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 : NOC:Theory and Applications in Thermal and Cold Plasma (Physics)

Co-ordinators : Prof. Srikumar Ghorui

Lecture 1 - Introduction

Lecture 2 - Fundamentals of Thermal and Cold Plasma

Lecture 3 - Theory and Applications in Thermal and Cold Plasma

Lecture 4 - Theory and Applications in Thermal and Cold Plasma

Lecture 5 - Saha Ionization Equation and That Follows

Lecture 6 - Tutorial-1: Theory and Applications in Thermal and Cold Plasma

Lecture 7 - Plasma Screening

Lecture 8 - Propagation of EM Waves in Plasma

Lecture 9 - Further Details on The Basics of EM Waves in Plasma

Lecture 10 - Collisions in Plasma: Plasma Temperature and Equilibria

Lecture 11 - Tutorial-2: Plasma Physics Fundamentals

Lecture 12 - Large Angle and Small Angle Scattering in Plasma

Lecture 13 - Small Angle Scattering in Plasma

Lecture 14 - Ambipolar Diffusion in Plasma

Lecture 15 - Description of Plasma Kinetics: Orbit Theory, Kinetic Theory and Fluid Model

Lecture 16 - Tutorial-3: Understanding Ionization, Gas Behavior, and Maxwell-Boltzmann Distribution

Lecture 17 - Description of Plasma Kinetics: Orbit Theory

Lecture 18 - Description of Plasma Kinetics: Orbit Theory-Plasma Confinement

Lecture 19 - Description of Plasma Kinetics: Plasma Kinetic Theory

Lecture 20 - Description of Plasma Kinetics: Electrostatic Waves in Plasma

Lecture 21 - Review of Key Concepts: Week 1-3 - Part A

Lecture 22 - Review of Key Concepts: Week 1-3 - Part B

Lecture 23 - Tutorial-4: Gas Ionization and Breakdown Mechanisms

Lecture 24 - Description of Plasma Kinetics: Langmuir Wave

Lecture 25 - Plasma Fluid Model

Lecture 26 - Some More Insights on High Frequency Electrostatic Waves in Plasma

Lecture 27 - Further Insights into Dispersion Relation

Lecture 28 - Tutorial-5: Plasma Kinetics, Thermodynamics and Excitation in Plasma

Lecture 29 - First Order Moment of Plasma Kinetic Equation

Lecture 30 - Generalized Ohms Law

Lecture 31 - Expression for Generalized Ohms Law and Reduction to Ordinary Ohmâ€™s Law

Lecture 32 - Energy Conservation Equation

Lecture 33 - Tutorial-6: Plasma Devices, Characteristics and Plasma Parameters

Lecture 34 - Energy Conservation Equation: Solution technique

Lecture 35 - Navier Stokes Equation in Plasma

Lecture 36 - Numerical Solution of Fluid Equations: Thermodynamic and transport properties, an example

Lecture 37 - Finding Solution of Fluid Equations in a Plasma Torch: example of N2-O2 plasma

Lecture 38 - Tutorial-7: Thermodynamic and Transport Properties in Plasma

Lecture 39 - Review of Key Concepts: Week 4-6 - Part A

Lecture 40 - Review of Key Concepts: Week 4-6 - Part B

Lecture 41 - Actual Solutions of Fluid Equations in a Plasma Torch

Lecture 42 - Understanding the Solution of Fluid Equations in a Plasma Torch

Lecture 43 - Understanding the Solution Results and Designing a Plasma Torch

Lecture 44 - Designing Plasma Torches with Desired Electrothermal Efficiency and Jet Characteristics

Lecture 45 - Tutorial-8: RF and Cold Plasma Devices

Lecture 46 - Features of Plasma Jets in Practice

Lecture 47 - Plasma Production

Lecture 48 - Paschen Break Down Criteria

Lecture 49 - AC Breakdown

Lecture 50 - Tutorial-9: Plasma Thermodynamics and Radiation equilibrium

Lecture 51 - Review of Key Concepts: Week 7-9 - Part A

Lecture 52 - Review of Key Concepts: Week 7-9 - Part B

Lecture 53 - Plasma Sources

Lecture 54 - Typical Configuration of Arc Devices and Special Features

Lecture 55 - Plasma Power Supplies: Steady and Unsteady Operating Points, RF Thermal Plasma Sources

