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NPTEL : Electroceramics (Metallurgy and Material Science)

Co-ordinators : Dr. Ashish Garg

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NPTEL : Steel Making (Metallurgy and Material Science)

Co-ordinators : Prof. Satish Ch. Koria, Prof. Dipak Mazumdar

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Lecture 8 - Defects Reaction+Kroger-Vink Notation

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Lecture 17 - Volterra Model + Structure of Dislocations + Burger vectors

Lecture 18 - Characteristics of Dislocations

Lecture 19 - Mixed Dislocations + Dislocation Loops

Lecture 20 - Elastic Continuum Model + Strain field for screw dislocations

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- Lecture 4 - Equilibrium, Stability and Phase Diagrams in Single Component Systems
- Lecture 5 - Third Law of Thermodynamics and Numerical Examples
- Lecture 6 - Thermodynamic Activity and Gibbs Free Energy of Mixing
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- Lecture 8 - Regular Solution Model: Application to Ternary System
- Lecture 9 - Gibbs Free Energy-Composition Curves, Phase Diagrams and Gibbs Phase rule
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- Lecture 12 - Diffusion flux and Frames of Reference
- Lecture 13 - Fick's Law
- Lecture 14 - Exercise: Deriving Sigma Cosine for any Cubic Lattice
- Lecture 15 - Fick's Law for Multicomponent Diffusion
- Lecture 16 - Diffusion Equation and Solution to Steady State Diffusion
- Lecture 17 - Conversion of Set of Interdiffusion Coefficients from One Dependent Compared to Another
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- Lecture 32 - Introduction to electrochemical methods; cyclic voltammetry and other related techniques
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- Lecture 34 - Preparation of ceramic powders: auto-combustion, sol-gel synthesis, microwave assisted hydrothermal synthesis
- Lecture 35 - Introduction to sintering, sintering mechanism
- Lecture 36 - Solid-state sintering and microstructure development
- Lecture 37 - Solid-state sintering and microstructure development (Continued...)
- Lecture 38 - Liquid phase sintering and microstructure development, speciality sintering, reactive sintering
- Lecture 39 - Processing of glass and amorphous/non-crystalline solids
- Lecture 40 - Fundamental of thin film growth, growth mechanism and kinetics
- Lecture 41 - Thin film growth techniques, thermal evaporation, CVD, sputtering, CSD
- Lecture 42 - Fundamentals and processing of conducting and semiconducting ceramic devices
- Lecture 43 - Processing of ceramics devices
- Lecture 44 - Organic electronic materials: conducting polymers, semi-conducting organic materials, applications
- Lecture 45 - Thermal analyses
- Lecture 46 - Introduction of spectroscopic technique : UV-VIS spectroscopy
- Lecture 47 - Infra-red and Raman spectroscopy
- Lecture 48 - Optical and scanning electron microscopy
- Lecture 49 - X-ray photoelectron spectroscopy
- Lecture 50 - Measurement of mechanical properties, fracture toughness, MOR, hardness
- Lecture 51 - Ferroelectric thin film: synthesis and characterization
- Lecture 52 - Thermal analysis techniques: Differential scanning calorimetry and thermogravimetry
- Lecture 53 - Measurement of optical properties
- Lecture 54 - Novel ferroic composites: Synthesis and measurement
- Lecture 55 - Fundamentals of corrosion, corrosion of materials
- Lecture 56 - Oxidation, corrosion of ceramic materials, degradation of polymers: swelling and dissolution, bond rupture, weathering
- Lecture 57 - Ceramics in biology and medicine
- Lecture 58 - Design of Ceramics
- Lecture 59 - Finishing of Ceramics
- Lecture 60 - Fly-ash based glazed wall tiles: A case study

Lecture 1 - Introduction to Microscopy

Lecture 2 - Scanning Electron Microscopy

Lecture 3 - SEM and Its Capabilities

Lecture 4 - Main Components of SEM - Electron Guns

Lecture 5 - Main Components of SEM - Electron Guns and Electromagnetic Lenses

Lecture 6 - Electron Probe Diameter Verses Electron Probe Current

Lecture 7 - Electron Beam - Specimen Interaction

Lecture 8 - Detectors

Lecture 9 - BSE Detector and Sample Preparation for SEM

Lecture 10 - Parameters Need to be Considered to obtain a Good SEM Image

Lecture 11 - How to Get a Good SEM Image

Lecture 12 - Additional Capabilities of SEM

Lecture 13 - Additional Capabilities of SEM (Continued...)

Lecture 14 - Additional Capabilities of SEM (Continued...)

Lecture 15 - Scanning Ion Microscopy - An Introduction

Lecture 16 - Ions Versus Electrons as Source for Microscopy

Lecture 17 - Ions Source in HIM

Lecture 18 - GFIS Properties and Ion Optical Column

Lecture 19 - Ion Optical Column

Lecture 20 - Ion-Solid Interactions and Signal Generation

Lecture 21 - Signal Generation and Contrast Mechanism

Lecture 22 - Contrast Mechanism and Imaging Modes

Lecture 23 - Scanning Transmission Ion Microscopy and Microanalysis with HIM

Lecture 24 - Creation and Modification of Materials by HIM

Lecture 25 - Introduction to Scanning Probe Microscopy

Lecture 26 - STM Instrumentation

Lecture 27 - Main Components of STM

Lecture 28 - Main Components of STM (Continued...)

Lecture 29 - Main Components of STM (Continued...)

Lecture 30 - Working Principle of STM

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[Lecture 33 - SPM - Atomic Force Microscopy \(AFM\)](#)

[Lecture 34 - Force Between Tip and Sample in AFM](#)

[Lecture 35 - Atomic Force Microscope - Parts](#)

[Lecture 36 - Modes of AFM Operation](#)

[Lecture 37 - Modes of AFM Operation \(Continued...\)](#)

[Lecture 38 - AFM Imaging](#)

[Lecture 39 - Phase Imaging, Noises and Resolution](#)

[Lecture 40 - Surface Properties Measurements using Other Forces](#)

[Lecture 41 - Surface Properties Measurements using AFM](#)

[Lecture 42 - Manipulation of Atoms, Molecules and Industrial Applications](#)

[Lecture 43 - Summary](#)

- Lecture 1 - Introduction to the course and basic principles of image formation
- Lecture 2 - Image formation, resolution, magnification, depth of field and depth of focus
- Lecture 3 - Aberrations in microscopy: General concepts
- Lecture 4 - Introduction, types and image formation in Optical microscopy
- Lecture 5 - Components of optical microscope
- Lecture 6 - Bright field and Dark field modes
- Lecture 7 - Phase contrast optical microscopy
- Lecture 8 - Polarized light microscopy
- Lecture 9 - Differential interference contrast
- Lecture 10 - Fluorescence microscopy
- Lecture 11 - Basic components of electron microscope
- Lecture 12 - Basic components of electron microscope (Continued...)
- Lecture 13 - Basic components of electron microscope (Continued...)
- Lecture 14 - Electron-material interaction
- Lecture 15 - Electron-material interaction (Continued...)
- Lecture 16 - Electron-material interaction (Continued...) and Image formation and contrast generation
- Lecture 17 - Modes of TEM (BF and DF)
- Lecture 18 - Modes of TEM
- Lecture 19 - Modes of TEM (Continued...) and Electron diffraction in TEM
- Lecture 20 - Electron diffraction in TEM
- Lecture 21 - Electron diffraction in TEM (Continued...)
- Lecture 22 - Electron diffraction in TEM (Continued...)
- Lecture 23 - Electron diffraction in TEM (Continued...)
- Lecture 24 - Electron diffraction in TEM (Continued...)
- Lecture 25 - Application of Electron diffraction
- Lecture 26 - Signal generation in SEM
- Lecture 27 - Signal generation in SEM (Continued...)
- Lecture 28 - Signal generation in SEM (Continued...)
- Lecture 29 - Signal generation in SEM (Continued...)
- Lecture 30 - Signal generation in SEM (Continued...)
- Lecture 31 - Basic components of SEM

