - Pauli Paramagnetism and Landau Diamagnetism

Lecture 38 - Band Magnetism; Itinerant Electrons; Stoner Model

Lecture 39 - Superconductivity - Perfect Electrical Conductivity and Perfect Diamagnetism

Lecture 40 - Type I and Type II Superconductors

Lecture 41 - Ginsburg - Landau Theory, Flux Quantization

Lecture 42 - Cooper Pairs

Lecture 43 - Microscopic (BCS) Theory of Superconductivity

Lecture 44 - BCS Theory (Continued...): Josephson Tunneling: Quantum Interference

Lecture 45 - Josephson Effect (Continued...); High Temperature Superconductors

Lecture 46 - Superconductors - Worked Examples

Lecture 47 - Energy Bands in Solids

Lecture 48 - Electron Dynamics in a Periodic Solid

Lecture 49 - Semiconductors

Lecture 50 - Semiconductors (Continued...)

Lecture 51 - Semiconductors - Worked Examples

Lecture 52 - Defects in Solids - Point Defects

Lecture 53 - Point Defects in Solids - Worked Examples

Lecture 54 - Defects in Solids - Line and Surface Defects

Lecture 55 - Dislocations in Solids - Worked Examples

Lecture 56 - Quantum Fluids and Quantum Solids

Lecture 57 - Quantum Liquids and Quantum Solids - Worked Examples

Lecture 58 - Epilogue

NPTEL : Quantum Field Theory (Physics)

Co-ordinators : Dr. Prasanta Tripathy

Lecture 1 - Introduction

Lecture 2 - Introduction to Classical Field Theory

Lecture 3 - Quantization of Real Scalar Field - I

Lecture 4 - Quantization of Real Scalar Field - II

Lecture 5 - Quantization of Real Scalar Field - III

Lecture 6 - Quantization of Real Scalar Field - IV

Lecture 7 - Quantization of Complex Scalar Field

Lecture 8 - Interacting Field Theory - I

Lecture 9 - Interacting Field Theory - II

Lecture 10 - Interacting Field Theory - III

Lecture 11 - Interacting Field Theory - IV

Lecture 12 - Interacting Field Theory - V

Lecture 13 - Interacting Field Theory - VI

Lecture 14 - Interacting Field Theory - VII

Lecture 15 - Quantuzation of Electromagnetic Field - I

Lecture 16 - Quantuzation of Electromagnetic Field - II

Lecture 17 - Fermion Quantization - I

Lecture 18 - Fermion Quantization - II

Lecture 19 - Fermion Quantization - III

Lecture 20 - Fermion Quantization - IV

Lecture 21 - Fermion Quantization - V

Lecture 22 - Fermion Quantization - VI

Lecture 23 - The S-Matrix Expansion in QED - I

Lecture 24 - The S-Matrix Expansion in QED - II

Lecture 25 - Feynman Rules in QED - I

Lecture 26 - Feynman Rules in QED - II

Lecture 27 - Compton Scattering - I

Lecture 28 - Compton Scattering - II

Lecture 29 - Compton Scattering - III

Lecture 30 - Moller Scattering - I

Lecture 31 - Moller Scattering - II

Lecture 32 - Vertex Correction - I

Lecture 33 - Vertex Correction - II

Lecture 34 - Vertex Correction - III

Lecture 35 - Vertex Correction - IV

Lecture 36 - Electron Selfenergy

Lecture 37 - Photon Selfenergy - I

Lecture 38 - Photon Selfenergy - II

NPTEL : Quantum Mechanics I (Physics)

Co-ordinators : Prof. S. Lakshmi Bala

Lecture 1 - Quantum Mechanics â€“ An Introduction

Lecture 2 - Linear Vector Spaces - I

Lecture 3 - Linear Vector Spaces - II: The two-level atom

Lecture 4 - Linear Vector Spaces - III: The three-level atom

Lecture 5 - Postulates of Quantum Mechanics - I

Lecture 6 - Postulates of Quantum Mechanics - II

Lecture 7 - The Uncertainty Principle

Lecture 8 - The Linear Harmonic Oscillator

Lecture 9 - Introducing Quantum Optics

Lecture 10 - An Interesting Quantum Superposition: The Coherent State

Lecture 11 - The Displacement and Squeezing Operators

Lecture 12 - Exercises in Finite Dimensional Linear Vector Spaces

Lecture 13 - Exercises on Angular Momentum Operators and their algebra

Lecture 14 - Exercises on Quantum Expectation Values

Lecture 15 - Composite Systems

Lecture 16 - The Quantum Beam Splitter

Lecture 17 - Addition of Angular Momenta - I

Lecture 18 - Addition of Angular Momenta - II

Lecture 19 - Addition of Angular Momenta - III

Lecture 20 - Infinite Dimensional Linear Vector Spaces

Lecture 21 - Square-Integrable Functions

Lecture 22 - Ingredients of Wave Mechanics

Lecture 23 - The Schrodinger equation

Lecture 24 - Wave Mechanics of the Simple Harmonic Oscillator

Lecture 25 - One-Dimensional Square Well Potential: The Bound State Problem

Lecture 26 - The Square Well and the Square Potential Barrier

Lecture 27 - The Particle in a one-dimensional Box

Lecture 28 - A Charged Particle in a Uniform Magnetic Field

Lecture 29 - The Wavefunction: Its Single-valuedness and its Phase

Lecture 30 - The Central Potential

Lecture 31 - The Spherical Harmonics

Lecture 32 - Central Potential: The Radial Equation

Lecture 33 - Illustrative Exercises - I

Lecture 34 - Illustrative Exercises - II

Lecture 35 - Ehrenfest's Theorem

Lecture 36 - Perturbation Theory - I

Lecture 37 - Perturbation Theory - II

Lecture 38 - Perturbation Theory - III

Lecture 39 - Perturbation Theory - IV

Lecture 40 - Time-dependent Hamiltonians

Lecture 41 - The Jaynes-Cummings model

NPTEL : Special Topics in Classical Mechanics (Physics)

Co-ordinators : Prof. P.C. Deshmukh

Lecture 1 - Course Overview

Lecture 2 - Equations of Motion (i)

Lecture 3 - Equations of Motion (ii)

Lecture 4 - Equations of Motion (iii)

Lecture 5 - Equations of Motion (iv)

Lecture 6 - Equations of Motion (v)

Lecture 7 - Oscillators, Resonances, Waves (i)

Lecture 8 - Oscillators, Resonances, Waves (ii)

Lecture 9 - Oscillators, Resonances, Waves (iii)

Lecture 10 - Oscillators, Resonances, Waves (iv)

Lecture 11 - Polar Coordinates (i)

Lecture 12 - Polar Coordinates (ii)

Lecture 13 - Dynamical Symmetry in the Kepler Problem (i)

Lecture 14 - Dynamical Symmetry in the Kepler Problem (ii)

Lecture 15 - Real Effects of Pseudo-Forces (i)

Lecture 16 - Real Effects of Pseudo-Forces (ii)

Lecture 17 - Real Effects of Pseudo-Forces (iii)

Lecture 18 - Real Effects of Pseudo-Forces (iv)

Lecture 19 - Special Theory of Relativity (i)

Lecture 20 - Special Theory of Relativity (ii)

Lecture 21 - Special Theory of Relativity (iii)

Lecture 22 - Special Theory of Relativity (iv)

Lecture 23 - Potentials Gradients Fields (i)

Lecture 24 - Potentials Gradients Fields (ii)

Lecture 25 - Potentials Gradients Fields (iii)

Lecture 26 - Gauss Law Eq of continuity (i)

Lecture 27 - Gauss Law Eq of continuity (ii)

Lecture 28 - Gauss Law Eq of continuity (iii)

Lecture 29 - Fluid Flow Bernoulli Principle (i)

Lecture 30 - Fluid Flow Bernoulli Principle (ii)

Lecture 31 - Classical Electrodynamics (i)

Lecture 32 - Classical Electrodynamics (ii)

Lecture 33 - Classical Electrodynamics (iii)

Lecture 34 - Classical Electrodynamics (iv)

Lecture 35 - Chaotic Dynamical Systems (i)

Lecture 36 - Chaotic Dynamical Systems (ii)

Lecture 37 - Chaotic Dynamical Systems (iii)

Lecture 38 - Chaotic Dynamical Systems (iv)

Lecture 39 - Chaotic Dynamical Systems (v)

Lecture 40 - The Scope and Limitations of Classical Mechanics

NPTEL : Special, Select Topics in the Theory of Atomic Collisions and Spectroscopy (Physics)

Co-ordinators : Prof. P.C. Deshmukh

Lecture 1 - Introduction to the STiTACS course

Lecture 2 - Quantum Theory of collisions

Lecture 3 - Quantum Theory of collisions: optical Theorem

Lecture 4 - Quantum Theory of collisions: Optical Theorem (Continued...)

Lecture 5 - Quantum Theory of collisions: Differential scattering cross section

Lecture 6 - Quantum Theory of collisions: Differential scattering cross section, Partial wave analysis

Lecture 7 - Quantum Theory of collisions: Optical Theorem Â– Unitarity of the Scattering Operator

Lecture 8 - Quantum Theory of collisions: Reciprocity Theorem, Phase shift analysis

Lecture 9 - Quantum Theory of collisions: More on Phase shift analysis

Lecture 10 - Quantum Theory of collisions: resonant condition in the l th partial wave.

Lecture 11 - Quantum Theory of collisions: LevinsonÂ's theorem

Lecture 12 - Quantum Theory of collisions: LevinsonÂ's theorem (Continued...)

Lecture 13 - Many body theory, electron correlations

Lecture 14 - Second Quantization Creation, Destruction and Number operators

Lecture 15 - Many-particle Hamiltonian & Schrodinger Equation in 2nd Quantization

Lecture 16 - Many-electron problem in quantum mechanics

Lecture 17 - Hartree-Fock Self-Consistent-Field

Lecture 18 - Exchange, Statistical, Fermi-Dirac correlations

Lecture 19 - Limitations of the Hartree-Fock Self-Consistent-Field formalism

Lecture 20 - Many-Body formalism, II Quantization

Lecture 21 - Density fluctuations in an electron gas

Lecture 22 - Bohm-Pines approach to Random Phase Approximation

Lecture 23 - Bohm-Pines approach to Random Phase Approximation (Continued...)

Lecture 24 - Bohm-Pines approach to Random Phase Approximation (Continued...)

Lecture 25 - Schrodinger, Heisenberg and Dirac Â"picturesÂ" of QM

Lecture 26 - DysonÂ's chronological operator

Lecture 27 - Gell-Mann-Low Theorem

Lecture 28 - Reyleigh-Schrodinger perturbation methods and adiabatic switching

Lecture 29 - Feynman Diagrams

Lecture 30 - I Order Feynman Diagrams

Lecture 31 - II and higher order Feynman Diagrams

Lecture 32 - Linear response of electron correlations

Lecture 33 - Lippman Schwinger equation of potential scattering

Lecture 34 - Born Approximation

Lecture 35 - Coulomb scattering

Lecture 36 - Scattering of partial waves

Lecture 37 - Scattering at high energy

Lecture 38 - Resonances in Quantum Collisions

Lecture 39 - Breit-Wigner Resonances

Lecture 40 - Fano parameterization of Breit-Wigner formula

Lecture 41 - Discrete state embedded in the continuum

Lecture 42 - Resonance life times

Lecture 43 - Wigner-Eisenbud formalism of time-delay in scattering

Lecture 44 - Photoionization and Photoelectron Angular Distributions

Lecture 45 - Ionization and Excitation of Atoms by Fast Charged Particles

Lecture 46 - Photo-absorption by Free and Confined Atoms and Ions: Recent Developments

NPTEL : Selected Topics in Mathematical Physics (Physics)

Co-ordinators : Prof. V. Balakrishnan

Lecture 1 - Analytic functions of a complex variable - Part I

Lecture 2 - Analytic functions of a complex variable - Part II

Lecture 3 - Calculus of residues - Part I

Lecture 4 - Calculus of residues - Part II

Lecture 5 - Calculus of residues - Part III

Lecture 6 - Calculus of residues - Part IV

Lecture 7 - Linear response; dispersion relations - Part I

Lecture 8 - Linear response; dispersion relations - Part II

Lecture 9 - Analytic continuation and the gamma function - Part I

Lecture 10 - Analytic continuation and the gamma function - Part II

Lecture 11 - MÃ¶bius transformations - Part I

Lecture 12 - MÃ¶bius transformations - Part II

Lecture 13 - MÃ¶bius transformations - Part III

Lecture 14 - Multivalued functions; integral representations - Part I

Lecture 15 - Multivalued functions; integral representations - Part II

Lecture 16 - Multivalued functions; integral representations - Part III

Lecture 17 - Multivalued functions; integral representations - Part IV

Lecture 18 - Laplace transforms - Part I

Lecture 19 - Laplace transforms - Part II

Lecture 20 - Fourier transforms - Part I

Lecture 21 - Fourier transforms - Part II

Lecture 22 - Fourier transforms - Part III

Lecture 23 - Fundamental Green function forÎ”2 - Part I

Lecture 24 - Fundamental Green function forÎ”2 - Part II

Lecture 25 - The diffusion equation - Part I

Lecture 26 - The diffusion equation - Part II

Lecture 27 - The diffusion equation - Part III

Lecture 28 - The diffusion equation - Part IV

Lecture 29 - Green function for (Î”2 + k2); nonrelativistic scattering - Part I

Lecture 30 - Green function for (Î”2 + k2); nonrelativistic scattering - Part II

Lecture 31 - Green function for (Î”2 + k2); nonrelativistic scattering - Part III

Lecture 32 - The wave equation - Part I

Lecture 33 - The wave equation - Part II

Lecture 34 - The rotation group and all that - Part I

Lecture 35 - The rotation group and all that - Part II

Lecture 36 - The rotation group and all that - Part III

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

Co-ordinators : Dr.G.Vaidyanathan

Lecture 1 - Energy Sources

Lecture 2 - Nuclear Power Production Cycle

Lecture 3 - Basic Physics of Nuclear Fission

Lecture 4 - Basic Physics of Nuclear Fission (Continued...)

