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Lecture 20 - Heat Utilization in Furnaces: Heat Recovery Concepts and Illustrations

Lecture 21 - Transport Phenomena in Furnaces: Fluid Flow

Lecture 22 - Macroscopic Energy Balance: Concepts

Lecture 23 - Macroscopic Energy Balance: Applications to Design Head Meters, Stack and Blowers, Types of Flames

Lecture 24 - Macroscopic Energy Balance: Applications to Design Head Meters, Stack and Blowers, Types of Flames

Lecture 25 - Macroscopic Energy Balance: Applications to Design Head Meters, Stack and Blowers, Types of Flames

Lecture 26 - Macroscopic Energy Balance: Applications to Design Head Meters, Stack and Blowers, Types of Flames

Lecture 27 - Principles of Burner Design

Lecture 28 - Transport Phenomena in Furnaces: Heat Transfer and Refractory Design

Lecture 29 - Transport Phenomena in Furnaces: Heat Transfer and Refractory Design

Lecture 30 - Transport Phenomena in Furnaces: Convection and Radiation Heat Transfer, Role of Refractory

Lecture 31 - Transport Phenomena in Furnaces: Convection and Radiation Heat Transfer, Role of Refractory

[Lecture 32 - Steady Heat flows in Furnace and Heat Exchanger](#)

[Lecture 33 - Exercises on Heat Flow in Furnaces and Heat Exchangers](#)

[Lecture 34 - Exercises on Heat Flow in Furnaces and Heat Exchangers](#)

[Lecture 35 - Miscellaneous Topics: Atmosphere in Furnaces](#)

[Lecture 36 - Miscellaneous Topics: Pyrometry](#)

[Lecture 37 - Miscellaneous Topics: Pyrometry](#)

[Lecture 38 - Miscellaneous topics: Electric Resistance Heating](#)

[Lecture 39 - Furnace efficiency, Fuel Saving, Carbon Offset: Concepts and Exercises](#)

[Lecture 40 - Furnace efficiency, Fuel Saving, Carbon Offset: Concepts and Exercises](#)

NPTEL : Introduction to Biomaterials (Metallurgy and Material Science)

Co-ordinators : Dr. Kantesh Balani, Dr. Birkamjit Basu

Lecture 1 - Introduction to basic concepts of Biomaterials Science; Salient properties of important material classes; overview of body environment,

Lecture 2 - Manufacturing and properties of metals, ceramics, polymers and composites

Lecture 3 - Concept of biocompatibility, host response, structure-property of biological cell

Lecture 4 - Structure and properties of cells, protein and cellular adaptation process

Lecture 5 - Cell-I

Lecture 6 - Cell-II

Lecture 7 - Cell Migration and Cell Division and cell death

Lecture 8 - Cell Differentiation and Cell Death

Lecture 9 - Cell Apoptosis-I

Lecture 10 - Cell Apoptosis-II

Lecture 11 - Structure and properties of Protein; cell - material interaction

Lecture 12 - Assessment of biocompatibility of biomaterials

Lecture 13 - Biological testing (hemocompatibility, tribological testing)

Lecture 14 - Structure and properties of bone as well as in vivo testing and histocompatibility assessment

Lecture 15 - Important biometallic alloys

Lecture 16 - Ti Alloy

Lecture 17 - Co-Cr-Mo alloys

Lecture 18 - Bioceramics

Lecture 19 - Processing of Bioceramics

Lecture 20 - Ceramics, Bioceramics and Glasses

Lecture 21 - Sintering and mechanical properties of ceramics

Lecture 22 - Fracture and toughening of ceramic composites

Lecture 23 - Development of based bioceramic composites for hard tissue replacement

Lecture 24 - Alternative phosphate materials, based composites with bactericidal property and glass ceramics for dental restoration

Lecture 25 - Electrostatic Spraying of UHMWPE-HA-CNT composites

Lecture 26 - Thin Films and Coatings

Lecture 27 - Thermal Spray Coatings

Lecture 28 - Biocompatibility of plasma sprayed CNT reinforced Hydroxyapatite biocomposite coatings