- [Lecture 32 - Basic components of SEM \(Continued...\)](#)
- [Lecture 33 - Optics of SEM](#)
- [Lecture 34 - Optics of SEM \(Continued...\)](#)
- [Lecture 35 - Optics of SEM \(Continued...\) and analytical detectors](#)
- [Lecture 36 - Analytical detectors in SEM](#)
- [Lecture 37 - Analytical \(WDS\) detector and contrast formation in SEM](#)
- [Lecture 38 - Imaging in SEM](#)
- [Lecture 39 - Imaging in SEM \(Continued...\)](#)
- [Lecture 40 - Imaging in SEM \(Continued...\)](#)
- [Lecture 41 - Imaging in SEM and X-ray diffraction](#)
- [Lecture 42 - Continuous and characteristics X-ray spectrum](#)
- [Lecture 43 - Characteristics X-ray radiation](#)
- [Lecture 44 - Characteristics X-ray radiation \(Continued...\) and X-ray absorption](#)
- [Lecture 45 - X-ray absorption \(Continued...\)](#)
- [Lecture 46 - X-ray absorption and filters](#)
- [Lecture 47 - Intensity of diffracted beam](#)
- [Lecture 48 - Intensity of diffracted beam \(Continued...\)](#)
- [Lecture 49 - Intensity of diffracted beam \(Continued...\)](#)
- [Lecture 50 - Intensity of diffracted beam \(Continued...\)](#)
- [Lecture 51 - Intensity of diffracted beam \(Continued...\)](#)
- [Lecture 52 - Intensity of diffracted beam \(Continued...\)](#)
- [Lecture 53 - Intensity of diffracted beam \(Continued...\)](#)
- [Lecture 54 - Intensity of diffracted beam \(Continued...\)](#)
- [Lecture 55 - Intensity of diffracted beam \(Continued...\)](#)
- [Lecture 56 - Intensity of diffracted beam \(Continued...\) and X-ray diffraction profile and analysis](#)
- [Lecture 57 - X-ray diffraction profile and analysis](#)
- [Lecture 58 - X-ray diffraction profile and analysis \(Continued...\)](#)
- [Lecture 59 - X-ray diffraction profile and analysis \(Continued...\)](#)
- [Lecture 60 - Electron backscatter diffraction \(EBSD\)](#)

Lecture 1 - Fundamentals of electrochemistry, definition of primary and secondary batteries

Lecture 2 - Primary batteries and Secondary batteries

Lecture 3 - Supercapacitors

Lecture 4 - Concepts of thermodynamics pertinent to electrochemical cells

Lecture 5 - Kinetics of electrochemical cells and structural characteristics of electrodes

Lecture 6 - Introduction to EMF, redox potential, Faraday law and Nernst's law

Lecture 7 - Terminology related to secondary battery : half-cell, full-cell, redox couple, positive

Lecture 8 - Measurements: Cyclic voltammetry, nominal voltage, capacity, rate performance

Lecture 9 - Impedance spectroscopy measurement and analyses

Lecture 10 - Measurement of rechargeable cell: Case study

Lecture 11 - History and categories of lithium batteries

Lecture 12 - Operational mechanisms for lithium batteries: Intercalation materials, alloys

Lecture 13 - Differences of voltage profiles between intercalation materials, alloys, and conversion

Lecture 14 - Properties of electrode materials (Case study: alloy as anode)

Lecture 15 - Properties of electrode materials (conversion type oxide as case study)

Lecture 16 - Positive electrodes: Lithiated transition metal oxides, lithiated iron oxyphosphates etc

Lecture 17 - Negative electrodes: Carbonaceous materials, lithium titanium oxides etc

Lecture 18 - Electrolyte :Liquid Electrolyte, Polymer Electrolyte

Lecture 19 - Current Collector, Conductive Agents, Separator and Other Accessories

Lecture 20 - Novel materials for lithium ion rechargeable cells

Lecture 21 - Principle of Operation of Commercial Cells : viz. C - NMC, C - NCA etc

Lecture 22 - Principle of operation of commercial cells

Lecture 23 - Major characteristics of commercial Li ion cells: Cell performance, degradation phenomena

Lecture 24 - Fabrication of Li ion cell: Cylindrical configuration

Lecture 25 - Fabrication of Li ion cell: Pouch and prismatic cell

Lecture 26 - Positive electrodes: Layered oxide, polyanionic compounds (phosphates, sulphates etc)

Lecture 27 - Negative electrodes: Carbonaceous materials, alloy based and other materials

Lecture 28 - Electrolytes: Roles and requirements, organic electrolyte, ionic liquid electrolyte

Lecture 29 - Performance of Na ion rechargeable cell

Lecture 30 - Future perspective of Na ion cells

Lecture 31 - Introduction to battery module, BMS, thermal management and pack design

- Lecture 32 - Degradation and safety issues of Li ion rechargeable cells
- Lecture 33 - Introduction to battery management system: BMS topologies, hardware, concept of active
- Lecture 34 - Introduction to thermal management: Active thermal management system, passive thermal
- Lecture 35 - Packaging of battery pack and battery testing: Material selection, sealing of enclosure
- Lecture 36 - Classification of supercapacitors: EDLC and pseudocapacitive type
- Lecture 37 - Pseudocapacitor
- Lecture 38 - Asymmetric supercapacitor and BATCAP: Battery supercapacitor hybrid electrochemical
- Lecture 39 - Electrolytes for supercapacitors: Aqueous/organic liquid electrolytes/ionic liquid
- Lecture 40 - Current collectors, separators etc. and their effect on performance
- Lecture 41 - Operational principles of aqueous and Li - O₂ batteries
- Lecture 42 - Electrolytes for Li - O₂ batteries
- Lecture 43 - Limitations of Li - Air batteries
- Lecture 44 - State of the art Li - Air batteries : Carbonaceous materials
- Lecture 45 - State of the art Li - Air batteries: Case study
- Lecture 46 - The element sulfur, principle of operation
- Lecture 47 - Advantages and disadvantages of Li - S batteries, positive electrodes
- Lecture 48 - Electrolyte and negative electrode for Li - S battery
- Lecture 49 - State of the art Li - S batteries : Case study - I
- Lecture 50 - State of the art Li - S batteries : Case study - II
- Lecture 51 - Global Geographic Distribution of Raw Lithium Resources
- Lecture 52 - Nature and geological origin of all potential lithium resources
- Lecture 53 - State of the art extraction techniques and known production reserves
- Lecture 54 - Recycling of lithium and other battery constituents from used battery
- Lecture 55 - Recycling of lithium and other battery constituents from used battery (Continued...)
- Lecture 56 - Lead Acid Batteries: Operational principles, main characteristics and applications
- Lecture 57 - Lead Acid Batteries: Operational principles, main characteristics and applications (Continued...)
- Lecture 58 - Ni-Cd and Ni-MeH Batteries: Operational principles, main characteristics and applications
- Lecture 59 - Redox flow battery vanadium redox battery, operational principle, and main characteristics
- Lecture 60 - Other Redox Flow Battery Technologies

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Lecture 2 - Texture and Anisotropy

Lecture 3 - Processing - Texture - Anisotropic Properties

Lecture 4 - Crystal Structure and Stereographic Projections

Lecture 5 - Utilization of Stereographic Projections

Lecture 6 - Diffraction and Bragg's Law

Lecture 7 - Structure Factor and Diffraction Extinction Criteria

Lecture 8 - Structure factor and diffraction extinction criteria (Continued...)

Lecture 9 - Pole figures

Lecture 10 - Pole figures (Continued...)