Lecture 5 - Nuclear Reactors

Lecture 6 - Reactors Generation

Lecture 7 - Radiation Sources and Protection

Lecture 8 - Biological Effects of Radiation

Lecture 9 - Safety Principles

Lecture 10 - Safety Principles (Continued...)

Lecture 11 - Safety Approach

Lecture 12 - Risk and Probabilistic safety analysis (PSA)

Lecture 13 - History of Events in Nuclear Power Plants and Radiation facilities

Lecture 14 - Other Events

Lecture 15 - Validation and Dynamic Analysis

Lecture 16 - Validation and Dynamic Analysis (Continued...)

Lecture 17 - Quality Assurance

Lecture 18 - Siting of Nuclear Plants

Lecture 19 - Siting of Nuclear Plants (Continued...)

Lecture 20 - Engineered Safety Systems

Lecture 21 - Engineered Safety Systems (Continued...)

Lecture 22 - Assessment of Radiological Consequences of Incidents

Lecture 23 - Safety Regulation in India

Lecture 24 - Safety Regulation in India (Continued...)

Lecture 25 - Safety Regulation in India (Continued...)

Lecture 26 - Safety Practices in Indian NPPs

Lecture 27 - Safety Practices in Indian NPPs (Continued...)

Lecture 28 - Safety Practices in Indian NPPs (Continued...)

Lecture 29 - Passive Safety

Lecture 30 - Passive Safety (Continued...)

NPTEL : Physical Applications of Stochastic Processes (Physics)

Co-ordinators : Prof. V. Balakrishnan

Lecture 1 - Discrete probability distributions - Part 1

Lecture 2 - Discrete probability distributions - Part 2

Lecture 3 - Continuous random variables

Lecture 4 - Central Limit Theorem

Lecture 5 - Stable distributions

Lecture 6 - Stochastic processes

Lecture 7 - Markov processes - Part 1

Lecture 8 - Markov processes - Part 2

Lecture 9 - Markov processes - Part 3

Lecture 10 - Birth-and-death processes

Lecture 11 - Continuous Markov processes

Lecture 12 - Langevin dynamics - Part 1

Lecture 13 - Langevin dynamics - Part 2

Lecture 14 - Langevin dynamics - Part 3

Lecture 15 - Langevin dynamics - Part 4

Lecture 16 - ItÂˆo and Fokker-Planck equations for di?usion processes

Lecture 17 - Level-crossing statistics of a continuous random process

Lecture 18 - Diffusion of a charged particle in a magnetic field

Lecture 19 - Power spectrum of noise

Lecture 20 - Elements of linear response theory

Lecture 21 - Random pulse sequences

Lecture 22 - Dichotomous di?usion

Lecture 23 - First passage time (Part 1)

Lecture 24 - First passage time (Part 2)

Lecture 25 - First passage and recurrence in Markov chains

Lecture 26 - Recurrent and transient random walks

Lecture 27 - Non-Markovian random walks

Lecture 28 - Statistical aspects of deterministic dynamics (Part 1)

Lecture 29 - Statistical aspects of deterministic dynamics (Part 2)

NPTEL : NOC:Mechanics, Heat Oscillations and Waves (Physics)

Co-ordinators : Prof. V. Balakrishnan

Lecture 1 - The Nature of Physical Laws

Lecture 2 - Fundamental Constants and Dimensional Analysis

Lecture 3 - Dimensional analysis and scaling

Lecture 4 - sketching Elementary Functions

Lecture 5 - The fundamental forces of nature

Lecture 6 - Scalars, Victors and All That

Lecture 7 - Plane Polar Coordinates

Lecture 8 - Vectors In a Plane, Scalars and Pseudoscalars

Lecture 9 - Kinematics In a Plane

Lecture 10 - Vectors in 3-Dimensional Space

Lecture 11 - Vectors in 3-Dimensional space (Continued...)

Lecture 12 - The Finite Rotation Formula, Polar Coordinates in 3-dimensions

Lecture 13 - Cylindrical and Spherical polar coordinates

Lecture 14 - Motion in a circle - Acceleration

Lecture 15 - Newtons laws of motion

Lecture 16 - Conservation Laws and Newtons Equations

Lecture 17 - Conservation of Angular Momentum

Lecture 18 - Two-Body Scattering

Lecture 19 - Two-Body Collision Kinematics

Lecture 20 - Conservative Forces - The Concept of a Potential

Lecture 21 - Central Potential and Central Force

Lecture 22 - The 2-Body Central Force Problem

Lecture 23 - Keplers Laws of Planetary Motion

Lecture 24 - Non-Inertial Forces (Pseudo-forces)

Lecture 25 - More on the Kepler problem; Satellite motion

Lecture 26 - Linear Elasticity of Solids

Lecture 27 - Simple Harmonic Motion

Lecture 28 - Some Physical Examples of Simple Harmonic Motion

Lecture 29 - More on Simple Harmonic Motion

Lecture 30 - Damped Simple Harmonic Motion

Lecture 31 - Wave Motion - Travelling and Standing Waves

Lecture 32 - Wave Motion - Wave Equation, General Solution

Lecture 33 - Fluid Dynamics - Hydrostatic Equilibrium

Lecture 34 - Fluid Dynamics - Equation of Continuity

Lecture 35 - Fluid Flow - Bernoullis Principle

Lecture 36 - Circulation and Vorticity

Lecture 37 - What is Thermodynamics?

Lecture 38 - The Classical Ideal Gas

Lecture 39 - The Laws of Thermodynamics

Lecture 40 - Specific Heat of an Ideal Gas

Lecture 41 - Van der Waals Equation

Lecture 42 - Phase Transitions

Lecture 43 - Summary

NPTEL : Nonequilibrium Statistical Mechanics (Physics)

Co-ordinators : Prof. V. Balakrishnan

Lecture 1 - Recapitulation of equilibrium statistical mechanics

Lecture 2 - The Langevin model (Part 1)

Lecture 3 - The Langevin model (Part 2)

Lecture 4 - The Langevin model (Part 3)

Lecture 5 - The Langevin model (Part 4)

Lecture 6 - Linear response theory (Part 1)

Lecture 7 - Linear response theory (Part 2)

Lecture 8 - Linear response (Part 3)

Lecture 9 - Linear response(Part 4)

Lecture 10 - Linear response (Part 5)

Lecture 11 - Linear response (Part 6)

Lecture 12 - Linear response theory (Part 7)

Lecture 13 - Quiz 1 - Questions and answers

Lecture 14 - Linear response theory (Part 8)

Lecture 15 - Linear response theory (Part 9)

Lecture 16 - The dynamic mobility

Lecture 17 - Fokker-Planck equations (Part 1)

Lecture 18 - Fokker-Planck equations (Part 2)

Lecture 19 - Fokker-Planck equations (Part 3)

Lecture 20 - The generalized Langevin equation (Part 1)

Lecture 21 - The generalized Langevin equation (Part 2)

Lecture 22 - Diffusion in a magnetic field

Lecture 23 - The Boltzmann equation for a dilute gas (Part 1)

Lecture 24 - The Boltzmann equation for a dilute gas (Part 2)

Lecture 25 - The Boltzmann equation for a dilute gas (Part 3)

Lecture 26 - The Boltzmann equation for a dilute gas (Part 4)

Lecture 27 - The Boltzmann equation for a dilute gas (Part 5)

Lecture 28 - Quiz 2 - Questions and answers

Lecture 29 - Critical phenomena (Part 1)

Lecture 30 - Critical phenomena (Part 2)

Lecture 31 - Critical phenomena (Part 3)

Lecture 32 - Critical phenomena (Part 4)

Lecture 33 - Critical phenomena (Part 5)

Lecture 34 - Critical phenomena (Part 6)

Lecture 35 - Critical phenomena (Part 7)

Lecture 36 - The Wiener process (standard Brownian motion)

NPTEL : NOC:Statistical Mechanics (Physics)

Co-ordinators : Prof. Ashwin Joy

Lecture 1 - Discrete Probability

Lecture 2 - Continous Probability

Lecture 3 - Characteristic Function

Lecture 4 - Gausssian Distribution

Lecture 5 - Binomial Distribution

Lecture 6 - Poisson Distribution

Lecture 7 - Central Limit Theorem

Lecture 8 - Many Random Variables

Lecture 9 - Entropy and Probability

Lecture 10 - Entropy Maximization

Lecture 11 - Transformation of Random Variables

Lecture 12 - Tutorial

Lecture 13 - Mathematical Preliminaries - 1

Lecture 14 - Microcanonical Ensemble

Lecture 15 - Two Level System (Microcanonical Ensemble)

Lecture 16 - Classical Ideal Gas (Microcanonical Ensemble)

Lecture 17 - Entropy of Mixing

Lecture 18 - Canonical Ensemble

Lecture 19 - Two Level System (Canonical Ensemble)

Lecture 20 - Classical Ideal Gas (Canonical Ensemble)

Lecture 21 - Gibbs Canonical Ensemble

Lecture 22 - Classical Ideal Gas (Gibbs Canonical Ensemble)

Lecture 23 - N Spins in a Uniform Magnetic Field

Lecture 24 - Grand Canonical Ensemble

Lecture 25 - Ideal Gas (Grand Canonical Ensemble)

Lecture 26 - N Non - Interacting Spins in Constant Magnetic Field

Lecture 27 - Qunatum Statistical Mechanics

Lecture 28 - Statistics of Fermions and Bosons

Lecture 29 - Quantum to Classical Correspondance

Lecture 30 - Vibrations of Solid (Low Temperature)

Lecture 31 - Vibrations of Solid (Continuation)

Lecture 32 - Free Electrons(Fermi Gas) in a Metal

Lecture 33 - Free Electrons(Fermi Gas) in a Metal (Continuation)

Lecture 34 - Problem solving demo - Part 1

Lecture 35 - Problem solving demo - Part 2

NPTEL : NOC:Computational Physics (Physics)

Co-ordinators : Prof. Prasenjit Ghosh

Lecture 1 - Introduction to Fortran - Part 1

Lecture 2 - Introduction to Fortran - Part 2

Lecture 3 - Introduction to Fortran - Part 3

Lecture 4 - Introduction to Fortran - Part 4

Lecture 5 - Introduction to Fortran - Part 5

Lecture 6 - Numerical Integration - Part 1

Lecture 7 - Numerical Integration - Part 2

Lecture 8 - Numerical Integration - Part 3

Lecture 9 - Numerical Integration - Part 4

Lecture 10 - Numerical Integration - Part 5

Lecture 11 - Numerical Integration - Part 6

Lecture 12 - Numerical Integration - Part 7

Lecture 13 - Numerical Integration - Part 8

Lecture 14 - Numerical Integration - Part 9

Lecture 15 - Numerical Integration - Part 10

Lecture 16 - Monte Carlo Simulation Introduction - Part 1

Lecture 17 - Monte Carlo Simulation Introduction - Part 2

Lecture 18 - Implementing the Ising model on computer

Lecture 19 - Periodic Boundary conditions and the Metropolis scheme

Lecture 20 - Testing the simulation and relaxation to equilibrium, finte size effects

Lecture 21 - Monte Carlo Simulation Analysis - Part 1

Lecture 22 - Monte Carlo Simulation Analysis - Part 2

Lecture 23 - Monte Carlo Simulation Analysis: Thermodynamic Quantities - Part 1

Lecture 24 - Monte Carlo Simulation Analysis: Thermodynamic Quantities - Part 2

Lecture 25 - Calculating T_c using Binders cumulant; Principle of detailed balance

Lecture 26 - Differential Equations Euler and Runge Kutta - Part 1

Lecture 27 - Differential Equations Euler and Runge Kutta - Part 2

Lecture 28 - Differential Coupled Equation Non Linear Equation - Part 1

Lecture 29 - Differential Coupled Equation Non Linear Equation - Part 2

Lecture 30 - Coupled Differential Equation Visualisation and Making Movie

Lecture 31 - Differential Equations With Specified Boundary Conditions - Part 1

Lecture 32 - Differential Equations With Specified Boundary Conditions - Part 2

Lecture 33 - Partial Differential equations - 1

Lecture 34 - Partial Differential equations - 2

Lecture 35 - Partial Differential equations - 3

Lecture 36 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 1

Lecture 37 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 2

Lecture 38 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 3

Lecture 39 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 4

Lecture 40 - Differential Equation for Quantum Mechanical Problems: Numerov Algorithm - 5

Lecture 41 - Differential Equation for Quantum Mechanical Problems: Variational principle - 1

Lecture 42 - Differential Equation for Quantum Mechanical Problems: Variational principle - 2

Lecture 43 - Differential Equation for Quantum Mechanical Problems: Variational principle - 3

Lecture 44 - Differential Equation for Quantum Mechanical Problems: Variational principle - 4

Lecture 45 - Differential Equation for Quantum Mechanical Problems: Variational principle - 5

Lecture 46 - Molecular Dynamics Introduction - Part 1

Lecture 47 - Molecular Dynamics Introduction - Part 2

Lecture 48 - Molecular Dynamics Details and Algorithm - Part 1

Lecture 49 - Molecular Dynamics Details and Algorithm - Part 2

Lecture 50 - Molecular Dynamics Details and Algorithm - Part 3

Lecture 51 - Molecular Dynamics Analysis - Part 1

Lecture 52 - Molecular Dynamics Analysis - Part 2

Lecture 53 - Molecular Dynamics Neighbours Lists - Part 1

Lecture 54 - Molecular Dynamics Neighbours Lists - Part 2

Lecture 55 - Molecular Dynamics: Calculation Of Themodynamics Quantities

Lecture 56 - Molecular Dynamics Diffusion Constant Calculation - Part 1

Lecture 57 - Molecular Dynamics Diffusion Constant Calculation - Part 2

Lecture 58 - Molecular Dynamics Diffusion Constant Calculation - Part 3

NPTEL : NOC:Waves and Oscillations (Physics)