Lecture 29 - Biocompatibility of Alumina and CNT reinforced Hydroxyapatite

Lecture 30 - Glass-ceramics for dental restoration applications

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Lecture 31 - Structure and properties of polymers

Lecture 32 - Biodegradable polymers (Importance)

Lecture 33 - Biodegradable polymers (Types)

Lecture 34 - Mechanisms of Bioerosion

Lecture 35 - External field and material interaction

Lecture 36 - Tissue Engineering and wound healing

Lecture 37 - Understanding Design Concepts of Bio-implants

Lecture 38 - Understanding Design Concepts of Dental-implants

Lecture 39 - Understanding Design Concepts of Orthopedic-implant

Lecture 1 - Introduction to Course

Lecture 2 - Measurement of Quantities

Lecture 3 - Exercises on Measurement of Quantities, Introduction to Stoichiometry

Lecture 4 - Stoichiometry Concept and Exercise

Lecture 5 - Exercise on Stoichiometry and Introduction to Thermochemistry

Lecture 6 - Thermochemistry

Lecture 7 - Exercise on Thermochemistry & Frequently Asked Questions

Lecture 8 - Errors in Measurements

Lecture 9 - Basics of Materials & Energy Balance

Lecture 10 - Introduction to Mineral Beneficiation

Lecture 11 - Materials Balance in Mineral Processing and Faq

Lecture 12 - Exercises in Mineral Processing

Lecture 13 - Calcination Concepts & Exercises

Lecture 14 - Pyromet Extraction Unit Processes

Lecture 15 - Predominance Area Diagram

Lecture 16 - Material Balance in Roasting; illustration

Lecture 17 - Heat Balance in Roasting illustration

Lecture 18 - Exercises on Roasting

Lecture 19 - Exercises on Roasting

Lecture 20 - Smelting Matte Smelting

Lecture 21 - Exercise-I Matte Smelting

Lecture 22 - Exercise-II Matte Smelting

Lecture 23 - Reduction Smelting

Lecture 24 - Lead Smelting Material Balance

Lecture 25 - Imperial Smelting Process

Lecture 26 - Introduction to Ironmaking

Lecture 27 - Coke Making

Lecture 28 - Ironmaking Fundamentals

Lecture 29 - Material & Heat Balance in Ironmaking - I

Lecture 30 - Material & Heat Balance in Ironmaking - II

Lecture 31 - RIST Diagram - I

[Lecture 32 - RIST Diagram - II](#)

[Lecture 33 - Concepts in Converting](#)

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[Lecture 35 - Additional Topics - I Melting in Cupola](#)

[Lecture 36 - Additional Topics - II Gasification](#)

[Lecture 37 - Additional Topics - III Material Balance in Gasification](#)

[Lecture 38 - Additional Topics - IV Industrial Furnaces](#)

[Lecture 39 - Energy Balance in Industrial Furnaces](#)

[Lecture 40 - Thoughts on Application of Energy Balance](#)

Lecture 1 - Conductivity of materials, Drude's theory and its failures

Lecture 2 - Free electron theory

Lecture 3 - Free electron theory

Lecture 4 - Crystal structure, Reciprocal lattice I

Lecture 5 - Reciprocal lattice II, Brillouin zone and Bragg's diffraction condition

Lecture 6 - Electrons in a crystal, Bloch's electron

Lecture 7 - Free electron band diagrams in an empty lattice

Lecture 8 - Effect of periodic potential, Origin of band-gap through Kronig-Penny model

Lecture 9 - Electron dynamics

Lecture 10 - Conduction in relation to band diagrams

Lecture 11 - Semiconductor E-k diagrams and their material properties

Lecture 12 - Equilibrium carrier statistics in semiconductors: density of states, fermi function and population density in bands

Lecture 13 - Equilibrium carrier statistics in semiconductors: qualitative examination of carrier densities in conduction and valence bands