Lecture 11 - Inverse Pole Figures

Lecture 12 - Three Dimensional Texture Analysis

Lecture 13 - Euler Angles and ODFs

Lecture 14 - Euler Angles and ODFs (Continued...)

Lecture 15 - Euler Angles and ODFs (Continued...)

Lecture 16 - Euler Angles and ODFs (Continued...)

Lecture 17 - Symmetry Effects on Orientation Matrix

Lecture 18 - Euler Space and Orientation Matrices

Lecture 19 - Texture Fibre, Periodicity in Euler Space, Incomplete Pole Figures

Lecture 20 - Crystal Structures and Symmetry

Lecture 21 - Size of Euler Space in Relation to Crystal and Sample Symmetry

Lecture 22 - Macrotexture and Microtexture Measurements

Lecture 23 - Penetration Depth of X-ray, Neutron, e-1 and Basics of X-ray Generation

Lecture 24 - Characteristic X-ray, Absorption and Filters

Lecture 25 - Principles of pole figure measurements by X-ray diffraction

Lecture 26 - Texture Goniometer Components

Lecture 27 - Limitations and Errors in X-ray Texture Measurement and Corrections

Lecture 28 - Basics of Electron Microscopy - I

Lecture 29 - Basics of Electron Microscopy - II

Lecture 30 - Kikuchi Diffraction Pattern - I

Lecture 31 - Kikuchi Diffraction Pattern - II

- Lecture 32 - Quantitative Evaluation of Kikuchi Diffraction Pattern - I
- Lecture 33 - Quantitative evaluation of Kikuchi Diffraction Pattern - II
- Lecture 34 - Quantitative evaluation of Kikuchi Diffraction Pattern - III
- Lecture 35 - Analysis using the TSL-OIM software
- Lecture 36 - Analysis using the AZtec Crystal software
- Lecture 37 - Analysis using the ATEX software
- Lecture 38 - Introduction to solidification texture
- Lecture 39 - Solidification texture in Alloys
- Lecture 40 - Solidification texture in FCC, BCC, and HCP structures
- Lecture 41 - Phase Transformation Texture and Bain Strain
- Lecture 42 - Orientation Relationships between FCC and BCC / BCT
- Lecture 43 - Various Orientation Relationships and Variants
- Lecture 44 - Basic Mechanics of Polycrystal Plasticity
- Lecture 45 - Basic Mechanics of Polycrystal Plasticity (Continued...)
- Lecture 46 - A Metallurgist Point of View
- Lecture 47 - A Metallurgist Point of View (Continued...)
- Lecture 48 - Texture in FCC polycrystals
- Lecture 49 - Texture in BCC polycrystals - I
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- Lecture 52 - Texture in HCP polycrystals - II
- Lecture 53 - Texture in HCP polycrystals - III
- Lecture 54 - Static recrystallization
- Lecture 55 - Dynamic recrystallization and recrystallization texture
- Lecture 56 - Dynamic recrystallization and grain refinement during hot large strain shear

- Lecture 1 - Classification of Mining and Bulk Solid Handling Systems
- Lecture 2 - Properties of bulk material vis-a-vis different bulk handling operations
- Lecture 3 - Fundamentals of BMH and Transport: Capacity and Productivity Concepts
- Lecture 4 - Bulk material handling in Processing plants: Crushing and Screening Flow Charts
- Lecture 5 - Introduction to Bulk Material Transport and Autonomous Vehicles
- Lecture 6 - Constructional Components: Trends of Developments
- Lecture 7 - Belt Conveyor Construction: Belting for Bulk Material Conveyor
- Lecture 8 - Idlers and Belt Cleaners
- Lecture 9 - Feeding and Discharging Devices
- Lecture 10 - Safety and Troubleshooting
- Lecture 11 - Size Selection and Power Calculation
- Lecture 12 - Principle of operations and applicability
- Lecture 13 - Basic Design Calculations
- Lecture 14 - Introduction to Pneumatic Conveying systems
- Lecture 15 - Design Calculations for Pneumatic Conveying
- Lecture 16 - Exercise with Basic Design Calculations
- Lecture 17 - Stackers and Reclaimers: Classification and Selection Criteria
- Lecture 18 - Stackers and Reclaimers: Comparison of Different Types
- Lecture 19 - Principles of Blending and Reclaiming
- Lecture 20 - Case studies of stacker and reclaimers application
- Lecture 21 - System Layout
- Lecture 22 - Introduction to Bin Bunker and Silo
- Lecture 23 - Introduction to Bunker
- Lecture 24 - Introduction to Silo
- Lecture 25 - Silo Failures and Maintenance
- Lecture 26 - Basics of Silo Design
- Lecture 27 - Feeder Selection and Design
- Lecture 28 - Crushers: Classification and selection
- Lecture 29 - Secondary Crushers
- Lecture 30 - Screen: Classification and Selection
- Lecture 31 - Monitoring and Maintenance of Processing Plant Equipment

Lecture 32 - Concentration and Separation

Lecture 33 - Fine Size Classification: Desliming and Cycloning

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Lecture 35 - Jigs and Thickeners

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Lecture 39 - Off-Highway trucks and Haul Roads - 1

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Lecture 41 - Recent Developments in Truck Transportation

Lecture 42 - RopeCon Transportation

Lecture 43 - Aerial Ropeways: Introduction

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Lecture 45 - Pipe Conveyor Belt: Enclosed Material Transport

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Lecture 48 - Main and Tail and Endless Rope Haulage

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Lecture 50 - Haulage calculation

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Lecture 52 - Low Profile Dumper

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Lecture 54 - Introduction to Cage and Skip Winding

Lecture 55 - Winding Calculations

Lecture 56 - Safety Aspects in Bulk Solid Handling and Transportation

Lecture 57 - Safety Aspects in Bulk Solid Handling and Transportation

Lecture 58 - Basic Introduction of Automatic Control

Lecture 59 - Automating Bulk Solids Processes

Lecture 60 - Online Monitoring

- Lecture 1 - Introduction to Materials and Environment
- Lecture 2 - Genesis of Materials Degradation
- Lecture 3 - Classification of degradation and Parameters Influencing it - Part I
- Lecture 4 - Parameters Influencing Degradation - Part II
- Lecture 5 - Engineering Solution to Combat Environmental Degradation of Materials
- Lecture 6 - Aqueous corrosion-thermodynamics of Wet Corrosion
- Lecture 7 - Aqueous corrosion-Classification - Part I
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- Lecture 9 - Classification of Aqueous corrosion - Part III
- Lecture 10 - Classification of Aqueous corrosion - Part IV
- Lecture 11 - Friction and Wear-Part - I
- Lecture 12 - Friction and Wear-Part - II
- Lecture 13 - Wear- Classification of wear - Part I
- Lecture 14 - Wear- Classification of wear - Part II
- Lecture 15 - Fatigue – Surface Dependent Property
- Lecture 16 - Failure Analysis - Part I
- Lecture 17 - Failure Analysis - Part II
- Lecture 18 - Characteristics of Failure - Part I
- Lecture 19 - Characteristics of Failure - Part II
- Lecture 20 - Characteristics of Failure - Part III
- Lecture 21 - Prevention
- Lecture 22 - Prevention of Chemical/Electrochemical Degradation
- Lecture 23 - Prevention of Chemical/Electrochemical Degradation (Continued...)
- Lecture 24 - Prevention of Chemical/Electrochemical Degradation (Continued...)
- Lecture 25 - Prevention of Mechanical Degradation
- Lecture 26 - Non Destructive Testing
- Lecture 27 - Mechanical and Electrochemical Testing - Part I
- Lecture 28 - Mechanical and Electrochemical Testing - Part II
- Lecture 29 - Mechanical and Electrochemical Testing - Part III
- Lecture 30 - Characterization
- Lecture 31 - Surface/Interface