Co-ordinators : Prof. M. S. Santhanam

Lecture 1 - Simple Harmonic Motion

Lecture 2 - Superposition of Oscillations : Beats

Lecture 3 - Superposition of Oscillations : Beats

Lecture 4 - Superposition of Oscillations : Lissajous Figures

Lecture 5 - Simple Harmonic Motion : Problems

Lecture 6 - Damped oscillator - Part 1

Lecture 7 - Damped oscillator - Part 2

Lecture 8 - Damped oscillator and Q-factor

Lecture 9 - Damped oscillator : Problems

Lecture 10 - Forced oscillator - Part 1

Lecture 11 - Forced oscillator - Part 2

Lecture 12 - Resonances

Lecture 13 - Q-factor of forced oscillator

Lecture 14 - Applications of forced oscillator

Lecture 15 - Forced Oscillator : Problems

Lecture 16 - Coupled Oscillations - Part 1

Lecture 17 - Coupled Oscillations - Part 2

Lecture 18 - Solving for normal modes

Lecture 19 - Coupled oscillations - More examples

Lecture 20 - Coupled oscillator : Problems

Lecture 21 - Coupled Oscillations of Loaded String

Lecture 22 - Solutions for Loaded String

Lecture 23 - Oscillations of Loaded String

Lecture 24 - Continuum Limit of Loaded String

Lecture 25 - Wave equation and its solutions

Lecture 26 - Wave equation - impedance and velocities

Lecture 27 - Standing waves

Lecture 28 - Transverse waves in periodic structures

Lecture 29 - Wave equation : Problems

Lecture 30 - Reflection and transmission of waves

Lecture 31 - Impedance matching

Lecture 32 - Energy of vibrating string

Lecture 33 - Dispersion of waves

Lecture 34 - Bandwidth theorem and problems

Lecture 35 - Longitudnal Waves and Speed of Sound

Lecture 36 - Longitudnal Standing Waves

Lecture 37 - Sound Intensity

Lecture 38 - Longitudnal Waves: Problems

Lecture 39 - Fourier Series - Part 1

Lecture 40 - Fourier Series - Part 2

Lecture 41 - Fourier Series and Energy of Vibrating String

Lecture 42 - Frequency Spectrum and Fourier Transforms

Lecture 43 - Fourier Series : Problems

Lecture 44 - Waves in Optical Systems

Lecture 45 - Waves in Optical Systems: Applying Fermat's Principle

Lecture 46 - Waves in Optical Systems: Thin Lens

Lecture 47 - Waves in Optical Systems: Matrix Method

Lecture 48 - Waves in Optical Systems: Problems

Lecture 49 - Interference: Part 1

Lecture 50 - Interference: Newton's rings

Lecture 51 - Michelson and Fabry-Perot Interferometers

Lecture 52 - Young's Double Slit Experiment

Lecture 53 - Diffraction

Lecture 54 - Beyond Linear Oscillators: Non-linear Pendulum

Lecture 55 - Beyond Linear Oscillators: Forced Oscillator

Lecture 56 - Beyond Linear Oscillators: Chaotic Oscillator

Lecture 57 - Beyond Linear Waves: Solitary Waves

Lecture 58 - Waves in Quantum Mechanics and Summary

NPTEL : NOC:Physics through Computational Thinking (Physics)

Co-ordinators : Prof. Auditya Sharma, Prof. Ambar Jain

Lecture 1 - Introduction to Mathematica, Wolfram language and Wolfram Cloud

Lecture 2 - Technical Prelim 1

Lecture 3 - Plotting Simple Functions

Lecture 4 - Function Behaviour near Extrema

Lecture 5 - Radicals and Logarithms

Lecture 6 - Properties of Functions

Lecture 7 - Vector Fields, Vector and Streamline Plots and Contour Plots

Lecture 8 - Introduction to Non-dimesionalisation

Lecture 9 - Non-dimensionalization and visual thinking

Lecture 10 - Non-dimensionalisation and Parametric Plot

Lecture 11 - Technical Prelim 2: Loops

Lecture 12 - Introduction to Simple Harmonic Oscillator

Lecture 13 - Simple Harmonic Oscillator with a spring mass system

Lecture 14 - More Examples of Simple Harmonic Oscillator

Lecture 15 - Anharmonic Oscillator

Lecture 16 - Introduction to Data Analysis - 1

Lecture 17 - Introduction to Data Analysis - 2

Lecture 18 - Curve fitting

Lecture 19 - Linear superposition of oscillations

Lecture 20 - Technical Prelim 3: Introduction to Calculus Tools

Lecture 21 - Damped Harminic Oscillator: LCR Circuit

Lecture 22 - Solving Initial Value Problem with Mathemtica

Lecture 23 - Damped Harmonic Oscillator: Spring-mass System with Friction

Lecture 24 - Technical Prelim 4: Manipulation of Lists using @, @@, /@ operators

Lecture 25 - Introduction to Euler's Method for Solving Differential Equation

Lecture 26 - Technical Prelim 5: Writing Custom Functions

Lecture 27 - Writing Euler's Method as a custom function

Lecture 28 - Mean Global Error in Euler's method and Application of Euler's method to damped oscillator

Lecture 29 - Improved Euler (RK2) and RK4 Methods for solving ODEs

Lecture 30 - Driven oscillations

Lecture 31 - Driven oscillations using the Improved Euler method

Lecture 32 - Falling Bodies

Lecture 33 - Escape velocity

Lecture 34 - Driven oscillations: Variations

Lecture 35 - Linear systems: Insights from the phase space picture - 1

Lecture 36 - Linear systems: Insights from the phase space picture - 2

Lecture 37 - Linearization - 1

Lecture 38 - Linearization - 2

Lecture 39 - The Monte Carlo Method - 1

Lecture 40 - The Monte Carlo Method - 2

Lecture 41 - The Monte Carlo Method - 3

Lecture 42 - The Monte Carlo Method - 4

Lecture 43 - The Monte Carlo Method - 5

Lecture 44 - Random Walks - 1

Lecture 45 - Random Walks - 2

Lecture 46 - Random Walks - 3

Lecture 47 - Random Walks - 4

Lecture 48 - Random Walks - 5

Lecture 49 - Random Walks - 6

Lecture 50 - Random Walks - 7

NPTEL : NOC:Electromagnetism (Physics)

Co-ordinators : Prof. Nirmal Ganguli

Lecture 1 - Vector algebra

Lecture 2 - Vector algebra in component form

Lecture 3 - Vector triple products

Lecture 4 - Vector differential calculus: Gradient

Lecture 5 - Divergence

Lecture 6 - Curl

Lecture 7 - Tutorial on differential vector calculus

Lecture 8 - More problems on vector differential calculus

Lecture 9 - Vector integral calculus: Line integral

Lecture 10 - Surface integral

Lecture 11 - Volume integral

Lecture 12 - Fundamental theorems of vector calculus: The gradient theorem

Lecture 13 - The divergence theorem (Gauss's theorem)

Lecture 14 - The curl theorem (Stokes' theorem)

Lecture 15 - Curvilinear coordinates: Cartesian vs. Polar

Lecture 16 - Generic curvilinear coordinate systems: Unit vectors and components

Lecture 17 - Differential vector calculus in curvilinear coordinate systems

Lecture 18 - Special curvilinear coordinate systems: Cylindrical and spherical

Lecture 19 - Vector calculus in spherical coordinate system

Lecture 20 - Vector calculus in cylindrical coordinate system

Lecture 21 - Introduction to Dirac delta function

Lecture 22 - Tutorial on vector calculus and curvilinear coordinates

Lecture 23 - Introduction to electrostatics

Lecture 24 - Continuous charge distribution: Line charge

Lecture 25 - Electric field due to a line charge distribution

Lecture 26 - Electric field lines, Flux, Gauss law

Lecture 27 - Application of Gauss law with cylindrical symmetry

Lecture 28 - Application of Gauss law on a flat 2D surface

Lecture 29 - Tutorial on Dirac delta function and electrostatics

Lecture 30 - Tutorial on electrostatics

Lecture 31 - The curl of an electric field

Lecture 32 - Scalar potential

Lecture 33 - Calculation of electric potential from different approaches

Lecture 34 - Boundary conditions on electric field and potential

Lecture 35 - Work and energy of an assembly of point charges

Lecture 36 - General idea of energy in electrostatics

Lecture 37 - Electrostatics with conductors

Lecture 38 - Capacitors

Lecture 39 - Laplace equation

Lecture 40 - Boundary conditions and the uniqueness theorems

Lecture 41 - The method of images

Lecture 42 - Induced charge

Lecture 43 - Force and energy

Lecture 44 - Another example of the method of images

Lecture 45 - Electric dipoles

Lecture 46 - Multipole expansion, continuous charge distriution, and assembly of point charges

Lecture 47 - Electric field due to a dipole

Lecture 48 - Introduction to electric polarization in matter

Lecture 49 - Electric polarization and bound charges

Lecture 50 - Electric displacement vector and Gauss law

Lecture 51 - Boundary conditions on the displacement vector and linear dielectric materials

Lecture 52 - Parallel plate capacitors

Lecture 53 - Energy in dielectric materials

Lecture 54 - Force on dielectric materials

Lecture 55 - Motion of a charged particle in electromagnetic field

Lecture 56 - Work done by a magnetic field

Lecture 57 - Electric current

Lecture 58 - Surface and volume current

Lecture 59 - Biot Savart law

Lecture 60 - Biot Savart law with surface and volume currents

Lecture 61 - A tutorial on currents and magnetic field

Lecture 62 - Straight line current: Curl of the magnetic field

Lecture 63 - Divergence and curl of a generic magnetic field

Lecture 64 - Ampere's law in integral form and its applications

Lecture 65 - Magnetic field in a long solenoid

Lecture 66 - A comparison between electrostatics nad magnetostatics

Lecture 67 - Magnetic vector potential

Lecture 68 - Tutorial on magnetic fields

Lecture 69 - Calculation of vector potential

Lecture 70 - Boundary conditions on magnetic field

Lecture 71 - Magnetic dipole

Lecture 72 - Multipole expansion of the vector potential

Lecture 73 - Magnetism, force and torque on magnetic dipole

Lecture 74 - Fringing magnetic field

Lecture 75 - Magnetization

Lecture 76 - A tutorial on the magnetic dipole moment

Lecture 77 - Ampere's law in magnetized materials

Lecture 78 - Electrodynamics

Lecture 79 - Electromagnetic induction

Lecture 80 - Laws of electromagnetism so far

Lecture 81 - Maxwell's correction to electromagnetism

Lecture 82 - Fictitious discussion about symmetry

Lecture 83 - Maxwell's equations in matter and the boundary conditions

NPTEL : NOC:Introduction to Classical Mechanics (Physics)

Co-ordinators : Prof. Anurag Tripathi

Lecture 1 - Introduction. Symmetries of space and time

Lecture 2 - Generalized coordinates and degrees of freedom

Lecture 3 - Virtual Work

Lecture 4 - Virtual Work (rigid body)

Lecture 5 - d'Alembert Principle

Lecture 6 - Euler Lagrange Equation for a holonomic system

Lecture 7 - Euler Lagrange Equations. Examples

Lecture 8 - Euler Lagrange Equations. Examples (Continued...)

Lecture 9 - Properties of Lagrangian

Lecture 10 - Kinetic term in generalized coordinates

Lecture 11 - Cyclic coordinates

Lecture 12 - Conservation laws - Conservation of Energy

Lecture 13 - Energy Function, Jacobi's Integral

Lecture 14 - Momemtum conservation

Lecture 15 - Matrices and all that

Lecture 16 - Matrices, Forms, and all that

Lecture 17 - Principal axis transformation

Lecture 18 - Small Oscilaltions

Lecture 19 - Oscillations, Normal Coordinates

Lecture 20 - Oscillations, Triatomic molecule

Lecture 21 - Triatomic molecule normal coordinates

Lecture 22 - Coupled pendulums, normal modes

Lecture 23 - Coupled pendulums, Beats

Lecture 24 - Oscillations, General solution

Lecture 25 - Forced oscillations

Lecture 26 - Damped oscillations

Lecture 27 - Forced Damped oscillations

Lecture 28 - one dimensional systems

Lecture 29 - Two-body problem

Lecture 30 - Two-body problem, Kepler's second law

Lecture 31 - Two-body problem, Kepler problem

Lecture 32 - Two-body problem, Conic Sections in Polar Coordinates

Lecture 33 - Two-body problem, Ellipse in polar coordinates

Lecture 34 - Orbits in Kepler Problem

Lecture 35 - Apsidal distances, eccentricity of orbits

Lecture 36 - Kepler's Third law; Laplace-Runge-Lenz vector

Lecture 37 - Rigid Body, degrees of freedom

Lecture 38 - Rigid Body, Transfromation matrix

Lecture 39 - Rigid Body, Euler Angles

Lecture 40 - Parameterization using Euler Angles

Lecture 41 - Rigid Body, Euler's Theorem

Lecture 42 - General motion of a rigid body

Lecture 43 - Moment of Inertia Tensor

Lecture 44 - Principal Moments

Lecture 45 - Langrangian of a rigid body

Lecture 46 - Motion of a free symmetric top

Lecture 47 - Angular velocity using Euler angles

Lecture 48 - Lagrangian of a heavy symmetric top

Lecture 49 - First integrals of a heavy symmetric top

Lecture 50 - Nutation and Precission of a heavy symmetric top

Lecture 51 - Sleeping Top

Lecture 52 - Rotating Frames. Euler Equations

Lecture 53 - Calculus of Variations: Functionals

Lecture 54 - Method of Lagrange Multipliers

Lecture 55 - Calculus of Variations: Condition for extremum

Lecture 56 - Calculus of Variations: Several variables

Lecture 57 - Cartesian Tensors

Lecture 58 - Hamiltonian Mechanics: Hamilton's equations of motion

Lecture 59 - Hamiltonian Mechanics: Liouville's theorem

Lecture 60 - Hamiltonian Mechanics: Poisson Bracket

Lecture 61 - Hamiltonian Mechanics: Canonical Coordinates

Lecture 62 - Hamiltonian Mechanics: Generating Function of Canonical Transformations

Lecture 63 - Hamiltonian Mechanics: Generating functions of the 4 kinds

Lecture 64 - Examples of Generating Functions

Lecture 65 - Harmonic Oscillator (Canonical Transformations)

Lecture 66 - Invariance of Poisson Brackets

Lecture 67 - Normal modes of triatomic molecule using Mathematica

NPTEL : NOC:Fluid Dynamics for Astrophysics (Physics)

Co-ordinators : Prof. Prasad Subramanian

Lecture 1 - Introduction to the course

Lecture 2 - Continuum hypothesis, distribution function and stress-viscosity relation