Lecture 14 - Equilibrium carrier statistics in semiconductors: quantitative examination of carrier densities in intrinsic semiconductor

Lecture 15 - Doping in semiconductors

Lecture 16 - Equilibrium carrier statistics in semiconductors: complete ionization of dopant levels

Lecture 17 - Equilibrium carrier statistics in semiconductors: carrier freeze out

Lecture 18 - Semiconductor junctions in band-diagrams

Lecture 19 - Linear dielectric behavior

Lecture 20 - Non-linear dielectric behavior

Lecture 21 - Carrier recombination-generation - I: band-to-band transition

Lecture 22 - Carrier recombination-generation - II: Other mechanisms

Lecture 23 - R-G statistics via R-G centers

Lecture 24 - Optoelectronic materials and bandgap engineering

Lecture 25 - Optical properties of materials

Lecture 26 - Optical properties of single interfaces: Fresnel reflection coefficients

Lecture 27 - Optical Properties of two interfaces: thin film case

Lecture 28 - Drift

Lecture 29 - Diffusion

Lecture 30 - Continuity Equation

[Lecture 31 - Resistor and diode \(p-n junction\)](#)

[Lecture 32 - Fundamentals of p-n junction](#)

[Lecture 33 - Fundamentals of p-n junction \(Continued...\)](#)

[Lecture 34 - Solar cells](#)

[Lecture 35 - Microelectronics processing](#)

[Lecture 36 - MOS capacitor](#)

[Lecture 37 - Transistor](#)

[Lecture 38 - Organic Electronics](#)

[Lecture 39 - Organic Light Emitting Diodes](#)

[Lecture 40 - Organic Solar Cells and Organics Thin Film Transistors](#)

NPTEL : Steel Making (Metallurgy and Material Science)

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

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Lecture 1 - Introduction, Basic definition of corrosion

Lecture 2 - Forms of Degradation, Thermodynamics of corrosion

Lecture 3 - Thermodynamics of corrosion

Lecture 4 - Thermodynamics of corrosion

Lecture 5 - Thermodynamics of corrosion, Electrochemical series, Concentration cell

Lecture 6 - Reduction Potential series, Pourbaix diagram

Lecture 7 - Pourbaix diagram

Lecture 8 - Pourbaix diagram

Lecture 9 - Pourbaix diagram, Kinetics of corrosion

Lecture 10 - Kinetics of corrosion, Rate expression, Solved problems

Lecture 11 - Solved problems on the corrosion rate, Exchange current density

Lecture 12 - Exchange current density, Polarization, Activation Polarization, Tafel Equation

Lecture 13 - Activation Polarization, Concentration Polarization

Lecture 14 - Concentration Polarization, Mixed Potential Theory

Lecture 15 - Mixed Potential Theory, Explanation of corrosion events on the basis of Mixed potential theory, Galvanization

Lecture 16 - Explanation of corrosion events on the basis of Mixed potential theory, Effect of impurity, Effect of area factor

Lecture 17 - Explanation of corrosion events on the basis of Mixed potential theory, Effect of area factor, Concentration polarization, Passivation

Lecture 18 - Passivation and Mixed potential theory

Lecture 19 - Passivation and Mixed potential theory

Lecture 20 - Different corrosion protection mechanisms, electrochemical ways of protection, cathodic protection

Lecture 21 - Cathodic and anodic protection

Lecture 22 - Anodic protection, Forms of corrosion, Factors of corrosion

Lecture 23 - Forms of corrosion, Uniform Corrosion, Galvanic corrosion

Lecture 24 - Galvanic corrosion

Lecture 25 - Crevice corrosion

Lecture 26 - Crevice corrosion, Pitting corrosion

Lecture 27 - Pitting corrosion, Intergranular corrosion

Lecture 28 - Intergranular corrosion, Dealloying

Lecture 29 - Dealloying, Erosion corrosion

Lecture 30 - Erosion corrosion, Cavitation

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Lecture 31 - Cavitation, Fretting corrosion, corrosion cracking