- Lecture 32 - Scope, Classification and Objectives of Surface Engineering
- Lecture 33 - Shot Peening
- Lecture 34 - Grinding and Polishing
- Lecture 35 - Ultrasonic Peening and Laser Shock Peening
- Lecture 36 - Conventional Surface Hardening (Flame and induction)
- Lecture 37 - Pack Carburizing
- Lecture 38 - Fluidized Bed Carburizing
- Lecture 39 - Fused bath and Gas Nitriding
- Lecture 40 - Plasma Nitriding
- Lecture 41 - Diffusion Based Coatings - Solid State
- Lecture 42 - Chemical Conversion Coatings
- Lecture 43 - Electrodeposition
- Lecture 44 - Electrophoretic and Electroless deposition
- Lecture 45 - Galvanizing and Hot Dipping
- Lecture 46 - Thick Coatings by Weld Overlay and Cladding
- Lecture 47 - Introduction to thin film deposition
- Lecture 48 - Physical Vapor Deposition including Sputtering
- Lecture 49 - Chemical Vapor Deposition (CVD) and Composite Coating
- Lecture 50 - Chemical Vapor Deposition (CVD) and Composite Coating
- Lecture 51 - Spray Coating Techniques II - Plasma Spray and Cold Spray
- Lecture 52 - Ion Implantation
- Lecture 53 - Electron Beam Assisted Surface Engineering
- Lecture 54 - Laser Material Processing
- Lecture 55 - Laser Surface Engineering
- Lecture 56 - Laser Assisted Additive Manufacturing, LAM
- Lecture 57 - Strengthening Mechanisms in Surface Engineering
- Lecture 58 - Microstructural Characterization after Surface Engineering
- Lecture 59 - Compositional Characterization after Surface Engineering
- Lecture 60 - Summary of surface engineering and Conclusion

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Lecture 2 - Theoretical Strengths and Defects

Lecture 3 - Stress Concentration

Lecture 4 - Griffith Criterion

Lecture 5 - Griffith Criteria - Modification

Lecture 6 - Stress Intensity Factor

Lecture 7 - Fracture Toughness and Plane Stress-Plane Strain

Lecture 8 - Plastic Zone Size

Lecture 9 - Plane stress and plane strain fracture toughness

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Lecture 11 - Plane Strain Fracture Toughness Testing

Lecture 12 - Plane Strain-Plane Stress Fracture Toughness Testing

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Lecture 14 - Plane Stress fracture toughness-J integral

Lecture 15 - Experimental determination of JIC

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Lecture 18 - Impact Toughness (Continued...)

Lecture 19 - Impact Toughness (Continued...)

Lecture 20 - Impact Toughness (Continued...)

Lecture 21 - Impact Toughness (Continued...)

Lecture 22 - Fracture Toughness

Lecture 23 - Fracture Toughness (Continued...)

Lecture 24 - Fracture Toughness (Continued...)

Lecture 25 - Fracture Toughness (Continued...)

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- [Lecture 33 - Stress Controlled Fatigue \(Continued...\)](#)
- [Lecture 34 - Stress Controlled Fatigue \(Continued...\)](#)
- [Lecture 35 - Strain Controlled Fatigue \(Continued...\)](#)
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- [Lecture 37 - Strain Controlled Fatigue \(Continued...\)](#)
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- [Lecture 39 - Fatigue Crack Nucleation](#)
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- [Lecture 43 - Fatigue Crack Propagation \(Continued...\)](#)
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- [Lecture 45 - Fatigue Crack Propagation \(Continued...\)](#)
- [Lecture 46 - Fatigue Crack Propagation \(Continued...\)](#)
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Lecture 1 - Introduction to closure concept

Lecture 2 - Mine Closure Objectives and Regulatory Aspects

Lecture 3 - Mining Footprint and Regulatory Aspects

Lecture 4 - Mine Closure Costs and Financing Approaches

Lecture 5 - Decommissioning of Mines

Lecture 6 - Demolition Techniques

Lecture 7 - Post Closure Liabilities and Activities

Lecture 8 - Post Closure Community Concerns and Sustainable Development Plans

Lecture 9 - Closure oriented Resource Development-Post Mining Land Uses

Lecture 10 - Post mining site monitoring

Lecture 11 - Planning inputs, tools and techniques

Lecture 12 - Tools and Techniques for Closure Plan Development and Procedures

Lecture 13 - Closure Plan Development Procedures

Lecture 14 - Monitoring, Review and Feedback of Closure Plan Implementation-Closure Criteria

Lecture 15 - Failure Mode and Effect Analysis Framework for Mine Closure Planning

Lecture 16 - Multiple Accounts Analysis (MAA) for Assessment of Closure Alternatives

Lecture 17 - Provisioning of capital

Lecture 18 - Closure costs and Rehabilitation Costs

Lecture 19 - Finance and Accounting: Closure cost estimate

Lecture 20 - Closure Economics and Audit

Lecture 21 - Application of Remote Sensing for Mine Closure-Introduction

Lecture 22 - Remote Sensing Sensors

Lecture 23 - Remote Sensing media and sensors

Lecture 24 - Image Processing and Data Interpretation

Lecture 25 - GIS for Mine Closure: Mapping and Geo-Spatial Data Analysis

Lecture 26 - Integration of phase operations

Lecture 27 - Integration of Interdepartmental work and phase operations - Part 1

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Lecture 29 - Risk Analysis Techniques and Management

Lecture 30 - Post Mine Closure Waste to Wealth Conversion

Lecture 31 - CSR and EMP Integration

- Lecture 32 - Introduction to Asset Management
- Lecture 33 - Principle of Asset Management and Decommissioning of Assets for Site Restoration
- Lecture 34 - Brownfield Redevelopment and Value Addition to Assets
- Lecture 35 - Landform Design and Post Mining Asset Creation
- Lecture 36 - Concept of Sustainable Development and Mining industry
- Lecture 37 - Sustainability Measurement and Reporting
- Lecture 38 - Sustainability Measurement and Reporting (Continued...)
- Lecture 39 - Sustainable Mineral Industry
- Lecture 40 - Policy and Legislative Framework of Sustainability for SDG and Mine Closure
- Lecture 41 - Communicating sustainability performance
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- Lecture 43 - Sustainable accounting
- Lecture 44 - Case studies on Sustainability initiatives in Mining Industry
- Lecture 45 - Data Analytics for Sustainability management
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- Lecture 48 - Reusable resource identification in post closure mine site
- Lecture 49 - Optimization of Residual Value of Assets
- Lecture 50 - Post Mining Site for Community wealth
- Lecture 51 - Management of water resources
- Lecture 52 - Soil Treatment and Revegetation
- Lecture 53 - Bio-diversity: Post Land reclamation and plantation
- Lecture 54 - Physical and Chemical Stability issues
- Lecture 55 - Economic Utilization of Post Mining Structures and assets
- Lecture 56 - Techniques for closing underground workings
- Lecture 57 - Application of Industry 4.0 for Mine
- Lecture 58 - Best mining practices for Sustainable mining - Case studies
- Lecture 59 - Stability Monitoring and Enhancing tools
- Lecture 60 - VR and AR Technology for Post Mining Mine site Visualization and Design