Lecture 56 - RF plasma-Thermal Plasma Sources

Lecture 57 - Non-Thermal Plasma Sources: Atmospheric pressure plasma jets (APPJ)

Lecture 58 - Tutorial-10: Advanced Plasma Diagnostics

Lecture 59 - Non-Thermal Plasma Sources: ECR Plasma and Plasma Sheath

Lecture 60 - Plasma Sheath-mathematical modelling

Lecture 61 - Plasma Diagnostics

Lecture 62 - Boltzmann Plot Technique

Lecture 63 - Plasma Diagnosis: Finding number density

Lecture 64 - Tutorial-11: Plasma Technology for Renewable Energy and Environment

Lecture 65 - Plasma Diagnosis: Langmuir Probe Principles

Lecture 66 - Plasma Application

Lecture 67 - Plasma Application: Waste Management Capacity, Efficacy and Empowerment, thermal plasma for material testing under extreme conditions

Lecture 68 - Atmospheric Pressure Plasma Spray (APS), Plasma Metallurgy and Novel Materials

Lecture 69 - Plasma Medicine and Plasma in Agriculture

Lecture 70 - Tutorial-12: Plasma Technology for Industrial Applications: Options, Efficacy and Benefits

Lecture 71 - Review of Key Concepts: Week 10-12 - Part A

Lecture 72 - Review of Key Concepts: Week 10-12 - Part B

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

Lecture 13 - Bandgap Engineering

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:Energy Materials and Devices (Physics)

Co-ordinators : Prof. Santanu Ghosh

Lecture 1 - Solar energy conversion and silicon solar cell

Lecture 2 - Solar energy conversion and silicon solar cell (Continued...)

Lecture 3 - Tutorial session on solar energy conversion and silicon solar cell

Lecture 4 - Wide band gap semiconductor based thin film solar cell: CdTe-CdS

Lecture 5 - Wide band gap semiconductor based thin film solar cell: Tutorial session

Lecture 6 - Dye sensitized solar cell

Lecture 7 - Quantum dot sensitized solar cell and Perovskite solar cell

Lecture 8 - DSCC and QDSSC: Tutorial session

Lecture 9 - Tandem Solar Cell

Lecture 10 - Tandem Solar Cell: Tutorial session

Lecture 11 - Thermoelectric Energy and materials

Lecture 12 - Thermoelectric Energy and materials (Continued...)

Lecture 13 - TEG Materials and devices

Lecture 14 - TEG Materials and devices (Continued...)

Lecture 15 - Tutorial session of Thermoelectric generator materials and devices

Lecture 16 - Thermionic emission fundamentals

Lecture 17 - Thermionic energy and materials

Lecture 18 - Tutorial of Thermionic energy and Materials

Lecture 19 - Materials for energy storage and devices: Battery and Capacitor

Lecture 20 - Materials for energy storage and devices: Supercapacitor

Lecture 21 - Materials for energy storage and devices: Lithium ion battery

Lecture 22 - Materials for energy storage and devices: Lithium ion battery (Continued...)

Lecture 23 - Materials for energy storage and devices: Tutorial-I

Lecture 24 - Materials for energy storage and devices: Fuel cell

Lecture 25 - Materials for energy storage and devices: Fuel cell (Continued...)

Lecture 26 - Materials for energy storage and devices: Fuel Cell (Tutorial)

Lecture 27 - Hydrogen production by PEC water splitting

Lecture 28 - PEC water splitting (Continued...)

Lecture 29 - PEC water splitting: Materials and Applications

Lecture 30 - PEC water splitting: Materials and Applications (Continued...)