Lecture 32 - Stress corrosion cracking: mechanisms (dissolution controlled)

Lecture 33 - Stress corrosion cracking: mechanisms (cleavage controlled), factors affecting SCC, hydrogen embrittlement, corrosion fatigue

Lecture 34 - Biologically influenced corrosion, liquid metal attack

Lecture 35 - Corrosion protection, change of materials, effect of design of component

Lecture 36 - Corrosion protection, change of environment, Inhibitors, coatings

Lecture 37 - Oxidation and hot corrosion, pitting Bedworth ratio, thermodynamics of oxidation

Lecture 38 - Thermodynamics of oxidation, Ellingham diagram, oxidation kinetics and laws

Lecture 39 - Oxide structure and Oxidation

Lecture 40 - Hot corrosion, corrosion testing and failure analysis, linear polarization

Lecture 41 - Degradation of composites, polymers and ceramics, corrosion and society

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Lecture 2 - Heterogeneous equilibrium and Free energy Formalism

Lecture 3 - Concept of Chemical Potential

Lecture 4 - Phase Rule-I

Lecture 5 - Phase Rule-II and Single Component Equilibria

Lecture 6 - Single Component Phase Diagram

Lecture 7 - Binary Phase Diagram - Isomorphous Diagram

Lecture 8 - Binary Isomorphous System

Lecture 9 - Solidification of Isomorphous Alloys

Lecture 10 - Free Energy of Binary Isomorphous Phase Diagram

Lecture 11 - Phase Diagram of Binary Eutectic Systems Edit Lesson

Lecture 12 - Solidification of eutectic, hypo-eutectic and hyper-eutectic alloys & their morphologies - I

Lecture 13 - Solidification of eutectic, hypo-eutectic and hyper-eutectic alloys & their morphologies - II

Lecture 14 - Phase diagrams of binary eutectic two terminal solid solution

Lecture 15 - Phase diagrams of binary peritectic System - I

Lecture 16 - Phase diagrams of binary peritectic System - II

Lecture 17 - Phase diagrams of binary peritectic System with intermediate phases

Lecture 18 - Intermediate Phases

Lecture 19 - Introduction to Monotectic Phase Diagram

Lecture 20 - Microstructural Evolution of Monotectic Phase Diagram

Lecture 21 - Free Energy Composition diagrams for Monotectic systems and Syntactic phase diagram

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Lecture 23 - Quasichemical theory - II

Lecture 24 - Quasichemical theory Free energy formalism

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Lecture 26 - Introduction to Iron-Carbon phase diagram

Lecture 27 - Eutectoid transformation in Iron-Carbon phase diagram

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Lecture 29 - Hypo-eutectoid steels

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- Lecture 33 - Tempering of Martensite
- Lecture 34 - Bainite Transformation
- Lecture 35 - TTT curves for Steel
- Lecture 36 - Cast Iron - I
- Lecture 37 - Cast Iron - II
- Lecture 38 - Ductile Iron and Nodular Iron
- Lecture 39 - Malleable Iron
- Lecture 40 - Alloyed Cast Iron
- Lecture 41 - Phase Diagram for different Solid State Reaction
- Lecture 42 - Phase Diagram of Ceramic
- Lecture 43 - Ternary Phase Diagram - I
- Lecture 44 - Ternary Phase Diagram - II
- Lecture 45 - Ternary Phase Diagram and Tie Line Construction - I
- Lecture 46 - Ternary Phase Diagram and Tie Line Construction - II
- Lecture 47 - Ternary Phase Diagram and Tie Line Construction - III
- Lecture 48 - Ternary Isomorphous Phase Diagram
- Lecture 49 - Ternary Three Phase Equilibria
- Lecture 50 - Three Phase Equilibria in Ternary Systems - I
- Lecture 51 - Three Phase Equilibria in Ternary Systems - II
- Lecture 52 - Solidification Behaviour of Ternary Alloy
- Lecture 53 - Three Phase Equilibria
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- Lecture 55 - Ternary Four Phase Equilibria - II
- Lecture 56 - Solidification Behaviour of Ternary Eutectic Alloys
- Lecture 57 - Phase Diagram of Ternary Eutectic with Terminal Solid Solution
- Lecture 58 - Ternary Peritectic Reaction
- Lecture 59 - Quasi-peritectic Reaction
- Lecture 60 - Case Studies on Ternary Phase Diagrams - I
- Lecture 61 - Case Studies on Ternary Phase Diagrams - II