- Lecture 1 - Fundamental aspects of hybrid materials
- Lecture 2 - Materials selection basics for design with hybrid materials
- Lecture 3 - Classes of materials and material property charts
- Lecture 4 - Material property charts and concept of material indices
- Lecture 5 - Material property chart-indices and concept of hybridization
- Lecture 6 - Hybrid materials - Composite
- Lecture 7 - Cellular solids - Applications of metal foams
- Lecture 8 - Cellular solids - Applications of porous ceramics and polymer foams
- Lecture 9 - Basics of Composite Materials and Classification
- Lecture 10 - Composite Classification - Matrix and Reinforcement
- Lecture 11 - Fibers - Fundamentals, Glass fiber
- Lecture 12 - Fibers - Boron and Carbon Fibers
- Lecture 13 - Fibers - Aramid and Ceramic fibers, Alumina fiber
- Lecture 14 - Fibers - SiC fiber and Whiskers
- Lecture 15 - Metal matrix composites (MMCs) - Basic concept, Liquid state processing
- Lecture 16 - Metal matrix composites (MMCs) - Liquid and Solid state processing
- Lecture 17 - Ceramic Matrix Composites (CMCs) - Basic concept, Processing techniques
- Lecture 18 - Ceramic Matrix Composites (CMCs) - Processing techniques
- Lecture 19 - CMCs and PMCs - Processing and Application
- Lecture 20 - Fabrication of cellular ceramics
- Lecture 21 - Sintering of ceramics - Aspects and mechanisms
- Lecture 22 - Fabrication of cellular ceramics
- Lecture 23 - Processing of metal foams - Foaming techniques
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- Lecture 26 - Polymer foams - Processing and properties
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- Lecture 28 - Cellular solids classification and Structure description
- Lecture 29 - Structure of cellular solids - Pore structure characterization
- Lecture 30 - Interfacial phenomena - Basic concept, Adhesion and Wettability
- Lecture 31 - Interfacial phenomena - Factors affecting wettability

- [Lecture 32 - Interfacial phenomena - Interfacial bonding](#)
- [Lecture 33 - Interfacial phenomena - Interfacial strength measurement](#)
- [Lecture 34 - Interfacial phenomena - Case study - Al-MWCNT nanocomposite](#)
- [Lecture 35 - Interfacial phenomena - Case studies: MMCs and CMCs](#)
- [Lecture 36 - Interfacial phenomena - Case studies: MMCs and CMCs \(Continued...\)](#)
- [Lecture 37 - Mechanics of Composites - Unidirectional Lamina](#)
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- [Lecture 39 - Mechanics: Fiber-reinforced composites - Problem Solving](#)
- [Lecture 40 - Mechanics: Fiber-reinforced composites - Discontinuous fibers](#)
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- [Lecture 42 - Dependence of properties on pore structure](#)
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- [Lecture 44 - Mechanics of cellular solids \(Continued...\)](#)
- [Lecture 45 - Deformation behavior of honeycomb and foams](#)
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- [Lecture 47 - Deformation behaviour of Foams \(Continued...\)](#)
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- [Lecture 49 - Thermal properties of foams](#)
- [Lecture 50 - Other important properties of foams \(Continued...\)](#)
- [Lecture 51 - Advanced composites - MMCs](#)
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- [Lecture 54 - Advanced composites - Advanced Processing Techniques](#)
- [Lecture 55 - Advanced composites - Advanced Processing Techniques \(Continued...\)](#)
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- [Lecture 57 - Advanced composites - Application oriented advanced composites](#)
- [Lecture 58 - Microstructure and properties of natural cellular solid - wood](#)
- [Lecture 59 - Advanced hybrid material - Functionally graded composite materials \(FGMs\)](#)
- [Lecture 60 - Advanced hybrid material - Functionally graded composite materials \(FGMs\) \(Continued...\)](#)

Lecture 1 - Basic definitions

Lecture 2 - Free energy, Stability, equilibrium in a unary system

Lecture 3 - Effect of Pressure on equilibrium transformations: Clausius Clapeyron equation, phase diagram for unary system

Lecture 4 - Free energy of solutions, free energy-composition diagrams

Lecture 5 - Solution models, chemical potential

Lecture 6 - Phase rule, free energy-composition diagrams and phase diagrams

Lecture 7 - Evolution of phase diagrams

Lecture 8 - Evolution of phase diagrams, miscibility gap

Lecture 9 - To concept, partition less solidification

Lecture 10 - To concept, partition less solidification (Continued...)

Lecture 11 - Eutectic solidification, glass formation

Lecture 12 - Kauzmann paradox, order of a transformation, glass forming ability

Lecture 13 - Eutectic solidification, coupled growth, heterogeneous nucleation

Lecture 14 - Peritectic solidification, metastable phase diagrams

Lecture 15 - Errors in drawing phase diagrams, Fe-C vs. Fe-Fe₃C phase diagram

Lecture 16 - Free energy of undercooled liquid, shape of nucleus

Lecture 17 - Solid state phase transformations - Precipitation

Lecture 18 - Precipitation

Lecture 19 - Precipitation - quasicrystals

Lecture 20 - Precipitate coarsening, stability of a phase, spinodal decomposition

Lecture 21 - Spinodal decomposition

Lecture 22 - Eutectoid reaction

Lecture 23 - Eutectoid reaction (Continued...)

Lecture 24 - Bainitic transformation

Lecture 25 - Kinetics of eutectoid transformations

Lecture 26 - Martensitic Transformation

Lecture 27 - Martensitic transformation, order-disorder transformation

Lecture 28 - Miscibility gap in phase diagrams

Lecture 29 - Phase diagram calculations

Lecture 30 - Thermodynamics of heterogeneous systems

Lecture 31 - Thermodynamics of heterogeneous systems (Continued...)

Lecture 1 - Properties of light, Image formation

Lecture 2 - Magnification and resolution

Lecture 3 - Depth of field, focus and field of view

Lecture 4 - Lens defects, filters and light microscopy introduction

Lecture 5 - Optical microscope demo., Bright field imaging, opaque specimen illumination

Lecture 6 - Opaque stop microscopy, Phase contrast microscopy

Lecture 7 - Dark field microscopy, Polarization microscopy

Lecture 8 - Differential interference contrast and fluorescence microscopy

Lecture 9 - Sample preparation techniques for optical microscopy

Lecture 10A - Tutorial problems (Continuation...)

Lecture 10 - Tutorial problems

Lecture 11 - Introduction to scanning electron Microscopy

Lecture 12 - Lens aberrations, Object resolution, Image quality

Lecture 13 - Interaction between electrons and sample, Imaging capabilities, Structural analysis, Elemental analysis

Lecture 14 - SEM and its mode of operation, Effect of aperture size, Working distance, condenser lens strength

Lecture 15 - SEM and its mode of operation- continuation, Relation between probe current and probe diameter, Summary

Lecture 16 - Factors affecting Interaction volume, Demonstration of SEM

Lecture 17 - Image formation and interpretation

Lecture 18 - Image formation and interpretation continued, EDS, WDS

Lecture 19 - Special contrast mechanisms, Monte Carlo simulations of Interaction volume

Lecture 20 - Electron channeling contrast imaging (ECCI), Electron back scattered diffraction (EBSD)-Theory & instrument demonstration

Lecture 21 - Tutorial Problems on SEM

Lecture 22 - Basics of X-ray emission from source, electron excitation and X-ray interaction with materials in general