Lecture 3 - Continuum hypothesis, distribution function and stress-viscosity relation - Recap

Lecture 4 - Fluid Kinematics

Lecture 5 - Fluid Kinematics - Recap

Lecture 6 - Conservation laws: Mass conservation and incomprehensibility

Lecture 7 - Conservation laws: Momentum conservation and Euler equation

Lecture 8 - Conservation laws - Recap

Lecture 9 - Potential flows

Lecture 10 - Bernoulli constant, its applications and voracity equation

Lecture 11 - Recap - Potential flows, Bernoulli constant and its applications

Lecture 12 - Voracity dynamics -- Kelvin's voracity theorem and Magus effect

Lecture 13 - Navier-Stokes equation

Lecture 14 - Navier-Stokes equation (Continued....) and energy equation

Lecture 15 - Energy equation in a conservative form

Lecture 16 - Boundary conditions in Navier-Stokes equation, d'Alembert's paradox

Lecture 17 - Poiseuille flow, deriving viscosity from microscopics

Lecture 18 - Dimensionless numbers -- Mach number, Reynolds number

Lecture 19 - DimDimensionless numbers (Continued...) -- plasma beta, magnetic Reynolds number, Alfven Mach number, Prandl numberensionless numbers -- Mach number, Reynolds number

Lecture 20 - Reynolds number and dynamic similarity

Lecture 21 - Reynolds number recap, Low Re flows, and drag on a sphere (Stokes law)

Lecture 22 - High Re flows -- turbulent drag law, vortex shedding and drag crisis

Lecture 23 - Lift on a body, introduction to compressible flows

Lecture 24 - Compressible flows -- derivation of sound speed and dispersion relation

Lecture 25 - Subsonic and supersonic flows

Lecture 26 - Propagation of sonic information, shock tube problem and piston problem

Lecture 27 - Criterion for neglect of compressibility, method of characteristics

Lecture 28 - Shock thickness

Lecture 29 - Shock thickness recap, shock jump conditions

Lecture 30 - Shock jump conditions (Continued...), transonic 1D flows, converging/diverging channels

Lecture 31 - Coverging/diverging channels, de Laval nozzle and its application to astrophysical jets

Lecture 32 - Spherically symmetric transonic flows

Lecture 33 - Spherically symmetric transonic flows (Continued...)

Lecture 34 - Solar wind : Parker's solution

Lecture 35 - Solar wind : Modifications in Parker's solution

Lecture 36 - Spherical accretion onto a compact object : Eddington luminosity and accretion rate

Lecture 37 - Spherical accretion onto a compact object : Solutions for flow properties

Lecture 38 - Spherical accretion (Continued...), disk accretion--Roche lobe overflow

Lecture 39 - Disk accretion : Mass conservation and vertical hydrostatic equilibrium

Lecture 40 - Disk accretion : Removal of angular momentum, Shakura-Sunyaev viscosity parameter

Lecture 41 - Disk accretion : Viscous dissipation and the energy equation, two-temperature criterion

Lecture 42 - Particle acceleration in astrophysical settings : Shocks and non-thermal energy distribution

Lecture 43 - Particle acceleration in astrophysical settings : Diffusive shock acceleration

Lecture 44 - Spherical blast waves : Bomb explosion and supernova explosion

Lecture 45 - Spherical blast waves : Sedov-Taylor solution

Lecture 46 - Spherical blast waves : Sedov-Taylor solution (Continued....)

Lecture 47 - Magnetohydrodynamics (MHD) : Introduction

Lecture 48 - Magnetohydrodynamics (MHD) : The induction equation

Lecture 49 - Magnetohydrodynamics (MHD) : Currents in MHD, momentum equation and magnetic stress tensor

Lecture 50 - Magnetohydrodynamics (MHD) : Magnetic stresses and magnetic buoyancy

Lecture 51 - Magnetohydrodynamics (MHD) : Plasma beta, force-free fields and potential configurations

Lecture 52 - Magnetohydrodynamics (MHD) : Magnetic flux-freezing

Lecture 53 - Magnetohydrodynamics (MHD) : Magnetic flux-freezing (Continued....), magnetic dynamos

Lecture 54 - Magnetohydrodynamics (MHD) : Dynamo theory

Lecture 55 - Magnetohydrodynamics (MHD) : Waves in MHD - Alfven waves

Lecture 56 - Magnetohydrodynamics (MHD) : Waves in MHD - Alfven waves and magnetosonic waves

Lecture 57 - Magnetohydrodynamics (MHD) : Waves in MHD - Magnetosonic waves

Lecture 58 - Magnetohydrodynamics (MHD) : Shocks in MHD

Lecture 59 - Magnetohydrodynamics (MHD) : Shocks in MHD - Shock jump conditions

Lecture 60 - Non-ideal MHD : Introduction to magnetic reconnection

Lecture 61 - Non-ideal MHD : Magnetic reconnection - The Sweet-Parker model

Lecture 62 - Non-ideal MHD : Magnetic reconnection - The Petscheck model

Lecture 63 - Sun's atmosphere : Solar corona and the coronal heating problem

Lecture 64 - Solar eruptions : Coronal Mass Ejections (CMEs) and solar flares

NPTEL : NOC:Quantum Transport (Physics)

Co-ordinators : Prof. Madhu Thalakulam

Lecture 1 - Introduction

Lecture 2 - Classical and Semi-classical Transport: Overview

Lecture 3 - Quantum Transport Regimes

Lecture 4 - Band-bending and Metal semiconductor Interfaces

Lecture 5 - Semiconductor Heterostructures

Lecture 6 - 2DEG and Electrostatic Gating

Lecture 7 - Device Fabrication - Photolithography

Lecture 8 - Device Fabrication - Electron-beam Lithography

Lecture 9 - Quantum hall Effect - Overview

Lecture 10 - Quantum Hall Effect: Quantization of electron orbitals, Landau levels and Flux quantization

Lecture 11 - Quantum Hall Effect: Lanau level, filling factor and Shubnikov-de-Haas effect

Lecture 12 - Quantum Hall Effect: Edge states and Resistance Quantization

Lecture 13 - Weak Localization

Lecture 14 - Aharonov-Bohm Effect

Lecture 15 - Ballistic 1D transport-Quantum Point contacts

Lecture 16 - Ballistic 1D transport-Current from transmission

Lecture 17 - Ballistic 1D transport-Where is the power dissipation?

Lecture 18 - 0D Transport - Single Electron Tunneling

Lecture 19 - Single Electron Transistors, Coulomb Blockade

Lecture 20 - Quantum Dots, Shell filling, Artificial Atoms

Lecture 21 - Transport on Double Quantum Dots - I

Lecture 22 - Transport on Double Quantum Dots - II

Lecture 23 - Superconductivity-Introduction

Lecture 24 - Superconducting tunnel junctions-Josephson effect - 1

Lecture 25 - Superconducting tunnel junctions-Josephson effect - 2

Lecture 26 - Charge sensing with quantum point contacts

Lecture 27 - Charge sengin with single electron transistors

Lecture 28 - Real-time charge sensing

Lecture 29 - Quantum Electrical Metrology - I

Lecture 30 - Quantum Electrical Metrology - II

Lecture 31 - Qubits - Overview

Lecture 32 - Superconducting qubits

Lecture 33 - Quantum dot qubits

NPTEL : NOC:Statistical Mechanics (2021) (Physics)

Co-ordinators : Prof. Dipanjan Chakraborty

Lecture 1 - Introduction to Thermodynamics

Lecture 2 - Laws of Thermodynamics

Lecture 3 - Second Law of Thermodynamics and Heat Engines

Lecture 4 - Entropy, Clausius Inequality, Thermodynamic Processes and Systems

Lecture 5 - Extensivity of Entropy and Internal Energy, Gibbs Duhem relation

Lecture 6 - Exact and Inexact differentials, Legendre Transformation

Lecture 7 - Free Energy in Thermodynamics

Lecture 8 - Maxwell's relations - Part I

Lecture 9 - Maxwell's relations - Part II

Lecture 10 - Maxwell's relations - Part III

Lecture 11 - Response Functions and manipulating Partial Derivatives

Lecture 12 - Working With Thermodynamics

Lecture 13 - Joule Expansion and Joule Thomson Effect

Lecture 14 - Stability of Thermodynamic Potentials

Lecture 15 - Consequences of Stability of Thermodynamic Potentials

Lecture 16 - Conditions of Equilibrium and Gibbs Phase Rule

Lecture 17 - Introduction to Probability

Lecture 18 - Discrete and Continuous Distributions

Lecture 19 - Central Limit Theorem and Statistical Entropy

Lecture 20 - Classical Probability Density and Liouville Equation

Lecture 21 - Classical Probability Density, Ergodicity and Microcanonical Ensemble

Lecture 22 - Microcanonical Ensemble

Lecture 23 - Examples of Microcanonical Ensemble - Two Level System

Lecture 24 - Examples of Microcanonical Ensemble - Magnetic System and Ideal Gas - Part I

Lecture 25 - Examples of Microcanonical Ensemble - Magnetic System and Ideal Gas - Part II

Lecture 26 - Examples of Microcanonical Ensemble - Ultra-Relativistic Gas

Lecture 27 - Microcanonical Ultrarelativistic Gas and Quantum Solid

Lecture 28 - Microcanonical Excluded Volume

Lecture 29 - Canonical Ensemble

Lecture 30 - Canonical Ensemble Paramagnet

Lecture 31 - Canonical Ensemble Ideal Gas

Lecture 32 - Canonical Ensemble Einstein Solid

Lecture 33 - Grand Canonical Ensemble

Lecture 34 - Grand Canonical Ensemble Ideal Gas - Part I

Lecture 35 - Grand Canonical Ensemble Ideal Gas - Part II

Lecture 36 - MicroCanonical to Canonical - Part I

Lecture 37 - MicroCanonical to Canonical - Part II

Lecture 38 - Interacting System - Part I

Lecture 39 - Interacting System - Part II

Lecture 40 - Van-Der Waals Equation of State

Lecture 41 - Quantum Statistical Mechanics Density Matrix

Lecture 42 - Density Matrix in different Ensembles

Lecture 43 - Free Particle Quantum Canonical Partition Function Free

Lecture 44 - Single Particle Quantum Partition Function Harmonic Oscillator - Part I

Lecture 45 - Single Particle Quantum Partition Function Harmonic Oscillator - Part II

Lecture 46 - Wigner Transformation

Lecture 47 - N-Particle partition function

Lecture 48 - Canonical Formulation of Ideal Gas

Lecture 49 - Grand Canonical Formulation of Ideal Gas

Lecture 50 - High Temperature Expansion

Lecture 51 - Degenerate Fermi Gas

Lecture 52 - Ideal Fermi Gas close to T=0, Chemical Potential and Specific Heat

Lecture 53 - Relativistic Fermi Gas at T=0

Lecture 54 - Ideal Bose Gas

Lecture 55 - Bose-Einstein Condensation

Lecture 56 - Pressure of an Ideal Bose Gas

Lecture 57 - Specific Heat of an Ideal Bose Gas - Part 1

Lecture 58 - Specific Heat of an Ideal Bose Gas - Part 2

Lecture 59 - Bose-Einstein Condensation in a Harmonically Trapped Bose Gas

Lecture 60 - Specific Heat of a Harmonically Trapped Bose Gas

Lecture 61 - General Treatment of a Bose gas - Part 1

Lecture 62 - General Treatment of a Bose gas - Part 2

Lecture 63 - Discontinuity in the Specific Heat of a Bose Gas - Part 1

Lecture 64 - Discontinuity in the Specific Heat of a Bose Gas - Part 2

Lecture 65 - Ultra Relativistic Bose Gas Stefan Boltzmann Law

NPTEL : NOC:Solid State Physics (2021) (Physics)

Co-ordinators : Prof. Nirmal Ganguli

Lecture 1 - What is solid?

Lecture 2 - Bravais lattice

Lecture 3 - Indexing of crystal planes

Lecture 4 - Simple crystal structures

Lecture 5 - Diffraction of waves by crystals

Lecture 6 - Fourier analysis of diffraction

Lecture 7 - Diffraction condition

Lecture 8 - Laue equations and Ewald construction

Lecture 9 - Introduction to Brillouin zone

Lecture 10 - Brillouin zones for bcc and fcc lattice

Lecture 11 - Fourier analysis of the basis and structure factor

Lecture 12 - Atomic form factor

Lecture 13 - Van der Waals attraction

Lecture 14 - Repulsive interaction

Lecture 15 - Equilibrium lattice constant and cohesive energy

Lecture 16 - Ionic crystals

Lecture 17 - Evaluation of the Madelungconstant

Lecture 18 - Covalent crystals: Linearcombination of atomic orbitals

Lecture 19 - Electron tunneling in covalentbonds

Lecture 20 - Metallic bonds

Lecture 21 - The Drude theory of metals

Lecture 22 - Hall effect and magnetoresistance

Lecture 23 - AC electrical conductivity

Lecture 24 - Thermal conductivity

Lecture 25 - Introduction to Sommerfeld theory - I

Lecture 26 - Introduction to Sommerfeld theory - II

Lecture 27 - Electronic states at finite temperature

Lecture 28 - Fermi-Dirac distribution

Lecture 29 - Thermal properties of the free electron gas

Lecture 30 - The Sommerfeld theory for conduction in metals

Lecture 31 - Thermal conductivity

Lecture 32 - One dimensional chain of atoms

Lecture 33 - One dimensional chain of atoms

Lecture 34 - Periodic boundary condition

Lecture 35 - Energy levels in periodic array of quantum wells

Lecture 36 - Tunneling of electrons

Lecture 37 - Reflection and transmission amplitudes and coefficients

Lecture 38 - Transfer matrix for a rectangular barrier

Lecture 39 - Electron tunneling through a periodic potential

Lecture 40 - The tight-binding approximation

Lecture 41 - Tridiagonal matrices and continued fraction

Lecture 42 - Plane-wave basis for nearly free electrons

Lecture 43 - Nearly free electron approximation

Lecture 44 - Dynamical aspects of electrons in band theory

Lecture 45 - Semiconductor crystals

Lecture 46 - Effective mass

Lecture 47 - Carrier concentration

Lecture 48 - Mobility, impurity conductivity, and Fermi surface

Lecture 49 - Vibration of crystals with monatomic basis

Lecture 50 - Analyzing the dispersion relation

Lecture 51 - Phonons with diatomic basis

Lecture 52 - Quantization of elastic waves

Lecture 53 - Phonon heat capacity

Lecture 54 - Phonon density of states

Lecture 55 - Introduction to diamagnetism

Lecture 56 - Issues with the classical theory of diamagnetism

Lecture 57 - Quantum theory of diamagnetism

Lecture 58 - The quantum theory of paramagnetism

Lecture 59 - Rare earth atoms, Hund's rule

Lecture 60 - Crystal field splitting

Lecture 61 - Quenching of orbital angular momentum

Lecture 62 - Paramagnetic susceptibility of conduction electrons

Lecture 63 - Ferromagnetism

Lecture 64 - Antiferromagnetism and ferrimagnetism

Lecture 65 - Introduction to superconductivity

Lecture 66 - Thermodynamics of superconducting transition,London equation

Lecture 67 - BCS theory of superconductivity

Lecture 68 - Flux quantization in a superconducting ring

Lecture 69 - Single particle tunneling and Josephson effect

Lecture 70 - AC Josephson effect and microscopic quantum interference

NPTEL : NOC:Introduction to Quantum Field Theory (Theory of Scalar Fields) (Physics)

Co-ordinators : Prof. Anurag Tripathi

Lecture 1 - Quantum Filed Theory

Lecture 2 - Quantizing Schrodinger Field

Lecture 3 - Quantizing Schrodinger Field (Continued...)