Lecture 31 - 5PEC water splitting tutorial

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 Lecture - 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 : NOC:Essentials of Quantum Optics (Physics)

Co-ordinators : Prof. Amarendra Kumar Sarma

Lecture 1 - Quantum Mechanics of Two-level Atom - I

Lecture 2 - Quantum Mechanics of Two-level Atom - II

Lecture 3 - Problem Solving Session - 1

Lecture 4 - Interaction of classical light with two-level atom - I

Lecture 5 - Interaction of classical light with two-level atom - II

Lecture 6 - Problem Solving Session - 2

Lecture 7 - Quantum States: Density Operator - I

Lecture 8 - Quantum States: Density Operator - II

Lecture 9 - Problem Solving Session - 3

Lecture 10 - Quantum States of Composite Systems

Lecture 11 - Quantum Computation Fundamentals - I

Lecture 12 - Quantum Computation Fundamentals - II

Lecture 13 - Problem Solving Session - 4

Lecture 14 - The Quantum Master Equation - I

Lecture 15 - The Quantum Master Equation - II

Lecture 16 - Problem Solving Session - 5

Lecture 17 - Electromagnetically Induced Transparency

Lecture 18 - Quantization of Light

Lecture 19 - Photon Statistics

Lecture 20 - Coherent States of Light

Lecture 21 - Squeezed States of Light

Lecture 22 - Problem Solving Session - 6

Lecture 23 - Circuit QED - I

Lecture 24 - Circuit QED - II

Lecture 25 - The Jaynes Cummings Model

Lecture 26 - Problem Solving Session - 7

Lecture 27 - Cavity Quantum Optomechanics - I

Lecture 28 - Cavity Quantum Optomechanics - II

Lecture 29 - Cavity Quantum Optomechanics - III

Lecture 30 - Problem Solving Session - 8

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

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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

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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 : NOC:Physics of Nanomaterials (Physics)

Co-ordinators : Prof. Amreesh Chandra

Lecture 1 - Introduction to nanomaterials and nanotechnology

Lecture 2 - Classification of Nanomaterials

Lecture 3 - Need of nanomaterials

Lecture 4 - Application of nanomaterials

Lecture 5 - Concept and Quantum Mechanical Explanation of Electron Confinement

Lecture 6 - Energy Band Diagram in Solid State Materials

Lecture 7 - Crystal Structures and Phase Transitions in Nanomaterials

Lecture 8 - Dimensionality Effects on the Electrical properties

Lecture 9 - Introduction to Synthesis Methods for Nanomaterials

Lecture 10 - Kinetically and Thermodynamically Controlled Routes

Lecture 11 - Top Down and Bottom Up Synthesis Routes - 1

Lecture 12 - Top Down and Bottom Up Synthesis Routes - 2

Lecture 13 - Low Dimensional Structures - Quantum Wells, Wires and Dots; Conduction Electrons and Dimensionality

Lecture 14 - Fermi Gas and Density of States

Lecture 15 - Fermi Gas and Density of States

Lecture 16 - Coulomb Potential and Single Electron Tunnelling

Lecture 17 - Metal Nanoclusters

Lecture 18 - Semiconducting Nanoparticle Clusters

Lecture 19 - Molecular Clusters

Lecture 20 - Quantum Devices - Infrared Detectors and Quantum Dot lasers

Lecture 21 - Application of carbon nanotubes

Lecture 22 - Carbon clusters and nanotubes

Lecture 23 - Electrical, Vibrational and Mechanical Properties of Carbon Nanotubes

Lecture 24 - Application of carbon nanotubes

Lecture 25 - Magnetism at Nanoscale

Lecture 26 - Nanostructured Magnetic Materials

Lecture 27 - Dynamics of Nanomagnets - I

Lecture 28 - Dynamics of Nanomagnets - II

Lecture 29 - Giant Magnetoresistance

Lecture 30 - Colossal Magnetoresistance

Lecture 31 - Nanocarbon Ferromagnets

Lecture 32 - Superparamagnetism and ferrofluids

Lecture 33 - Self Assembly and Catalysis

Lecture 34 - Process of Self Assembly

Lecture 35 - Monolayers and Porous Materials

Lecture 36 - Nature of Catalysis,Pillard Clays and Colloids

Lecture 37 - Nanomaterials for Energy Devices

Lecture 38 - Secondary Batteries

Lecture 39 - Supercapacitors

Lecture 40 - Porous Silicon, Photoluminescence and Photovoltaics

Lecture 41 - Introduction to useful various techniques

Lecture 42 - Particle size determination

Lecture 43 - Phase Transition Using X-ray Diffraction

Lecture 44 - Strain Estimation

Lecture 45 - TEM and SEM

Lecture 46 - Infrared and Raman Spectroscopy

Lecture 47 - Porosity and Specific Surface Areas

Lecture 48 - Infrared and Raman Spectroscopy

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

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Lecture 64 - Solar eruptions : Coronal Mass Ejections (CMEs) and solar flares