Lecture 23 - Properties of X-rays

Lecture 24 - Bragg's Law Derivation

Lecture 25 - Diffraction relationship with reciprocal space

Lecture 26 - X-ray scattering

Lecture 27 - Factors affecting intensities of X-ray peaks

Lecture 28 - Factors affecting intensities of X-ray peaks- continuation

Lecture 29 - Effect of crystallite size and strain on intensity of X-rays

- Lecture 30 - Profile fit, Factors affecting peak broadening
- Lecture 31 - Indexing of diffraction pattern, Quantitative analysis
- Lecture 32 - Indexing, Quantitative analysis-continuation, Residual stress measurements
- Lecture 33 - XRD and Residual stress measurement- lab demonstration
- Lecture 34 - Introduction to Transmission Electron Microscopy (TEM)
- Lecture 35 - Fundamentals of Transmission Electron Microscopy (TEM)
- Lecture 36 - Basics of Diffraction-1
- Lecture 37 - Basics of Diffraction-2
- Lecture 38 - TEM imaging-1
- Lecture 39 - TEM imaging-2
- Lecture 40 - TEM instrument demonstration
- Lecture 41 - TEM sample preparation-1
- Lecture 42 - TEM sample preparation-2
- Lecture 43 - XRD Tutorial - 1
- Lecture 44 - XRD tutorial - 2
- Lecture 45 - TEM Tutorial - 1
- Lecture 46 - TEM Tutorial - 2
- Lecture 47 - Quantitative metallography - Tutorial 1
- Lecture 48 - Quantitative metallography - Tutorial 2
- Lecture 49 - Quantitative metallography - Tutorial 3
- Lecture 50 - Quantitative metallography - Tutorial 4
- Lecture 51 - Quantitative metallography - Tutorial 5
- Lecture 52 - Quantitative metallography - Tutorial 6
- Lecture 53 - Quantitative metallography - Tutorial 7

Lecture 1 - Introduction

Lecture 2 - Properties of Materials

Lecture 3 - Thermal Expansion

Lecture 4 - Measuring Electrical Conductivity: DC and AC

Lecture 5 - Free Electron Gas

Lecture 6 - The Ideal Gas

Lecture 7 - Drude Model: Electrical Conductivity

Lecture 8 - Drude Model: Thermal Conductivity

Lecture 9 - Drude Model: Successes and Limitations

Lecture 10 - Drude Model: Source of Shortcomings

Lecture 11 - Large Systems and Statistical Mechanics

Lecture 12 - Maxwell Boltzmann Statistics

Lecture 13 - Classical Particles and Quantum Particles

Lecture 14 - History of Quantum Mechanics - 1

Lecture 15 - History of Quantum Mechanics - 2

Lecture 16 - Introduction to Drude Sommerfeld model

Lecture 17 - Fermi-Dirac Statistics - Part 1

Lecture 18 - Fermi-Dirac Statistics - Part 2

Lecture 19 - Features of the Fermi Dirac Distribution Function

Lecture 20 - Maxwell-Boltzmann Distribution Vs Fermi-Dirac Distribution

Lecture 21 - Anisotropy and Periodic Potential in a Solid

Lecture 22 - Confinement and Quantization - Part 1

Lecture 23 - Confinement and Quantization - Part 2

Lecture 24 - Density of States

Lecture 25 - Fermi Energy, Fermi Surface, Fermi Temperature

Lecture 26 - Electronic Contribution to Specific Heat at Constant Volume

Lecture 27 - Reciprocal Space-1: Introduction to Reciprocal Space

Lecture 28 - Reciprocal Space-2: Condition for Diffraction

Lecture 29 - Reciprocal Space-3: Ewald sphere, Simple Cubic, FCC and BCC in Reciprocal Space

Lecture 30 - Wigner Seitz Cell and Introduction to Brillouin Zones

Lecture 31 - Brillouin Zones, Diffraction, and Allowed Energy Levels

[Lecture 32 - E Vs k, Brillouin Zones and the Origin of Bands](#)

[Lecture 33 - Calculating Allowed Energy Bands and Forbidden Band Gaps](#)

[Lecture 34 - Bands; Free Electron Approximation, Tight Binding Approximation](#)

[Lecture 35 - Semiconductors](#)

[Lecture 36 - Magnetic Properties](#)

[Lecture 37 - Electron Compounds; Phonons, Optoelectronic Materials](#)

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- Lecture 1 - Metals, semiconductors and insulators
- Lecture 2 - Introduction to semiconductors
- Lecture 3 - Density of states and Fermi-Dirac statistics
- Lecture 4 - Assignment 1 - Bonding, DOS, and Fermi statistics
- Lecture 5 - Intrinsic semiconductors
- Lecture 6 - Intrinsic semiconductors - conductivity
- Lecture 7 - Assignment 2 - Intrinsic semiconductors
- Lecture 8 - Extrinsic semiconductors
- Lecture 9 - Extrinsic semiconductors - Fermi level
- Lecture 10 - Extrinsic semiconductors - conductivity
- Lecture 11 - Assignment 3 - Extrinsic semiconductors
- Lecture 12 - Metal-semiconductor junctions
- Lecture 13 - Assignment 4 - Metal-semiconductor junctions
- Lecture 14 - pn junctions in equilibrium
- Lecture 15 - pn junctions under bias
- Lecture 16 - pn junction breakdown and heterojunctions
- Lecture 17 - Assignment 5 - pn junctions
- Lecture 18 - Transistors
- Lecture 19 - MOSFETs
- Lecture 20 - Assignment 6 - transistors
- Lecture 21 - Optoelectronic devices: Introduction
- Lecture 22 - Optoelectronic devices: LEDs
- Lecture 23 - Optoelectronic devices: LASERS
- Lecture 24 - Optoelectronic devices: photodetector
- Lecture 25 - Optoelectronic devices: solar cells
- Lecture 26 - Assignment 7 - optical properties
- Lecture 27 - Assignment 8 - optoelectronic devices
- Lecture 28 - Semiconductor manufacturing: Introduction
- Lecture 29 - Si wafer manufacturing
- Lecture 30 - IC device manufacturing: overview
- Lecture 31 - Layering: thermal oxidation

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[Lecture 33 - Lithography](#)

[Lecture 34 - Etching and deposition \(growth\)](#)

[Lecture 35 - Metallization and polishing](#)

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[Lecture 39 - Devices and IC formation](#)

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Lecture 7 - Dark field microscopy, Polarization microscopy

Lecture 8 - Differential interference contrast and fluorescence microscopy

Lecture 9 - Sample preparation techniques for optical microscopy

Lecture 10 - Tutorial problems

Lecture 11 - Tutorial problems (Continued...)

Lecture 12 - Introduction to scanning electron Microscopy

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Lecture 14 - Interaction between electrons and sample, Imaging capabilities, Structural analysis, Elemental analysis

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Lecture 19 - Image formation and interpretation continued, EDS, WDS

Lecture 20 - Special contrast mechanisms, Monte Carlo simulations of Interaction volume

Lecture 21 - Electron channeling contrast imaging (ECCI), Electron back scattered diffraction (EBSD)-Theory & instrument demonstration

Lecture 22 - Tutorial Problems on SEM

- Lecture 1 - Electronic Materials
- Lecture 2 - Semiconductors - Introduction
- Lecture 3 - Electron statistics in a solid
- Lecture 4 - Worked numericals on week 1 lessons
- Lecture 5 - Intrinsic semiconductors
- Lecture 6 - Intrinsic semiconductors - conductivity
- Lecture 7 - Optional - worked assignment on intrinsic semiconductors
- Lecture 8 - Extrinsic semiconductors - Introduction
- Lecture 9 - Extrinsic semiconductors - Fermi level
- Lecture 10 - Extrinsic semiconductors - Mobility
- Lecture 11 - Worked assignment on extrinsic semiconductors
- Lecture 12 - Metal-semiconductor junctions
- Lecture 13 - pn junctions in equilibrium
- Lecture 14 - Optional - worked assignment on metal-semiconductor junctions
- Lecture 15 - pn junctions under bias
- Lecture 16 - Junction breakdown and heterojunctions
- Lecture 17 - Worked assignment on pn junctions
- Lecture 18 - Transistors - overview
- Lecture 19 - MOSFETs
- Lecture 20 - Worked assignment on transistors
- Lecture 21 - Optoelectronic devices - Introduction
- Lecture 22 - Light emitting diodes
- Lecture 23 - Solid state semiconductor lasers
- Lecture 24 - Optional - worked assignment on optical properties
- Lecture 25 - Photodetectors
- Lecture 26 - Solar cells
- Lecture 27 - Worked assignment on optoelectronic devices