Lecture 4 - Symmetry and normalization of the states

Lecture 5 - A multiparticle system of Bosons

Lecture 6 - Klein-Gordon Equation

Lecture 7 - Quantization of Klein-Gordon Theory

Lecture 8 - Quantization of Klein-Gordon Theory (Continued...)

Lecture 9 - Quantization of Klein-Gordon Theory (Continued...)

Lecture 10 - Quantization of Klein-Gordon Theory (Continued...)

Lecture 11 - Quantization of Klein-Gordon Theory (Continued...)

Lecture 12 - Qunatization of Klein-Gordon Theory (Continued...)

Lecture 13 - Quantization of Klein-Gordon Theory (Continued...)

Lecture 14 - Feynman propagator - 2

Lecture 15 - Feynman propagator - 3

Lecture 16 - Symmetries

Lecture 17 - Lorentz transformations

Lecture 18 - Lorentz transformations (Continued...)

Lecture 19 - Lorentz Group

Lecture 20 - Groups and Generators

Lecture 21 - SU(3) Generators

Lecture 22 - Representation of groups. Poincare group

Lecture 23 - Poincare Algebra

Lecture 24 - Symmetries in Classical Field Theories

Lecture 25 - Symmetries (Continued...)

Lecture 26 - Symmetries (Continued...)

Lecture 27 - Symmetries (Continued...)

Lecture 28 - Noether's theorem: The Proof

Lecture 29 - Noether's theorem (Continued...)

Lecture 30 - Momentum in KG Theory

Lecture 31 - Noether Currents corresponding to Lorentz symmetry

Lecture 32 - Conserved currents and charges due to Lorentz symmetry

Lecture 33 - Conserved charges as symmetry generators

Lecture 34 - Consequences of symmetry

Lecture 35 - A boring world: Scattering in a free theory

Lecture 36 - Phi-4 Theory

Lecture 37 - Phi-4 Theory: Manipulating the ground state

Lecture 38 - Phi-4 Theory: Interaction picture - 1

Lecture 39 - Phi-4 Theory: Interaction picture - 2

Lecture 40 - Phi-4 Theory: Interaction picture (Continued...)

Lecture 41 - Phi-4 Theory: Interaction picture (Continued...)

Lecture 42 - Wick's Theorem

Lecture 43 - Wick's Theorem (Continued...)

Lecture 44 - Feynman Diagrams

Lecture 45 - Feynman Diagrams (Continued...)

Lecture 46 - Momentum space Feynman rules for G(x1,..xN)

Lecture 47 - Feynman rules for G(p1,p2,,,,pN)

Lecture 48 - Feynman rules for G(p1,p2,,,,pN) (Continued...)

Lecture 49 - Cancellation of Bubble diagrams

Lecture 50 - Examples of Feynman Diagrams

Lecture 51 - Survery

NPTEL : NOC:Introduction to Quantum Field Theory (Theory of Scalar Fields) - Part 2 (Physics)

Co-ordinators : Prof. Anurag Tripathi

Lecture 1 - Scattering Matrix

Lecture 2 - Scattering Matrix (Continued...)

Lecture 3 - Scattering Matrix (Continued...)

Lecture 4 - Creating single particle states - 1

Lecture 5 - Creating single particle states - 2

Lecture 6 - Annihilating single particle states

Lecture 7 - Creating Multiparticle States

Lecture 8 - LSZ reduction

Lecture 9 - LSZ reduction (Continued...)

Lecture 10 - S matrix

Lecture 11 - S matrix (Continued...)

Lecture 12 - S matrix (Continued...)

Lecture 13 - Pole and residue of the propagator

Lecture 14 - Kallen-Lehmann spectral representation

Lecture 15 - Kallen-Lehmann spectral representation (Continued...)

Lecture 16 - High Energy Experiment Setup - 1

Lecture 17 - High Energy Experiment Setup - 2

Lecture 18 - Scattering cross-section

Lecture 19 - Differential cross-section

Lecture 20 - 2-2 scattering cross-section

Lecture 21 - Loop diagrams - 1

Lecture 22 - Wick rotated Green's functions

Lecture 23 - UV divergences - Part 1

Lecture 24 - UV divergences - Part 2

Lecture 25 - UV divergences - Part 3

Lecture 26 - Explicit evalutation of Feynman integrals

Lecture 27 - Few more Feynman integrals

Lecture 28 - UV Singularity structure in dimensional regularization

Lecture 29 - Renormalization - Part 1

Lecture 30 - Renormalization - Part 2

Lecture 31 - Renormalization - Part 3

Lecture 32 - Renormalization - Part 4

Lecture 33 - Renormalization - Part 5

Lecture 34 - Renormalization Group Equation - 1

Lecture 35 - Renormalization Group Equation - 2

Lecture 36 - Renormalization Group Equation - 3

Lecture 37 - Solution of Callan Symanzik Equation

Lecture 38 - UV and IR fixed points and Asymptotic Freedom

Lecture 39 - Behaviour near fixed point

NPTEL : NOC:Radio Astronomy (Physics)

Co-ordinators : Prof. Abhirup Datta

Lecture 1 - Introduction to Radio Astronomy

Lecture 2 - Review of Electromagnetism - Part 1

Lecture 3 - Review of Electromagnetism - Part 2

Lecture 4 - Radio Astronomy - Tutorial 1

Lecture 5 - Milestones in Radio Astronomy

Lecture 6 - Radio Astronomy Fundamentals - Part 1

Lecture 7 - Radio Astronomy Fundamentals - Part 2

Lecture 8 - Radiative Transfer - Tutorial 1

Lecture 9 - Fundamentals of Antenna

Lecture 10 - Fundamental of Antenna Theory - Part 1

Lecture 11 - Fundamental of Antenna Theory - Part 2

Lecture 12 - Fundamental of Antenna Theory - Part 3

Lecture 13 - Signal Processing and Receivers

Lecture 14 - Signal Proceeding and Receivers - Part 2

Lecture 15 - Radio Telescopes

Lecture 16 - Single Dish Observations

Lecture 17 - Demonstration of Antenna Design and Simulation - Part 1

Lecture 18 - Demonstration Of Antenna Design and Simulation - Part 2

Lecture 19 - What Have we Learnt so Far? - A Review

Lecture 20 - Demonstration of Antenna Design and Simulation - Part 3

Lecture 21 - Co-ordinate System

Lecture 22 - Radio Interferometers

Lecture 23 - Example Questions

Lecture 24 - Python Crash Course

Lecture 25 - Few Concepts with the help of python as a computational tool

Lecture 26 - Live session

Lecture 27 - Example Questions

Lecture 28 - Radio Interferometry and Aperture Synthesis

Lecture 29 - Introduction to CASA

Lecture 30 - Examples

Lecture 31

Lecture 32

Lecture 33 - Revision

Lecture 34 - Revision

NPTEL : NOC:Foundations of Quantum Theory: Non-Relativistic Approach (Physics)

Co-ordinators : Prof. Sandeep Kumar Goyal, Prof. Kinjalk Lochan

Lecture 1 - Axiomatic Approach to Quantum Mechanics - Part 1

Lecture 2 - Axiomatic Approach to Quantum Mechanics - Part 2

Lecture 3 - Linear Vector Space

Lecture 4 - Linear Operators - Part 1

Lecture 5 - Linear Operators - Part 2

Lecture 6 - Qubits: Introduction

Lecture 7 - Qubits: State Tomography

Lecture 8 - Qubits: Density Operators - Part 1

Lecture 9 - Qubits: Density Operators - Part 2

Lecture 10 - Qubits: Unitary Transformation

Lecture 11 - Qubits: Bloch Sphere

Lecture 12 - Composite Systems: Pure States, Schmidt Decomposition, Operators Acting on Composite Systems - Part 1

Lecture 13 - Composite Systems: Pure States, Schmidt Decomposition, Operators Acting on Composite Systems - Part 2

Lecture 14 - Composite Systems: Density Operators

Lecture 15 - Quantum Maps: Positive Maps

Lecture 16 - Quantum Maps: Completely Positive Maps - Part 1

Lecture 17 - Quantum Maps: Completely Positive Maps - Part 2

Lecture 18 - Measurements: Introduction

Lecture 19 - Measurements: POVM

Lecture 20 - Measurements: Optical Scheme for POVM

Lecture 21 - Measurements: State Discrimination

Lecture 22 - Measurements: Weak Measurements

Lecture 23 - Entanglement: Introduction

Lecture 24 - Entanglement Measures

Lecture 25 - EPR Paradox and Bohrâ€™s Argument, Bohmâ€™s Argument and Merminâ€™s Argument - Part 1

Lecture 26 - EPR Paradox and Bohrâ€™s Argument, Bohmâ€™s Argument and Merminâ€™s Argument - Part 2

Lecture 27 - Hidden Variable Theory, Bell model, Bell Inequality, Bell CHSH Inequality

Lecture 28 - Open Quantum Systems: Introduction - Part 1

Lecture 29 - Open Quantum Systems: Introduction - Part 2

Lecture 30 - Open Quantum Systems: Introduction - Part 3

Lecture 31 - Open Quantum Systems: Optical Master Equation, Thermalization

Lecture 32 - Open Quantum Systems: Solving Master Equaitons

Lecture 33 - Open Quantum Systems: Quantum Trajectory Aproach

Lecture 34 - Open Quanutm Systems: Decoherence

NPTEL : NOC:Foundations of Quantum Theory: Relativistic Approach (Physics)

Co-ordinators : Prof. Kinjalk Lochan

Lecture 1 - Perturbation theory 1.1

Lecture 2 - Perturbation theory 1.2

Lecture 3 - Perturbation theory 1.3

Lecture 4 - Perturbation theory 1.4

Lecture 5 - Time dependent perturbation theory 1.1

Lecture 6 - Time dependent perturbation theory 1.2

Lecture 7 - Time dependent perturbation theory 1.3

Lecture 8 - Special Relativity 1.1

Lecture 9 - Special Relativity 1.2

Lecture 10 - Special Relativity 1.3

Lecture 11 - Relativistic Quantum Mechanics 1.1

Lecture 12 - Relativistic Quantum Mechanics 1.2

Lecture 13 - Relativistic Quantum Mechanics 1.3

Lecture 14 - Relativistic Quantum Mechanics 1.4

Lecture 15 - Quantum Field Theory 1.1

Lecture 16 - Quantum Field Theory 1.2

Lecture 17 - Quantum Field Theory 1.3

Lecture 18 - Quantum Field Theory 1.4

Lecture 19 - Quantum Field Theory 2.1

Lecture 20 - Quantum Field Theory 2.2

Lecture 21 - Quantum Field Theory 2.3

Lecture 22 - Spinor Field quantization 1.1

Lecture 23 - Spinor Field quantization 1.2

Lecture 24 - Spinor Field quantization 1.3

Lecture 25 - Spinor Field quantization 1.4

Lecture 26 - Electromagnetic Field Quantization 1.1

Lecture 27 - Electromagnetic Field Quantization 1.2

Lecture 28 - Electromagnetic Field Quantization 1.3

Lecture 29 - Quantum Fields expectation

Lecture 30 - Quantum Field Coherent State

Lecture 31 - Thermal Fields 1.1

Lecture 32 - Thermal Fields 1.2

Lecture 33 - Matter-Field interaction 1.1

Lecture 34 - Matter-Field interaction 1.2

Lecture 35 - Matter-Field interaction 1.3

Lecture 36 - Atom-Field Coupling

Lecture 37 - Excitation of atom through field interaction

Lecture 38 - Spontaneous and Stimulated emission

Lecture 39 - Lindblad Master Equation

Lecture 40 - Relativistic corrections in transitions

Lecture 41 - Change in atomic characteriscs via field interaction

Lecture 42 - Shift in eigen energies via field interaction

NPTEL : NOC:Fiber Optics (Physics)