HTML Links for 1,32,200+ NPTEL PDF Lectures, Created by LinuXpert Systems, Chennai

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:Introduction to General Relativity (Physics)

Co-ordinators : Prof. Shubho R. Roy, Prof. Arpan Bhattacharyya

Lecture 1 - Newton's Gravitation - Part I

Lecture 2 - Newton's Gravitation - Part II

Lecture 3 - Newton's Gravitation - Part III

Lecture 4 - Newton's Gravitation - Part IV

Lecture 5 - Newton's Gravitation - Tutorial 1

Lecture 6 - Newton's Gravitation - Tutorial 2

Lecture 7 - Special Relativity Review

Lecture 8 - Minkowski Spacetime

Lecture 9 - Lorentz Group - Part I

Lecture 10 - Lorentz Group - Part II

Lecture 11 - Topology of Lorentz Group

Lecture 12 - Lorentz Group: Tutorial

Lecture 13 - Relativistic index/component notation

Lecture 14 - Tensor analysis - I

Lecture 15 - Tensor analysis - II

Lecture 16 - Tensor analysis - III

Lecture 17 - Introduction to differential forms

Lecture 18 - Exterior Calculus

Lecture 19 - Differential Forms: Tutorial

Lecture 20 - Free Point Particle - I

Lecture 21 - Free Point Particle - II

Lecture 22 - Point Particle with interactions

Lecture 23 - Tensor Fields

Lecture 24 - Point Particle with interactions: Tutorial

Lecture 25 - Covariant equations for Fluid mechanics - I

Lecture 26 - Covariant equations for Fluid mechanics - II

Lecture 27 - Stress-Energy-Momentum Tensor: Tutorial

Lecture 28 - Electrodynamics in Lorentz covariant form - I

Lecture 29 - Electrodynamics in Lorentz covariant form - II

Lecture 30 - Electrodynamics in Lorentz covariant form: Tutorial

Lecture 31 - Alternative route to Maxwell's equations from Electrostatics - I

Lecture 32 - Alternative route to Maxwell's equations from Electrostatics - II

Lecture 33 - Towards a Lorentz covariant formulation for Newton's gravitation - I

Lecture 34 - Towards a Lorentz covariant formulation for Newton's gravitation - II