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Lecture 2 - Solidification (Casting)

Lecture 3 - Solidification (Welding)

Lecture 4 - Thermodynamics of Solidification

Lecture 5 - Kinetics of Solidification (Homogeneous)

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Lecture 12 - Heat Flow (Effect of Superheat)

Lecture 13 - Heat Flow (Solidification of Alloys)

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Lecture 19 - Zone Refining (Continued...)

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Lecture 22 - Cellular Solidification of Single Phase Alloy (Continued...)

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Lecture 28 - Powder characterization

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Lecture 1 - Introduction to Heat Treatment and Importance of Material Tetrahedron

Lecture 2 - Case studies in reference to Material tetrahedron T/t information and processing

Lecture 3 - Few more case studies in reference to processing with T/t modification

Lecture 4 - Critical Definition and Phase Transformation Thermodynamics and Driving Force

Lecture 5 - Thermodynamics of Phase Transformation Driving force of Phase Transformation

Lecture 6 - Thermodynamics of Phase Transformation and Driving Force for Phase Transformation

Lecture 7 - Finding Value of Driving Force (ΔG) and Single Component (liquid-solid)

Lecture 8 - Finding Value of Driving Force (ΔG) and Nucleation Single Component (liquid-solid)

Lecture 9 - Nucleation Treatment Single Component (Solid-Liquid) - I

Lecture 10 - Nucleation Treatment Single Component (Solid-Liquid) - II

Lecture 11 - Solved Problem on Nucleation rate and How to determine the value of γ_{sl} Physical Concept & Interfacial Energy

Lecture 12 - How to determine the value of γ_{sl} (Physical Concept and Interfacial Energy)

Lecture 13 - Interfacial Energy - I

Lecture 14 - Interfacial Energy - II

Lecture 15 - Heterogeneous Nucleation - I

Lecture 16 - Heterogeneous Nucleation - II

Lecture 17 - Solid - Solid Transformation and Nucleation rate - I

Lecture 18 - Solid - Solid Transformation and Nucleation rate - II

Lecture 19 - Phase Diagram and G vs X plot - I

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Lecture 22 - Introduction to Kinetics of Phase Transformation

Lecture 23 - Variation of ΔG^* and r^* with Undercooling

Lecture 24 - Nucleation rate - I

Lecture 25 - Nucleation Rate - II

Lecture 26 - Critical Undercooling

Lecture 27 - Maximum nucleation rate for homogeneous nucleation

Lecture 28 - Maximum nucleation rate for heterogeneous nucleation

Lecture 29 - Nucleation kinetics in solid state

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Lecture 2 - Continuum Mechanics

Lecture 3 - Stress Invariants

Lecture 4 - Strain Tensors and Mohr circle for strains

Lecture 5 - Yield Stress Criterion

Lecture 6 - Effective Stress and Strain

Lecture 7 - Work Hardening and Flow Behaviour

Lecture 8 - Effect of Strain Rate

Lecture 9 - Combined Effect of Strain, Strain Rate and Temperature

Lecture 10 - Effect of Temperature

Lecture 11 - Cold, Warm and Hot Working

Lecture 12 - Mechanics of Metal Working

Lecture 13 - Wire Drawing

Lecture 14 - Wire Drawing (Continued...)