Co-ordinators : Prof. Vipul Rastogi

Lecture 1 - Introduction

Lecture 2 - Need for Optical Communication

Lecture 3 - Salient Features of Optical Fiber - I

Lecture 4 - Salient Features of Optical Fiber - II

Lecture 5 - Optical Fiber Fabrication

Lecture 6 - Transmission Characteristics - I

Lecture 7 - Transmission Characteristics - II

Lecture 8 - Transmission Characteristics - III

Lecture 9 - Propagation in Infinitely Extended Dielectric

Lecture 10 - EM Waves in Dielectrics

Lecture 11 - Electromagnetic Analysis of Waveguides - I

Lecture 12 - Electromagnetic Analysis of Waveguides - II

Lecture 13 - Electromagnetic Analysis of Waveguides - III

Lecture 14 - Electromagnetic Analysis of Waveguides - IV

Lecture 15 - Electromagnetic Analysis of Waveguides - V

Lecture 16 - Electromagnetic Analysis of Waveguides - VI

Lecture 17 - Electromagnetic Analysis of Waveguides - VII

Lecture 18 - Electromagnetic Analysis of Waveguides - VIII

Lecture 19 - Optical Fiber Waveguide - I

Lecture 20 - Optical Fiber Waveguide - II

Lecture 21 - Optical Fiber Waveguide - III

Lecture 22 - Optical Fiber Waveguide - IV

Lecture 23 - Optical Fiber Waveguide - V

Lecture 24 - Splice Loss

Lecture 25 - Waveguide Dispersion - I

Lecture 26 - Waveguide Dispersion - II

Lecture 27 - Recap: Propagation Characteristics

Lecture 28 - Optical Fiber Components and Devices - I

Lecture 29 - Optical Fiber Components and Devices - II

Lecture 30 - Optical Fiber Components and Devices - III

Lecture 31 - Optical Fiber Components and Devices - IV

Lecture 32 - Optical Fiber Components and Devices - V

Lecture 33 - Optical Sources and Detectors - I

Lecture 34 - Optical Sources and Detectors - II

Lecture 35 - Optical Sources and Detectors - III

Lecture 36 - Optical Sources and Detectors - IV

Lecture 37 - Optical Sources and Detectors - V

Lecture 38 - System Design Aspects

Lecture 39 - Optical Fiber Measurements

Lecture 40 - Summary and Recent Advances

NPTEL : NOC:Solar Photovoltaics Fundamentals, Technology and Applications (Physics)

Co-ordinators : Prof. Soumitra SataPathi

Lecture 1 - Energy and its Sources

Lecture 2 - Introduction to Solar Energy

Lecture 3 - Introduction of Quantum Mechanics in Solar Photovoltaics - I

Lecture 4 - Introduction of Quantum Mechanics in Solar Photovoltaics - II

Lecture 5 - Introduction of Quantum Mechanics in Solar Photovoltaics - III

Lecture 6 - Band Theory

Lecture 7 - Energy Band Diagram

Lecture 8 - Charge Carrier Dynamics in Semiconductor

Lecture 9 - P-N junction model and Diode working principle

Lecture 10 - Current-Voltage Characteristics of Solar Cell

Lecture 11 - Equivalent Circuits of Solar Cells, Fill Factor

Lecture 12 - Fabrication Process of Semiconductor Grade Silicon

Lecture 13 - Fabrication Process of Single crystalline Silicon

Lecture 14 - Thin Film deposition Techniques

Lecture 15 - Thin Film Solar Cells: Amorphous Silicon

Lecture 16 - Photo Physics of Dye Sensitized Solar Cells

Lecture 17 - Fabrication of Dye Sensitized Solar Cells

Lecture 18 - Design of Novel dyes

Lecture 19 - Design of Electrolytes

Lecture 20 - Quantum Dot Solar Cells

Lecture 21 - Fabrication of Organic Solar Cells

Lecture 22 - Physics of Bulk Hetero Junction (BHJ) Solar Cells

Lecture 23 - Photo Physics of Organic Solar Cells

Lecture 24 - Morphology Optimization of Organic Solar Cells

Lecture 25 - Perovskite Solar Cells

Lecture 26 - Fabrication of Perovskite Solar Cells

Lecture 27 - Photo Physics of Perovskite Solar Cells

Lecture 28 - Stability in Perovskite Solar Cells

Lecture 29 - Morphology Optimization of Perovskite Solar Cells

Lecture 30 - Perovskite Single Crystal Solar Cells

Lecture 31 - Photophysics in Perovskite Single Crystal Solar Cells

Lecture 32 - Applicationss of Perovskite Single Crystal Solar Cells

Lecture 33 - Organic Nano Particles Based Solar Cells

Lecture 34 - Morphology Optimization in Organic Nanoparticle Based Solar Cells

Lecture 35 - Multijunction Tandem Solar Cells

Lecture 36 - Introduction to Characterization Techniques

Lecture 37 - Vacuum Technology in Solar Photovoltaics

Lecture 38 - Introduction of Pressure Gauges

Lecture 39 - Electron Microscopy in Solar Photovoltaics

Lecture 40 - Impedance Spectroscopy

NPTEL : NOC:Introduction to Atmospheric and Space Sciences (Physics)

Co-ordinators : Prof. M V Sunil Krishna

Lecture 1 - An Introduction to the Earth's Atmosphere and Source of Energy - The Sun

Lecture 2 - Primary Source of Energy on the Earth - The Sun

Lecture 3 - Evolution of the Earth's Atmosphere

Lecture 4 - Earth's Second Atmosphere and Rise of Oxygen

Lecture 5 - Atmosphere of Other Planets in Solar System

Lecture 6 - Structure of Earth's Atmosphere

Lecture 7 - Vertical Structure of Atmosphere

Lecture 8 - Characterization of Atmosphere Based on Electrical Properties

Lecture 9 - Coupling of Solar Radiation with the Earth's Atmosphere

Lecture 10 - Forces and Their Classifications

Lecture 11 - Forces - Gravitational Force

Lecture 12 - Forces - Viscous Force

Lecture 13 - Forces - Coriolis Force

Lecture 14 - Coriolis Force and Curvature Effect

Lecture 15 - Hydrostatic Equation

Lecture 16 - Hypsometric Equation

Lecture 17 - Atmospheric Thermodynamics

Lecture 18 - Thermodynamics - Dry Air

Lecture 19 - Thermodynamics - Moist Air

Lecture 20 - Geopotential and Scale Height

Lecture 21 - Specific Heats

Lecture 22 - Air Parcel and Potential Temperature

Lecture 23 - Moisture Parameters

Lecture 24 - Saturation Mixing Ratio and Relative Humidity

Lecture 25 - Pseudo-Adiabatic Processes

Lecture 26 - Convection of Air

Lecture 27 - Atmospheric Stability and Cloud Formation

Lecture 28 - Cloud Formation

Lecture 29 - Cloud Formation and Lifting

Lecture 30 - Cloud Morphology

Lecture 31 - Secondary Cloud Classification and Fog

Lecture 32 - Atmospheric Stability

Lecture 33 - Atmospheric Stability Conditions

Lecture 34 - Stable Unstable and Neutral Atmosphere

Lecture 35 - Cloud Seeding and Precipitation

Lecture 36 - Measuring Precipitation

Lecture 37 - Droplet Growth and Curvature Effect

Lecture 38 - Droplet Growth and Solute Effect

Lecture 39 - Radial Growth of Droplets by Diffusion

Lecture 40 - Radial Growth of Droplets by Diffusion (Continued...)

Lecture 41 - Ionospheric Layers and Photochemistry

Lecture 42 - Ionization Processes

Lecture 43 - Ionospheric Chemical Reactions and Layers

Lecture 44 - Chapman's Theory of Layer Production

Lecture 45 - Chapman's Theory of Layer Production (Continued...)

Lecture 46 - Chapman's Alpha Layer

Lecture 47 - Hydrogen in Ionosphere

Lecture 48 - Debye's Shielding

Lecture 49 - Debye's Shielding and Debye's Potential

Lecture 50 - Debye's Potential (Continued...)

Lecture 51 - Particle Motion in Uniform Electric Field

Lecture 52 - Particle Motion in Uniform Magnetic Field

Lecture 53 - Particle Motion in Uniform Magnetic Field and Guiding Center

Lecture 54 - Particle Motion in Uniform Electric and Magnetic Fields

Lecture 55 - Gradient Magnetic Field

Lecture 56 - Gradient Drift and Curvature Drift

Lecture 57 - Vacuum Drift and Planetary Ring Current

Lecture 58 - Magnetic Mirroring

Lecture 59 - Magnetic Mirroring and Loss Cone

Lecture 60 - Airglow and Aurora

NPTEL : NOC:Optical Sensors (Physics)

Co-ordinators : Prof. Sachin Kumar Srivastava

Lecture 1 - Introduction

Lecture 2 - Sensor Fabrication and Characterization

Lecture 3 - Basic Optics for Optical Sensing - I

Lecture 4 - Basic Optics for Optical Sensing - II

Lecture 5 - Basic Optics for Optical Sensing - III

Lecture 6 - Basic Optics for Optical Sensing - IV

Lecture 7 - Basic Optics for Optical Sensing - V

Lecture 8 - Basic Optics for Optical Sensing - VI

Lecture 9 - Basic Optics for Optical Sensing - VII

Lecture 10 - Plasmons - I

Lecture 11 - Plasmons - II

Lecture 12 - Plasmons - III

Lecture 13 - Plasmons - IV

Lecture 14 - Plasmons - V

Lecture 15 - Plasmons - VI

Lecture 16 - Multiple Optical Sensors of Different Mechanisms

Lecture 17 - Interference based Sensors

Lecture 18 - Interference, Diffraction and Optical Fiber Sensors

Lecture 19 - Review of Biomaterial Optics

Lecture 20 - Terahertz Based Detection and Circular Dichroism

NPTEL : NOC:Advanced Atmospheric Physics (Physics)

Co-ordinators : Prof. M V Sunil Krishna

Lecture 1 - Atmospheric Forces and Dynamics - Part 1

Lecture 2 - Atmospheric Forces and Dynamics - Part 2

Lecture 3 - Total Derivative (Introduction)

Lecture 4 - Total Derivative of a Vector in a Rotating Frame of Reference

Lecture 5 - Momentum Equations and its Vectorial Form in Spherical Polar Coordinates - Part 1

Lecture 6 - Momentum Equations and its Vectorial Form in Spherical Polar Coordinates - Part 2

Lecture 7 - Momentum Equations and its Vectorial Form in Spherical Polar Coordinates - Part 3

Lecture 8 - Total Derivative and Lagrangian

Lecture 9 - Continuity Equation: Eulerian

Lecture 10 - Energy Equations - Part 1

Lecture 11 - Energy Equations - Part 2

Lecture 12 - Scaling analysis - Part 1

Lecture 13 - Scaling analysis - Part 2

Lecture 14 - Scaling Analysis of Governing Equations - Part 1

Lecture 15 - Scaling Analysis of Governing Equations - Part 2

Lecture 16 - Scaling Analysis - Part 3, A Tutorial

Lecture 17 - Scaling Analysis - Part 4, A Tutorial

Lecture 18 - Introduction of Atmospheric Waves - Part 1

Lecture 19 - Introduction of Atmospheric Waves - Part 2

Lecture 20 - Problems based on Total Derivative - Part 1

Lecture 21 - Problems based on Total Derivative - Part 2

Lecture 22 - Shallow Water Gravity Waves - Part 1

Lecture 23 - Shallow Water Gravity Waves - Part 2

Lecture 24 - Acoustic Waves

Lecture 25 - Internal Gravity Waves - Part 1

Lecture 26 - Internal Gravity Waves - Part 2

Lecture 27 - Internal Gravity Waves - Part 3

Lecture 28 - Pressure as a vertical coordinate - Part 1

Lecture 29 - Pressure as a vertical coordinate - Part 2

Lecture 30 - Pressure as a vertical coordinate - Part 3

Lecture 31 - General circulation and global winds

Lecture 32 - Introduction to different types of Fronts

Lecture 33 - Geostrophic winds

Lecture 34 - Natural coordinate and Inertial flows

Lecture 35 - Cyclostrophic winds and Rossby number

Lecture 36 - Gradient winds

Lecture 37 - Thermal winds

Lecture 38 - Problems on thermal winds

Lecture 39 - Ionosphere introduction (Basics)- Part 1

Lecture 40 - Ionosphere introduction (Different layers) - Part 2

Lecture 41 - Ionosphere introduction (Photochemistry) - Part 3

Lecture 42 - Ionosphere introduction (Recombination) - Part 4

Lecture 43 - Composite F layer - Part 1

Lecture 44 - Composite F layer - Part 2

Lecture 45 - Composite F layer H/He ions - Part 3

Lecture 46 - The Sun - Earth Energetics and Aurora

Lecture 47 - Airglows and Aurora

Lecture 48 - Sun's magnetic field, Formation of Aurora, and Solar cycle

Lecture 49 - Sun's internal structure, Prominences

Lecture 50 - Solar wind - Magnetosphere interactions

Lecture 51 - Solar wind interactions with different planets

Lecture 52 - Solar wind properties and its interaction with different planets

Lecture 53 - Static Model of Corona

Lecture 54 - Parker's Theory of Solar Wind Acceleration - Part 1

Lecture 55 - Parker's Theory of Solar Wind Acceleration - Part 2

Lecture 56 - Parker's Theory of Solar Wind Acceleration - Part 3

Lecture 57 - Parker's Theory of Solar Wind Acceleration - Part 4

Lecture 58 - Introduction to Space Weather - Part 1

Lecture 59 - Introduction to Space Weather - Part 2

Lecture 60 - Introduction to Space Weather - Part 3

NPTEL : NOC:Nuclear Astrophysics (Physics)

Co-ordinators : Prof. Anil Kumar Gourishetty

Lecture 1 - Historical Background, Observational Astronomy, Properties of Sun and of Stars

Lecture 2 - Properties of Galaxies and Universe

Lecture 3 - Background of elemental abundance curve

Lecture 4 - Evidences of Nucleosynthesis - I

Lecture 5 - Evidences of Nucleosynthesis - II

Lecture 6 - Evidences of Nucleosynthesis - III and Mass gaps

Lecture 7 - H-R Diagram

Lecture 8 - M-L relation, Hubbleâ€™s Law and Echo of Big Bang

Lecture 9 - Thermonuclear reactions and Reaction cross-section

Lecture 10 - Reaction rate

Lecture 11 - Reaction rate and Neutron induced reactions

Lecture 12 - Gamma induced reactions and Inverse reactions

Lecture 13 - Inverse reactions

Lecture 14 - Inverse reactions and Mean life time of a nuclei

Lecture 15 - Mean life time of a nuclei and Time dependent abundance evolution

Lecture 16 - Non-resonant charged particle induced reactions

Lecture 17 - Astrophysical S-factor and Non-resonant charged particle induced reactions