Lecture 1 - Reciprocal space; Definition and Properties

Lecture 2 - Condition for Diffraction

Lecture 3 - Worked out examples

Lecture 4 - Ewald Sphere and lattices in reciprocal space

Lecture 5 - Wigner Sietz cells and Brillouin Zones

Lecture 6 - Worked out exmaples

Lecture 7 - Brillouin Zones, Diffraction and allowed energy levels

Lecture 8 - E Vs K, Brillouin zones and the Origin of Bands

Lecture 9 - Week 3 Worked out examples

Lecture 10 - Reciprocal space as Fourier transform of real lattice

Lecture 11 - Alternate notation of reciprocal space

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Lecture 2 - Introduction to fusion welding processes: Part 2/2

Lecture 3 - Heat sources - Part 1/2

Lecture 4 - Heat sources - Part 2/2

Lecture 5 - Heat removal

Lecture 6 - Thermal Modelling - Part 1/2

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Lecture 8 - Zones in a weldment

Lecture 9 - Analytical Solutions to Weld Thermal Field

Lecture 10 - Conduction to Keyhole mode

Lecture 11 - Fluid flow modelling - Part 1/2

Lecture 12 - Fluid flow modelling - Part 2/2

Lecture 13 - Solute transfer modelling - Part 1/2

Lecture 14 - Solute transfer modelling - Part 2/2

Lecture 15 - Solute segregation profile - Part 1/2

Lecture 16 - Solute segregation profile - Part 2/2

Lecture 17 - Microstructure Formation in Fusion Welds

Lecture 18 - Numerical Solutions to Thermal Field and Fluid Flow in Welding - Part 1

Lecture 19 - Numerical Solutions to Thermal Field and Fluid Flow in Welding - Part 2

Lecture 20 - Dissimilar Welding

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Lecture 2 - Properties of X-rays

Lecture 3 - Bragg's law derivation

Lecture 4 - Diffraction relationship with reciprocal space

Lecture 5 - X-ray scattering

Lecture 6 - Factors affecting intensities of X-ray peaks

Lecture 7 - Factors affecting intensities of X-ray peaks (Continued...)

Lecture 8 - Effect of crystallite size and strain on intensity of X-rays

Lecture 9 - Profile fit, Factors affecting peak broadening

Lecture 10 - Indexing of diffraction pattern, Quantitative analysis

Lecture 11 - Indexing and Quantitative analysis-continuation, Residual stress measurements

Lecture 12 - XRD and Residual stress measurement - lab demonstration

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Lecture 14 - XRD tutorial - 2

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Lecture 22 - TEM sample preparation - 1

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Lecture 1 - Visual optical method

Lecture 2 - Dye Penetrant Testing - 1

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Lecture 4 - Dye Penetrant Testing - 3

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Lecture 6 - Magnetic particle testing - 1

Lecture 7 - Magnetic particle testing - 2

Lecture 8 - Magnetic particle testing - 3

Lecture 9 - Magnetic particle testing - 4

Lecture 10 - Magnetic particle testing - 5

Lecture 11 - Eddy current testing - 1

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Lecture 13 - Eddy current testing - 3

Lecture 14 - Eddy current testing - 4

Lecture 15 - Eddy current testing - 5

Lecture 16 - Ultrasonic testing - 1

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Lecture 23 - Ultrasonic testing - 8

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Lecture 26 - Acoustic Emission Testing - 1

Lecture 27 - Acoustic Emission Testing - 2

Lecture 28 - Acoustic Emission Testing - 3

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Lecture 1 - Introduction to defects in materials

Lecture 2 - 1-D Lattice

Lecture 3 - 2-D Lattice

Lecture 4 - 3-D Lattice - a

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Lecture 7 - 3-D Crystals

Lecture 8 - Types of Point Defects

Lecture 9 - Vacancy Concentration Determination - 1

Lecture 10 - Vacancy Concentration Determination - 2

Lecture 11 - Point Defect Interstitial

Lecture 12 - Transformation of co-ordinates

Lecture 13 - Tensor - 1

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Lecture 15 - Strain

Lecture 16 - Stress

Lecture 17 - Description of Dislocation - 1

Lecture 18 - Description of Dislocation - 2

Lecture 19 - Stress field around Dislocation

Lecture 20 - Self Energy of Dislocation

Lecture 21 - Force on Dislocation

Lecture 22 - Forces Between Dislocation

Lecture 23 - Chemical Force on Dislocation

Lecture 24 - Perfect Dislocation in FCC Structures

Lecture 25 - Intrinsic Stacking Faults in FCC

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Lecture 27 - Dislocations in BCC and HCP

Lecture 28 - Dislocations in Ordered Alloys and Dislocation Dislocation Interaction

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Lecture 31 - Martensitic Transformation - 1

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[Lecture 35 - Defect Interaction and Strength](#)

Lecture 1 - Method of Stereology

Lecture 2 - Volume Fraction and Particle Size - Part 1

Lecture 3 - Volume Fraction and Particle Size - Part 2

Lecture 4 - Geometric Probability - Part 1

Lecture 5 - Geometric Probability - Part 2

Lecture 6 - Probability Distributions

Lecture 7 - Volume Fraction and Particle Size - Part 3

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Lecture 9 - Geometrical Probability - I

Lecture 10 - Geometrical Probability - II

Lecture 11 - Basic Stereological Parameters - Part 1

Lecture 12 - Basic Stereological Parameters - Part 2

Lecture 13 - Counting of grains and particles - Part 1

Lecture 14 - Description of Polycrystalline Microstructures derived measures

Lecture 15 - Counting of grains and particles - Part 2

Lecture 16 - Counting of Grains and Particles - Part 3

Lecture 17 - Counting of Grains and Particles - Part 4

Lecture 18 - Other Applications of the Disector

Lecture 19 - Stereology of Anisotropic Microstructures

- Lecture 1 - Introduction to the course, Introduction to physical metallurgy of steels
- Lecture 2 - Martensitic transformation, Introduction to modern automotive steels
- Lecture 3 - Introduction to modern automotive steels
- Lecture 4 - Introduction to advanced high strength steels
- Lecture 5 - Introduction to Dual Phase Steel and TRIP Steel Heat Treatments
- Lecture 6 - Thermal and Mechanical Processing of TRIP and Hot Forming Steels
- Lecture 7 - Introduction to Welding Processes in Automotive Industries
- Lecture 8 - Principles of Resistance Spot Welding (RSW)
- Lecture 9 - Process Characteristics of Resistance Spot Welding - Part I
- Lecture 10 - Process Characteristics of Resistance Spot Welding - Part II
- Lecture 11 - Introduction to Laser Beam Welding - Part I
- Lecture 12 - Introduction to Laser Beam Welding - Part II
- Lecture 13 - Principles of Gas Metal Arc Welding - Part I
- Lecture 14 - Principles of Gas Metal Arc Welding - Part II
- Lecture 15 - Welding Metallurgy of Advanced High Strength Steels - Part I
- Lecture 16 - Microstructural Evolution During Welding of Advanced High Strength Steels
- Lecture 17 - Elemental Behaviour During Welding of Advanced High Strength Steels
- Lecture 18 - Quantification of Microstructural Constituents in Automotive Steel Welds - Part I
- Lecture 19 - Quantification of Microstructural Constituents in Automotive Steel Welds - Part II and Mechanical Properties
- Lecture 20 - Methodologies to Improve the Weldability of Advanced High Strength Steels