Lecture 15 - Hodographs

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Lecture 3 - Correlation between bond and physical properties

Lecture 4 - Crystal Structure: Lattice and Basis

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Lecture 7 - Bravais Lattice and Symmetry in Crystals

Lecture 8 - Symmetry in Crystals

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Lecture 11 - Miller Indices - Part 2

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Lecture 4 - Vacancy Concentration Measurement Techniques

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

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Lecture 25 - Image Forces on Dislocations

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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

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

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- 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
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- 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
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- Lecture 21 - Electron diffraction in TEM (Continued...)
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- Lecture 24 - Electron diffraction in TEM (Continued...)
- Lecture 25 - Application of Electron diffraction
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- Lecture 30 - Signal generation in SEM (Continued...)
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- [Lecture 35 - Optics of SEM \(Continued...\) and analytical detectors](#)
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- [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 \(Continued...\)](#)
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- [Lecture 59 - X-ray diffraction profile and analysis \(Continued...\)](#)
- [Lecture 60 - Electron backscatter diffraction \(EBSD\)](#)

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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

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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)

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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
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- Lecture 50 - State of the art Li - S batteries : Case study - II
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- 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
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- 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 3 - Processing - Texture - Anisotropic Properties

Lecture 4 - Crystal Structure and Stereographic Projections

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Lecture 10 - Pole figures (Continued...)

Lecture 11 - Inverse Pole Figures

Lecture 12 - Three Dimensional Texture Analysis

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

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

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

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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

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

Lecture 24 - Characteristic X-ray, Absorption and Filters

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

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- Lecture 32 - Quantitative Evaluation of Kikuchi Diffraction Pattern - I
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- 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
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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

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- Lecture 2 - Genesis of Materials Degradation
- Lecture 3 - Classification of degradation and Parameters Influencing it - Part I
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- Lecture 5 - Engineering Solution to Combat Environmental Degradation of Materials
- Lecture 6 - Aqueous corrosion-thermodynamics of Wet Corrosion
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- Lecture 15 - Fatigue – Surface Dependent Property
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- Lecture 30 - Characterization
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- Lecture 32 - Scope, Classification and Objectives of Surface Engineering
- Lecture 33 - Shot Peening
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- Lecture 52 - Ion Implantation
- Lecture 53 - Electron Beam Assisted Surface Engineering
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- Lecture 56 - Laser Assisted Additive Manufacturing, LAM
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- Lecture 58 - Microstructural Characterization after Surface Engineering
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Lecture 2 - Theoretical Strengths and Defects

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Lecture 5 - Griffith Criteria - Modification

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Lecture 2 - Mine Closure Objectives and Regulatory Aspects

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Lecture 4 - Mine Closure Costs and Financing Approaches

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Lecture 6 - Demolition Techniques

Lecture 7 - Post Closure Liabilities and Activities

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

Lecture 10 - Post mining site monitoring

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

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- Lecture 3 - Classes of materials and material property charts
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- Lecture 11 - Fibers - Fundamentals, Glass fiber
- Lecture 12 - Fibers - Boron and Carbon Fibers
- Lecture 13 - Fibers - Aramid and Ceramic fibers, Alumina fiber
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- Lecture 19 - CMCs and PMCs - Processing and Application
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- Lecture 26 - Polymer foams - Processing and properties
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- Lecture 29 - Structure of cellular solids - Pore structure characterization
- Lecture 30 - Interfacial phenomena - Basic concept, Adhesion and Wettability
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- Lecture 34 - Interfacial phenomena - Case study - Al-MWCNT nanocomposite
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Lecture 3 - Effect of Pressure on equilibrium transformations: Clausius Clapeyron equation, phase diagram for unary system

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Lecture 11 - Eutectic solidification, glass formation

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

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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

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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
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- 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

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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 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

[Lecture 32 - Doping: thermal and ion implantation](#)

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

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Lecture 11 - Tutorial problems (Continued...)