Lecture 18 - Gamow peak and Electron screening effect

Lecture 19 - Resonant reactions

Lecture 20 - Resonant reactions

Lecture 21 - Neutron induced non-resonant reactions

Lecture 22 - Burning stages of stars and Hydrogen burning

Lecture 23 - pp chain

Lecture 24 - pp chain and CN cycle

Lecture 25 - CNO cycle, Shell model and Gamma decay

Lecture 26 - Formation of 12C

Lecture 27 - Survival of 12C

Lecture 28 - Carbon, Neon, Oxygen and Silicon burning

Lecture 29 - Nucleosynthesis beyond Iron

Lecture 30 - s-, r- and p-process

Lecture 31 - Charged particle and Neutron beams

Lecture 32 - Accelerators and Targets

Lecture 33 - Backing materials and Target preparation

Lecture 34 - Contaminants and Radiation sources

Lecture 35 - Detectors - I

Lecture 36 - Detectors - II

Lecture 37 - Activity method

Lecture 38 - Kinematics - I

Lecture 39 - Kinematics - II

Lecture 40 - Time of flight method and Indirect methods

NPTEL : NOC:Applied Optics (Physics)

Co-ordinators : Prof. Akhilesh Kumar Mishra

Lecture 1 - Course Overview

Lecture 2 - Introduction to Geometrical Optics

Lecture 3 - Ray Theory, Fermat's Principle

Lecture 4 - Refraction from Single Interface

Lecture 5 - Refraction from double interface

Lecture 6 - Matrix method in paraxial optics - I

Lecture 7 - Matrix Method in Paraxial Optics - II

Lecture 8 - Thick and Thin Lenses, Unit Planes

Lecture 9 - Nodal Planes, System of Thin Lenses

Lecture 10 - Problems on Geometrical Optics

Lecture 11 - Concept of Wavefront, Huygens Principle - I

Lecture 12 - Concept of Wavefront, Huygens Principle - II

Lecture 13 - Superposition of Waves

Lecture 14 - Introduction to Polarization, Linear and Circular Polarization

Lecture 15 - Elliptical Polarization

Lecture 16 - Interference of Light Waves, Interference of Polarized Light - I

Lecture 17 - Interference of Light Waves, Interference of Polarized Light - II

Lecture 18 - Young's Double Slit Experiment - I

Lecture 19 - Young's Double Slit Experiment - II

Lecture 20 - Interference with White Light, Displacement of Fringes, Fresnel's Biprism

Lecture 21 - Interference by Division of Amplitude

Lecture 22 - Thin Parallel Films, Wedge Shaped Films

Lecture 23 - Newton's Rings

Lecture 24 - Michelson Interferometer and Its Applications - I

Lecture 25 - Michelson Interferometer and Its Applications - II

Lecture 26 - Multiple Beam Interference

Lecture 27 - Fabry-Perot Interferometer and Etalon - I

Lecture 28 - Fabry-Perot Interferometer and Etalon - II

Lecture 29 - Concept of Coherence - I

Lecture 30 - Concept of Coherence - II

Lecture 31 - Introduction to Diffraction

Lecture 32 - Fraunhofer Diffraction

Lecture 33 - Single Slit Diffraction

Lecture 34 - Double Slit Diffraction

Lecture 35 - Multiple Slit Diffraction

Lecture 36 - Diffraction at a Rectangular Aperture

Lecture 37 - Diffraction at a Circular Aperture

Lecture 38 - Diffraction Grating

Lecture 39 - Grating Spectrum and Resolving Power

Lecture 40 - Fresnel Diffraction

Lecture 41 - Fresnel Half Period Zones

Lecture 42 - Vibration Curve

Lecture 43 - Circular Obstacle, Zone Plates

Lecture 44 - Rectangular Aperture

Lecture 45 - Diffraction of a Plane Wave by a Long Narrow Slit

Lecture 46 - Brewster's Law, Malus' Law

Lecture 47 - Phenomenon of Double Refraction

Lecture 48 - Normal and Oblique Incidence

Lecture 49 - Production of Polarized Light

Lecture 50 - Quarter and Half Wave Plates

Lecture 51 - Analysis of Polarized Light and Optical Activity

Lecture 52 - Plane Wave Propagation in Anisotropic Media - I

Lecture 53 - Plane Wave Propagation in Anisotropic Media - II

Lecture 54 - Antireflecting Coating

Lecture 55 - Basic Concepts of Holography - I

Lecture 56 - Basic Concepts of Holography - II

Lecture 57 - Basic Concepts and Ray Optics Consideration of Optical Fiber

Lecture 58 - Introduction to Lasers - I

Lecture 59 - Introduction to Lasers - II

Lecture 60 - Trifle

NPTEL : NOC:Newtonian Mechanics With Examples (Physics)

Co-ordinators : Prof. Shiladitya Sengupta

Lecture 1 - Scalars vectors, and tensors - basic definitions

Lecture 2 - Scalars, vectors and tensors - most general definition

Lecture 3 - Elementary vector algebra - I (unit vector, dot product)

Lecture 4 - Elementary vector algebra - II (cross product, triple product)

Lecture 5 - Review of Newtonâ€™s laws of motion - tools for analysis

Lecture 6 - Newtonâ€™s laws of motion - third and second law

Lecture 7 - Newtonâ€™s laws of motion - first law

Lecture 8 - Solving mechanics problems - how to draw free body diagram correctly

Lecture 9 - Mechanical equilibrium (statics) using force and torque balance

Lecture 10 - Mechanical equilibrium (statics) using force and torque balance - more examples

Lecture 11 - Mechanical equilibrium of rope like structures, nature of tension force

Lecture 12 - Massless, flexible suspension cable in mechanical equilibrium

Lecture 13 - Massive flexible suspension cable in mechanical equilibrium

Lecture 14 - Mechanical equilibrium of truss (framework) - nature of internal forces

Lecture 15 - Mechanical equilibrium of truss (framework) - examples

Lecture 16 - Mechanical equilibrium of truss - uniqueness of solution, beam with distributed load

Lecture 17 - Mechanical equilibrium of truss - more on beam with distributed load

Lecture 18 - Mechanical equilibrium - more examples, principle of virtual work, constrained motion

Lecture 19 - Mechanical equilibrium: constraints, degrees of freedom, work done by constrained force

Lecture 20 - d'Alembert - Lagrange principle of virtual work - statement and examples

Lecture 21 - Equivalence of principles of force, torque balance and virtual work, stability analysis

Lecture 22 - Mechanical equilibrium: stability analysis, energy diagram technique

Lecture 23 - Friction between solids - Amonton-Coulomb laws, common misconceptions

Lecture 24 - Friction between solids - worked out examples

Lecture 25 - Friction between solid and fluid - drag force

Lecture 26 - Friction examples - projectile motion with drag force, tying a rope

Lecture 27 - Work-energy theorem in one dimension, importance of conservation laws

Lecture 28 - Work-energy theorem in higher dimensions, conservative forces

Lecture 29 - Momentum balance principle, critical review: projectile motion in real-life

Lecture 30 - Projectile motion - effect of lift and thrust force by examples

Lecture 31 - More on rocket motion - comparing effect of thrust in deep space and at lift off

Lecture 32 - Collisions in daily life - application of energy and momentum balance principles

Lecture 33 - Collision at micro-meter, atomic and sub-atomic scales - Brownian motion, Compton effect

Lecture 34 - Concepts necessary for translation and rotation of rigid bodies - centre of mass

Lecture 35 - Centre of mass of composite objects

Lecture 36 - Concepts necessary for translation and rotation of rigid bodies - moment of inertia

Lecture 37 - More on moment of inertia - 3D objects, composite objects, engineering applications

Lecture 38 - Symmetry of mass distribution - product of inertia

Lecture 39 - Determining the principal axes of rotation and moment of inertia about them

Lecture 40 - Example of finding principal axes, introduction to rotation, the angular velocity vector

Lecture 41 - Rotation of rigid bodies - the angular momentum vector

Lecture 42 - Rotation of rigid bodies - torque

Lecture 43 - Translation and rotation of rigid bodies - computing rules

Lecture 44 - Translation and rotation of rigid bodies - examples (rolling, collision with rotation)

NPTEL : NOC:Plasma Physics and Applications (Physics)

Co-ordinators : Prof. M.V. Sunil Krishna

Lecture 1 - Introduction to Plasma - I

Lecture 2 - Introduction to Plasma - II

Lecture 3 - Plasma Oscillations

Lecture 4 - Debye Shielding

Lecture 5 - Debye Potential - I

Lecture 6 - Debye Potential - II

Lecture 7 - Debye Length and Plasma Criteria

Lecture 8 - More Aspects of Debye Shielding

Lecture 9 - Numerical Problems on Debye Shielding - I

Lecture 10 - Plasma as a Gas and Distribution of Velocities

Lecture 11 - Numerical Problems on Debye Shielding - II

Lecture 12 - Single-Particle Motion in Uniform Electric Field

Lecture 13 - Single-Particle Motion in Uniform Magnetic Field - I

Lecture 14 - Single-Particle Motion in Uniform Magnetic Field - II

Lecture 15 - Single-Particle Motion in Uniform Magnetic Field - III

Lecture 16 - Single-Particle Motion Under Uniform Magnetic field - IV

Lecture 17 - Motion in Perpendicular Electric and Magnetic fields - I

Lecture 18 - Motion in Perpendicular Electric and Magnetic fields - II

Lecture 19 - Gradient Drift

Lecture 20 - Gradient and Curvature Drifts

Lecture 21 - Vacuum Drift

Lecture 22 - Numerical Problems on Drifts

Lecture 23 - Magnetic Mirroring - I

Lecture 24 - Magnetic Mirroring - II

Lecture 25 - Magnetic Mirroring - III

Lecture 26 - Magnetic Mirroring - IV

Lecture 27 - Motion in Time Varying Magnetic Field - I

Lecture 28 - Motion in Time Varying Magnetic Field - II

Lecture 29 - Motion in Time Varying Electric field - I

Lecture 30 - Motion in Time Varying Electric field - II

Lecture 31 - Plasma as a Fluid: Equation of Continuity

Lecture 32 - Plasma as a Fluid: Fluid Equation - I

Lecture 33 - Plasma as a Fluid: Fluid Equation - II

Lecture 34 - Plasma as a fluid: Governing Equations

Lecture 35 - MHD Approximation - I

Lecture 36 - MHD Approximation - II

Lecture 37 - Plasma as a fluid: Electric and Magnetic Properties - I

Lecture 38 - Plasma as a fluid: Electric and Magnetic Properties - II

Lecture 39 - Plasma as a fluid: Fluid Drift - I

Lecture 40 - Plasma as a fluid: Fluid Drift - II

Lecture 41 - Magnetic Pressure

Lecture 42 - Wave in Plasma: Perturbation Theory

Lecture 43 - Wave in Plasma: Plasma Oscillation

Lecture 44 - Wave in Plasma: Dispersion Relation

Lecture 45 - Ion Acoustic Wave - I

Lecture 46 - Ion Acoustic Wave - II

Lecture 47 - Ion Acoustic Wave - III

Lecture 48 - Invalidity of Plasma Approximation - I

Lecture 49 - Invalidity of Plasma Approximation - II

Lecture 50 - Electromagnetic Waves in Plasma

Lecture 51 - Collisions and Diffusion in Plasma - I

Lecture 52 - Collisions and Diffusion in Plasma - II

Lecture 53 - Ambipolar Diffusion - I

Lecture 54 - Ambipolar Diffusion - II

Lecture 55 - Diffusion Equation

Lecture 56 - Diffusion in Presence of B - I

Lecture 57 - Diffusion in Presence of B - II

Lecture 58 - Instabilities in Plasma

Lecture 59 - Laser Produced Plasma and Pulsed Laser Deposited (PLD) Thin Film - I

Lecture 60 - Laser Produced Plasma and Pulsed Laser Deposited (PLD) Thin Film - II

Lecture 61 - Surface Modification of Metallic Components by Plasma Nitriding - I

Lecture 62 - Surface Modification of Metallic Components by Plasma Nitriding - II

NPTEL : Relativistic Quantum Mechanics (Physics)

Co-ordinators : Prof. Apoorva D Patel

Lecture 1 - Introduction, The Klein-Gordon equation

Lecture 2 - Particles and antiparticles, Two component framework

Lecture 3 - Coupling to electromagnetism, Solution of the Coulomb problem

Lecture 4 - Bohr-Sommerfeld semiclassical solution of the Coulomb problem, The Dirac equation and the Clifford algebra

Lecture 5 - Dirac matrices, Covariant form of the Dirac equation, Equations of motion, Spin, Free particle solutions

Lecture 6 - Electromagnetic interactions, Gyromagnetic ratio

Lecture 7 - The Hydrogen atom problem, Symmetries, Parity, Separation of variables

Lecture 8 - The Frobenius method solution, Energy levels and wavefunctions

Lecture 9 - Non-relativistic reduction, The Foldy-Wouthuysen transformation

Lecture 10 - Interpretation of relativistic corrections, Reflection from a potential barrier

Lecture 11 - The Klein paradox, Pair creation process and examples

Lecture 12 - Zitterbewegung, Hole theory and antiparticles

Lecture 13 - Charge conjugation symmetry, Chirality, Projection operators, The Weyl equation

Lecture 14 - Weyl and Majorana representations of the Dirac equation, Unitary and antiunitary symmetries

Lecture 15 - Time reversal symmetry, The PCT invariance

Lecture 16 - Arrow of time and particle-antiparticle asymmetry, Band theory for graphene

Lecture 17 - Dirac equation structure of low energy graphene states, Relativistic signatures in graphene properties

Lecture 18 - Groups and symmetries, The Lorentz and Poincare groups

Lecture 19 - Group representations, generators and algebra, Translations, rotations and boosts

Lecture 20 - The spinor representation of SL(2,C), The spin-statistics theorem

Lecture 21 - Finite dimensional representations of the Lorentz group, Euclidean and Galilean groups

Lecture 22 - Classification of one particle states, The little group, Mass, spin and helicity

Lecture 23 - Massive and massless one particle states

Lecture 24 - P and T transformations, Lorentz covariance of spinors

Lecture 25 - Lorentz group classification of Dirac operators, Orthogonality and completeness of Dirac spinors, Projection operators

Lecture 26 - Propagator theory, Non-relativistic case and causality

Lecture 27 - Relativistic case, Particle and antiparticle contributions, Feynman prescription and the propagator