- Lecture 1 - Introduction to the course
- Lecture 2 - Classification of welding processes and definition of welding arc
- Lecture 3 - Physics of welding arc - Part 1
- Lecture 4 - Physics of welding arc - Part 2
- Lecture 5 - Physics of welding arc - Part 3
- Lecture 6 - Physics of welding arc - Part 4
- Lecture 7 - Fundamentals of ionisation in welding arc
- Lecture 8 - Electrical conductivity of welding arc
- Lecture 9 - Electrical resistivity of welding arc
- Lecture 10 - Heat transfer inside the arc
- Lecture 11 - Arc ignition mechanisms Part - I
- Lecture 12 - Arc ignition mechanisms Part - II
- Lecture 13 - Principles of Gas Tungsten Arc Welding
- Lecture 14 - Shielding gases for arc welding
- Lecture 15 - Selection of shielding gases for engineering alloys
- Lecture 16 - Arc welding power sources - Part 1
- Lecture 17 - Arc welding power sources - Part 2
- Lecture 18 - Arc welding power sources - Part 3
- Lecture 19 - Variations in GTAW process
- Lecture 20 - Square wave, variable polarity, GTAW with filler, hot wire GTAW
- Lecture 21 - Dual gas GTAW and Plasma Welding processes
- Lecture 22 - Multi cathode GTAW and Activated GTAW
- Lecture 23 - Buried GTAW and Rate controlling parameters of GTAW
- Lecture 24 - Introduction to consumable welding processes
- Lecture 25 - Melting rate of consumable wires
- Lecture 26 - Physics of droplet transfer in consumable welding
- Lecture 27 - Modes of droplet transfer - Part 1
- Lecture 28 - Modes of droplet transfer - Part 2
- Lecture 29 - Modes of droplet transfer - Part 3
- Lecture 30 - Shielded Metal Arc Welding
- Lecture 31 - Flux cored arc welding - Introduction

- Lecture 32 - Electrode fluxes and process characteristics of flux cored arc welding
- Lecture 33 - Flux cored arc welding - Process characteristics
- Lecture 34 - Advances in gas metal arc welding - Pulsed GMAW
- Lecture 35 - Advances in gas metal arc welding - Controlled dip short circuiting processes
- Lecture 36 - Submerged arc welding
- Lecture 37 - Resistance welding - Fundamentals
- Lecture 38 - Resistance spot welding - Part 1
- Lecture 39 - Resistance spot welding - Part 2
- Lecture 40 - Resistance spot welding - Part 3
- Lecture 41 - Resistance spot welding - Part 4
- Lecture 42 - Variants in resistance welding - Part 1
- Lecture 43 - Variants in resistance welding - Part 2
- Lecture 44 - Laser welding process - Introduction - Part 1
- Lecture 45 - Laser welding process - Part 2
- Lecture 46 - Laser welding process - Part 3
- Lecture 47 - Laser welding process - Part 4
- Lecture 48 - Electron beam welding process
- Lecture 49 - Other welding processes - Electroslag welding
- Lecture 50 - Magnetically Impelled Arc Butt (MIAB) welding
- Lecture 51 - Aluminothermic (thermit) welding
- Lecture 52 - Introduction to solid state welding processes - Friction welding
- Lecture 53 - Friction stir welding - Part 1
- Lecture 54 - Friction stir welding - Part 2
- Lecture 55 - Other solid state welding processes
- Lecture 56 - Joining processes for Plastics - Part 1
- Lecture 57 - Joining processes for Plastics - Part 2
- Lecture 58 - Adhesive bonding of plastics
- Lecture 59 - Welding nomenclatures

- Lecture 1 - Importance of studying creep
- Lecture 2 - Basics of plastic deformation and characteristics of dislocations - Part 1
- Lecture 3 - Basics of plastic deformation and characteristics of dislocations - Part 2
- Lecture 4 - Basics of plastic deformation and characteristics of dislocations - Part 3
- Lecture 5 - Creep and different factors that influence creep deformation - Part 1
- Lecture 6 - Creep and different factors that influence creep deformation - Part 2
- Lecture 7 - Creep and different factors that influence creep deformation - Part 3
- Lecture 8 - Creep and different factors that influence creep deformation - Part 4
- Lecture 9 - Creep and different factors that influence creep deformation - Part 5
- Lecture 10 - Creep and different factors that influence creep deformation - Part 6
- Lecture 11 - Mechanisms of Creep - Part 1
- Lecture 12 - Mechanisms of Creep - Part 2
- Lecture 13 - Mechanisms of Creep - Part 3
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- Lecture 16 - Transitions in Creep Mechanisms and Creep Constitutive Equation
- Lecture 17 - Deformation Mechanism Maps - Part 1
- Lecture 18 - Deformation Mechanism Maps - Part 2
- Lecture 19 - Modeling the Useful Creep Life of Materials/Components - Part 1
- Lecture 20 - Modeling the Useful Creep Life of Materials/Components - Part 2
- Lecture 21 - Modeling the Useful Creep Life of Materials/Components - Part 3
- Lecture 22 - Creep Testing Methods - Part 1
- Lecture 23 - Creep Testing Methods - Part 2
- Lecture 24 - Improving Creep Resistance of Materials

- Lecture 1 - Nanotechnology Science and Applications - Introduction
- Lecture 2 - Nanotechnology : A Walk through History
- Lecture 3 - Discussion on Feynman's talk on Nanotechnology - Part I
- Lecture 4 - Discussion on Feynman's talk on Nanotechnology - Part II
- Lecture 5 - Impact of the nanoscale on thermodynamic considerations
- Lecture 6 - Phase Diagrams and Stable Phases
- Lecture 7 - Calorimetry
- Lecture 8 - Zirconia - ZrO₂
- Lecture 9 - Experimentally Investigating the Hall-Petch relationship
- Lecture 10 - Impact of the Nanoscale on the Hall-Petch Relationship
- Lecture 11 - Impact of the nanoscale on Mechanical properties
- Lecture 12 - Superplasticity and the Nanoscale: Background
- Lecture 13 - Superplasticity and the Nanoscale: Experimental aspects
- Lecture 14 - Severe Plastic Deformation and the nanoscale: Experimental Utility
- Lecture 15 - An approach to prepare bulk nanostructures
- Lecture 16 - Nanosized Ferroelectrics
- Lecture 17 - Impact of the nanoscale on optical properties
- Lecture 18 - Experimental approach to study impact of the nanoscale on optical properties
- Lecture 19 - Impact of the nanoscale on optical properties: measurements
- Lecture 20 - Nanocomposites
- Lecture 21 - Effect of Nanoscale on Magnetic Properties: Potential use of biomaterials
- Lecture 22 - Effect of Nanostructure on Damping Properties
- Lecture 23 - Carbon
- Lecture 24 - Carbon Nanotubes
- Lecture 25 - Graphene, a 2D nanomaterials

Lecture 1 - Introduction to Powder Metallurgy

Lecture 2 - Powder Fabrication Methods: Mechanical Fabrication

Lecture 3 - Powder Fabrication Methods: Mechanical and Electrolytic Fabrication

Lecture 4 - Powder Fabrication Methods: Chemical Fabrication

Lecture 5 - Powder Fabrication Methods: Atomization

Lecture 6 - Gas atomization

Lecture 7 - Water Atomization

Lecture 8 - Centrifugal Atomization

Lecture 9 - Comparison of Atomization techniques

Lecture 10 - Nucleation and Growth

Lecture 11 - Thermodynamics and Kinetic of Solidification

Lecture 12 - Microstructure Control

Lecture 13 - Microstructure control: Effect of process parameters

Lecture 14 - Dendritic growth in pure metals

Lecture 15 - Dendritic growth in alloys

Lecture 16 - Crystalline and Amorphous structures

Lecture 17 - Crystalline vs Amorphous

Lecture 18 - T-T-T diagram: Formation of Amorphous solids

Lecture 19 - Effect of particle size on microstructure

Lecture 20 - Powder Characterization

Lecture 21 - Basis for particle size measurement

Lecture 22 - Measurement of particle size and size distribution

Lecture 23 - Particle size distribution

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