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- 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
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- Lecture 14 - Optional - worked assignment on metal-semiconductor junctions
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- Lecture 20 - Worked assignment on transistors
- Lecture 21 - Optoelectronic devices - Introduction
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- 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

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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

Lecture 7 - Thermal Modelling - Part 2/2

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

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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

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

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Lecture 27 - TEM Tutorial - 4

Lecture 1 - Visual optical method

Lecture 2 - Dye Penetrant Testing - 1

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Lecture 4 - Dye Penetrant Testing - 3

Lecture 5 - Dye Penetrant Testing - 4

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 18 - Ultrasonic testing - 3

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Lecture 26 - Acoustic Emission Testing - 1

Lecture 27 - Acoustic Emission Testing - 2

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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 16 - Stress

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Lecture 18 - Description of Dislocation - 2

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Lecture 24 - Perfect Dislocation in FCC Structures

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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 2 - Volume Fraction and Particle Size - Part 1

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Lecture 4 - Geometric Probability - Part 1

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Lecture 6 - Probability Distributions

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Lecture 9 - Geometrical Probability - I

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Lecture 11 - Basic Stereological Parameters - Part 1

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Lecture 13 - Counting of grains and particles - Part 1

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Lecture 16 - Counting of Grains and Particles - Part 3

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Lecture 18 - Other Applications of the Disector

Lecture 19 - Stereology of Anisotropic Microstructures

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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

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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

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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

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Lecture 22 - Creep Testing Methods - Part 1

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Lecture 24 - Improving Creep Resistance of Materials

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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

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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

Lecture 24 - Dynamic Light Scattering - 1

Lecture 25 - Dynamic Light Scattering - 2

Lecture 26 - Particle size measurement - Other methods

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Lecture 30 - Interparticle friction

Lecture 31 - Powder packing

- Lecture 32 - Powder mixing and blending
- Lecture 33 - Powder Lubrication and Coating
- Lecture 34 - Powder compaction - 1
- Lecture 35 - Powder compaction - 2
- Lecture 36 - Powder compaction - 3
- Lecture 37 - Cold Isostatic Pressing and; Powder Injection Molding
- Lecture 38 - Powder Injection Molding - 2
- Lecture 39 - Slurry Techniques
- Lecture 40 - Tape casting
- Lecture 41 - Sintering - 1
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- Lecture 43 - Sintering - 3
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- Lecture 45 - Sintering - 5
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- Lecture 49 - Sintering - 9
- Lecture 50 - Sintering - 10
- Lecture 51 - Liquid Phase Sintering - 1
- Lecture 52 - Liquid Phase Sintering - 2
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- Lecture 60 - Spark Plasma Sintering (SPS)

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- Lecture 2 - Mathematical Representation of Material Properties
- Lecture 3 - Story of Carbon: Carbon on Earth and in Outer Space
- Lecture 4 - Story of Carbon: Carbon in Technology
- Lecture 5 - Isotopes of carbon
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- Lecture 7 - sp^3 , sp^2 and sp Hybridization: Diamond, Graphite and Carbyne
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- Lecture 9 - Allotropes of Carbon and Their Classification
- Lecture 10 - Carbon Allotrope Conversion
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- Lecture 16 - Synthetic Graphite Production from Needle Coke
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- Lecture 18 - Highly Oriented Pyrolytic Graphite
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[Lecture 32 - Sliding wear of alumina ceramics and zirconia ceramics in cryogenic environment](#)

[Lecture 33 - Sliding wear of silicon carbide in cryogenic environment](#)

[Lecture 34 - Wear of TiB₂ Ceramic Composites](#)

[Lecture 35 - Erosive wear of ultra-high temperature NbB₂-based ceramic composites](#)

[Lecture 36 - Erosive wear of ultra-high temperature ZrB₂-based ceramic composites](#)

[Lecture 37 - Computational analysis in assessing wear](#)

[Lecture 38 - Basics of ceramics coating techniques](#)

[Lecture 39 - Erosive wear of WC-Co coating](#)

[Lecture 40 - Abrasive wear of WC-Co coating](#)