Lecture 28 - Interactions and formal perturbative theory, The S-matrix and Feynman diagrams

Lecture 29 - Trace theorems for products of Dirac matrices

Lecture 30 - Photons and the gauge symmetry

Lecture 31 - Abelian local gauge symmetry, The covariant derivative and invariants

Lecture 32 - Charge quantisation, Photon propagator, Current conservation and polarisations

Lecture 33 - Feynman rules for Quantum Electrodynamics, Nature of perturbative expansion

Lecture 34 - Dyson's analysis of the perturbation series, Singularities of the S-matrix, Elementary QED processes

Lecture 35 - The T-matrix, Coulomb scattering

Lecture 36 - Mott cross-section, Compton scattering

Lecture 37 - Klein-Nishina result for cross-section

Lecture 38 - Photon polarisation sums, Pair production through annihilation

Lecture 39 - Unpolarised and polarised cross-sections

Lecture 40 - Helicity properties, Bound state formation

Lecture 41 - Bound state decay, Non-relativistic potentials

Lecture 42 - Lagrangian formulation of QED, Divergences in Green's functions, Superficially divergent 1-loop diagrams and regularisation

Lecture 43 - Infrared divergences due to massless particles, Renormalisation and finite physical results

Lecture 44 - Symmetry constraints on Green's functions, Furry's theorem, Ward-Takahashi identity, Spontaneous breaking of gauge symmetry and superconductivity

Lecture 45 - Status of QED, Organisation of perturbative expansion, Precision tests

NPTEL : NOC:Control System Design (Physics)

Co-ordinators : Prof. G R Jayanth

Lecture 1 - Introduction

Lecture 2 - Linear Systems

Lecture 3 - Homogeneous linear time invariant ordinary differential equations

Lecture 4 - In-homogeneous linear time invariant ordinary differential equations

Lecture 5 - Fourier transforms - Part 1

Lecture 6 - Fourier transforms - Part 2

Lecture 7 - Laplace transforms - Part 1

Lecture 8 - Laplace transforms - Part 2

Lecture 9 - Introduction to feedback control - Part 1

Lecture 10 - Introduction to feedback control - Part 2

Lecture 11 - Nyquist stability theory - Part 1

Lecture 12 - Nyquist stability theory - Part 2

Lecture 13 - Nyquist stability theory - Part 3

Lecture 14 - Bode plots

Lecture 15 - Steps for performing control design - Part 1

Lecture 16 - Steps for performing control design - Part 2

Lecture 17 - General controllers - Part 1

Lecture 18 - General controllers - Part 2

Lecture 19 - General controllers - Part 3

Lecture 20 - Bode plot-based control design - Part 1

Lecture 21 - Bode plot-based control design - Part 2

Lecture 22 - Introduction to root-locus

Lecture 23 - Control system design using root-locus

Lecture 24 - Control of systems with some known parameters - Part 1

Lecture 25 - Control of systems with some known parameters - Part 2

Lecture 26 - Limitations of 1-degree of freedom control

Lecture 27 - Introduction to 2-degree of freedom control

Lecture 28 - 2-Degree of freedom robust control design for plants with gain uncertainty - Part 1

Lecture 29 - 2-Degree of freedom robust control design for plants with uncertain gain - Part 2

Lecture 30 - 2-Degree of freedom robust control design for plants with uncertain pole

Lecture 31 - 2-Degree of freedom robust control design for plants with multiple uncertainties in their structure

Lecture 32 - Issues connected with 2-Degree of freedom control design using root-locus

Lecture 33 - Introduction to Nichols plot

Lecture 34 - Feedback control design using Nichols plot

Lecture 35 - Robust control design using Quantitative feedback theory - Part 1

Lecture 36 - Robust control design using Quantitative feedback theory - Part 2

Lecture 37 - Tutorial on QFT Toolbox software - Part 1

Lecture 38 - Tutorial on QFT Toolbox software - Part 2

Lecture 39 - Tutorial on QFT Toolbox software - Part 3

Lecture 40 - Fundamental properties of the loop gain - Part 1

Lecture 41 - Fundamental properties of the loop gain - Part 2

Lecture 42 - Ideal Bode Characteristic - Part 1

Lecture 43 - Ideal Bode Characteristic - Part 2

Lecture 44 - Introduction to nonminimum phase systems

Lecture 45 - Fundamental properties of nonminimum phase systems - Part 1

Lecture 46 - Fundamental properties of nonminimum phase systems - Part 2

Lecture 47 - Fundamental properties of unstable systems

Lecture 48 - Consequences of actuator bandwidth limitations while controlling unstable systems

Lecture 49 - Describing functions - Part 1

Lecture 50 - Describing functions - Part 2

NPTEL : NOC:Bonds and Bands in Solids (Physics)

Co-ordinators : S. Ramashesha

Lecture 1 - Born-Oppenheimer approximation

Lecture 2 - Self-consistent field (SCF) method

Lecture 3 - Simple MO Theory of Hydrogen Molecule

Lecture 4 - Blochâ€™s theorem

Lecture 5 - Tight binding approximation

Lecture 6 - Energy band theory - 1

Lecture 7 - Energy band theory - 2

Lecture 8 - Density of states

Lecture 9 - Energy band theory - 3

Lecture 10 - Energy band theory - 4

Lecture 11 - Drudeâ€™s classical free electron model - 1

Lecture 12 - Drudeâ€™s classical free electron model - 2

Lecture 13 - Drudeâ€™s classical free electron model - 3

Lecture 14 - Drudeâ€™s classical free electron model - 4

Lecture 15 - Sommerfeldâ€™s quantum free electron model

Lecture 16 - Specific heat of Fermi gas

Lecture 17 - Energy dispersion relation in a periodic potential - 1

Lecture 18 - Energy dispersion relation in a periodic potential - 2

Lecture 19 - Brief overview of space groups and constant energy surface in 2D

Lecture 20 - Energy band and effective mass

Lecture 21 - Effective mass

Lecture 22 - kâ‹…p perturbation method

Lecture 23 - Revisiting Blochâ€™s theorem and tight binding functions

Lecture 24 - Symmetries in crystal Hamiltonian - 1

Lecture 25 - Symmetries in crystal Hamiltonian - 2

Lecture 26 - Tight binding method - 1

Lecture 27 - Tight binding method - 2

Lecture 28 - Tight binding method - 3

Lecture 29 - Plane wave method

Lecture 30 - Pseudo potential method

Lecture 31 - Cellular method of energy band calculation

Lecture 32 - Muffin tin potential and APW functions

Lecture 33 - Augmented plane wave method of energy band calculation - 1

Lecture 34 - Augmented plane wave method of energy band calculation - 2

Lecture 35 - Greenâ€™s function method of energy band calculation - 1

Lecture 36 - Greenâ€™s function method of energy band calculation - 2

Lecture 37 - Cyclotron resonance technique

Lecture 38 - De Haas-van Alphen effect

Lecture 39 - De Haas-van Alphen effect conclusion.Introduction to point impurity effect on band structure

Lecture 40 - Point impurity in crystal

Lecture 41 - Friedel Oscillations

Lecture 42 - Lindhard dielectric constant

Lecture 43 - Dielectric anomaly. Crystal momentum

Lecture 44 - Spatial and time reversal symmetries in crystals

Lecture 45 - Time reversal symmetry (Continued...)

Lecture 46 - Spin orbit interaction

Lecture 47 - Disordered solids and transport in disordered solids

Lecture 48 - Optical properties of semiconductors

Lecture 49 - Excitonic states in semiconductors

Lecture 50 - Excitonic states in semiconductors (Continued...)

Lecture 51 - Molecular orbital calculation - I

Lecture 52 - Mott-Hubbard transition

Lecture 53 - Hubbard model

Lecture 54 - Electron repulsion and magnetic exchange

Lecture 55 - Beyond on-site electron repulsions;Pariser-Parr-Pople model

Lecture 56 - Electron-hole symmetry and Pairing theorem. Solitons

Lecture 57 - Density waves in 1-d systems and Lattice vibrations - I

Lecture 58 - Lattice vibrations - II

Lecture 59 - Lattice vibrations - III

Lecture 60 - Lattice vibrations - IV

NPTEL : NOC:Advanced NMR Techniques in Solution and Solid-State (Physics)

Co-ordinators : Prof. N. Suryaprakash

Lecture 1 - Introduction to NMR

Lecture 2 - NMR concepts and spin physics - I

Lecture 3 - NMR concepts and spin physics - II

Lecture 4 - Internal interaction parameters and chemical shifts

Lecture 5 - Chemical shifts

Lecture 6 - Scalar couplings

Lecture 7 - Multiplicity patterns of coupled spins and analysis of 1H NMR spectrum

Lecture 8 - Multiplicity pattern and analysis of NMR spectra - II

Lecture 9 - Analysis of NMR spectra and their analysis

Lecture 10 - Heteronuclear NMR

Lecture 11 - Introduction to Fourier series

Lecture 12 - Complex form of Fourier series

Lecture 13 - Fourier theorems

Lecture 14 - Fourier transformation in NMR

Lecture 15 - Pople notation, construction of spin Hamiltonian

Lecture 16 - Quantum mechanical analysis of AX spectra

Lecture 17 - Quantum mechanical analysis of AB spin system

Lecture 18 - Quantum mechanical analysis of coupled spin systems

Lecture 19 - RF pulses and their phases

Lecture 20 - Receiver phase and phase cycling

Lecture 21 - Evolution of chemical shift

Lecture 22 - Evolution of J couplings: polarization transfer

Lecture 23 - selective saturation in homo and heteronuclear spin systems, coupled anddecoupled INEPT

Lecture 24 - INEPT and DEPT

Lecture 25 - Coherence transfer pathway

Lecture 26 - Examples of coherence pathway selection

Lecture 27 - Pulse field gradients - I

Lecture 28 - Pulse field gradients - II

Lecture 29 - Selective excitation, selective inversion

Lecture 30 - Relaxation phenomenon

Lecture 31 - T1 relaxation concepts and measurements

Lecture 32 - Spectral density function and relaxation mechanisms

Lecture 33 - T1 Relaxation mechanisms

Lecture 34 - T1 Relaxation mechanisms and T2 relaxation

Lecture 35 - Measurement of T1 and T2

Lecture 36 - Decoupling and NOE concepts

Lecture 37 - DQ and ZQ relaxation pathways

Lecture 38 - Positive and Negative NOE and spectral density functions

Lecture 39 - NOE and correlation time

Lecture 40 - Product operators

Lecture 41 - Product operator analysis

Lecture 42 - Productor operator analysis of pulse sequences

Lecture 43 - Product operators for two J coupled spins

Lecture 44 - Spin echo sequences

Lecture 45 - Introduction to 2D NMR

Lecture 46 - 2D NMR concepts, 2D experiments

Lecture 47 - 2D COSY experiment

Lecture 48 - 2D COSY and its variants

Lecture 49 - TOCSY Heteronuclear 2D experiments

Lecture 50 - coupled and decoupled HSQC, HMBC, INADEQUATE, 2D Jresolved

Lecture 51 - Introduction to multiple quantum NMR

Lecture 52 - DQ and ZQ of coupled spins

Lecture 53 - MQ and relative signs of couplings

Lecture 54 - MQ and spin system filtering

Lecture 55 - Introduction to solid state NMR

Lecture 56 - CSA and dipolar couplings

Lecture 57 - Magic Angle Spinning

Lecture 58 - WAHUHA and Cross Polarization

Lecture 59 - Cross Polarization

Lecture 60 - CP at high speeds, Side band suppression, TOSS

NPTEL : NOC:Particle Physics and the Standard Model (Physics)

Co-ordinators : Prof. Nirmal Raj

Lecture 1 - Introduction to the course

Lecture 2 - Field content and symmetries

Lecture 3 - Stability of particles vs symmetry

Lecture 4 - Parity

Lecture 5 - Parity violation

Lecture 6 - Charge conjugation

Lecture 7 - CP and CPT symmetries

Lecture 8 - CP violation in weak forces

Lecture 9 - CP violation and time reversal

Lecture 10 - Special lecture: Feynman diagrams

Lecture 11 - More Feynman diagrams

Lecture 12 - Spin and statistics

Lecture 13 - Spinors: Round 1

Lecture 14 - Introduction to group theory

Lecture 15 - Isospin

Lecture 16 - Consequences of isospin

Lecture 17 - Continuous groups

Lecture 18 - Introduction to quantum field theory

Lecture 19 - Action principle

Lecture 20 - Spin-0 fields: zero-point energy

Lecture 21 - Cosmological constant problem

Lecture 22 - Spin-1 fields

Lecture 23 - Proca Lagrangian

Lecture 24 - Maxwell Lagrangian

Lecture 25 - Spin-1/2 fields: Dirac Lagrangian

Lecture 26 - Lorentz group

Lecture 27 - Spinors: Round 2

Lecture 28 - Gauge invariance and QED

Lecture 29 - Non-abelian gauges

Lecture 30 - Asymptotic freedom

Lecture 31 - Standard Model field content

Lecture 32 - The Higgs field

Lecture 33 - Breaking symmetry: Round 1

Lecture 34 - Breaking symmetry: Round 2

Lecture 35 - Goldstoneâ€™s theorem

Lecture 36 - Higgs mechanism

Lecture 37 - CKM matrix

Lecture 38 - CKM parameterisation

Lecture 39 - Weak CP violation

Lecture 40 - FCNCs and PMNS matrix

Lecture 41 - Unitarity triangles

Lecture 42 - Neutrino oscillations

Lecture 43 - Oscillation length

Lecture 44 - Atmospheric neutrinos

Lecture 45 - Solar neutrinos and matter effects

Lecture 46 - Neutrino mass ordering

Lecture 47 - Neutrino experiments

Lecture 48 - Particle collider configurations

Lecture 49 - Cross section

Lecture 50 - Deriving 2-to-2 cross section

Lecture 51 - Centre-of-momentum frame cross section

Lecture 52 - Particle decay

Lecture 53 - Proton decay

Lecture 54 - Dimensionality of time and particle decay

Lecture 55 - Scattering without QFT

Lecture 56 - Forward-backward asymmetry

Lecture 57 - Deep inelastic scattering

Lecture 58 - Quark parton model, summary of course