Lecture 35 - Consistent coupling of gravity to matter - I

Lecture 36 - Consistent coupling of gravity to matter - II

Lecture 37 - Covariance vs Invariance principles

Lecture 38 - Mathematical Preliminaries-I : Basics of Point-Set Topology - 1

Lecture 39 - Mathematical Preliminaries-I : Basics of Point-Set Topology - 2

Lecture 40 - Mathematical Preliminaries-I : Basics of Differential Geometry - 1

Lecture 41 - Mathematical Preliminaries-I : Basics of Differential Geometry - 2

Lecture 42 - Mathematical Preliminaries-I : Calculus on manifolds - 1

Lecture 43 - Mathematical Preliminaries-I : Calculus on manifolds - 2

Lecture 44 - Mathematical Preliminaries-II : Riemannian manifolds

Lecture 45 - Mathematical Preliminaries-II : Riemannian Geometry

Lecture 46 - Mathematical Preliminaries-II : Riemannian Geometry

Lecture 47 - Mathematical Preliminaries-II : Riemannian Geometry

Lecture 48 - Mathematical Preliminaries-II : Riemannian Geometry

Lecture 49 - Geodesic Deviation and the Riemann Curvature tensor

Lecture 50 - Principle of Minimal Coupling

Lecture 51 - Einstein Field Equations - I

Lecture 52 - Einstein Field Equations - II

Lecture 53 - Weak field limit: Linearized GR

Lecture 54 - Gravitational Waves

Lecture 55 - Gravitational Radiation

Lecture 56 - Schwarzschild Solution - I

Lecture 57 - Schwarzschild Solution - II

Lecture 58 - Schwarzschild Solution - III

Lecture 59 - Timelike geodesics in Schwarzschild geometry

Lecture 60 - Precession of perihelion of planets

Lecture 61 - Lightlike geodesics in Schwarzschild geometry

Lecture 62 - Gravitational Deflection and Retardation of light

Lecture 63 - Cosmology-I : Kinematics - Part 1

Lecture 64 - Cosmology-I : Kinematics - Part 2

Lecture 65 - Cosmology-II : Dynamics - Part 1

Lecture 66 - Cosmology-II : Dynamics - Part 2

Lecture 67 - Cosmology-II : Dynamics - Part 3

Lecture 68 - Cosmology-II : Dynamics - Part 4

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

NPTEL : NOC:Quantum Mechanics in the Relativistic Regime (Physics)

Co-ordinators : Prof. Sudhir Kumar Vempati

Lecture 1 - Recap of NRQM

Lecture 2 - Finite Step Potential: Schrodinger equation solution

Lecture 3 - Properties of wavefunction

Lecture 4 - Matrix Mechanics

Lecture 5 - Basics of STR

Lecture 6 - Natural Units

Lecture 7 - Relativistic effects in Quantum Mechanics

Lecture 8 - Building Relativistic Wave Theories

Lecture 9 - Solutions to the KG equation

Lecture 10 - Introduction to Relativistic Lagrangian

Lecture 11 - Scalar Quantum Electrodynamics (SQED)

Lecture 12 - Non-Relativistic Limit of the KG Equation: The Schrodinger Equation

Lecture 13 - Revisiting KG Equation's Negative Energy Solutions

Lecture 14 - Klein Paradox

Lecture 15 - Scalar Quantum Electrodynamics (SQED)

Lecture 16 - Dirac Theory

Lecture 17 - Dirac Equation and its solution

Lecture 18 - Dirac Spinors

Lecture 19 - Properties of Spinor

Lecture 20 - Group Theory

Lecture 21 - Rotation Groups and their Properties

Lecture 22 - Lie Group and Lorentz Boost

Lecture 23 - Group Representations - I

Lecture 24 - Group Representations - II

Lecture 25 - Symmetry and Isomorphism

Lecture 26 - Lorentz Group - I

Lecture 27 - Lorentz Group - II

Lecture 28 - Decomposition of Lorentz Group

Lecture 29 - Boost and Rotation Generators

Lecture 30 - Poincare Group

Lecture 31 - Representations of Poincare group

Lecture 32 - Solution of Dirac equation

Lecture 33 - Properties of Dirac Spinors and Probability Currents

Lecture 34 - Parity Violation and Axial Currents

Lecture 35 - Dirac interpretation for Negative Energy states

Lecture 36 - Dirac Hole Theory

Lecture 37 - Properties and Interpretations of Anti-Particle

Lecture 38 - Solutions of Massless Dirac Equation

Lecture 39 - Real Solutions of Dirac Equation

Lecture 40 - Properties of Majorana Fermions - I

Lecture 41 - Properties of Majorana Fermions - II

Lecture 42 - Examples of Majorana Fermions in different systems

Lecture 43 - Propagator Theory - I

Lecture 44 - Propagator Theory - II

Lecture 45 - Greenâ€™s Functions as Propagators

Lecture 46 - Solving for Greenâ€™s function

Lecture 47 - Photon Propagator

Lecture 48 - KG Propagator and its Properties

Lecture 49 - Scattering in SQED

Lecture 50 - Pion-Pion Scattering Channels

Lecture 51 - Pion-Pion Matrix Amplitude

Lecture 52 - Dirac Propagator and its Properties

Lecture 53 - Dyson equation and series

Lecture 54 - QED (Compton Scattering)

Lecture 55 - Dynamical Photon field processes

Lecture 56 - Employing trace theorems to calculate matrix element

Lecture 57 - Tree level QED processes

Lecture 58 - Pion mediated Processes

Lecture 59 - Loops and Renormalization

Lecture 60 - Bound states in RQM

Lecture 61 - Non-relativistic reduction of Dirac equation

Lecture 62 - Relativistic Corrections to H atom