NPTEL : NOC:Phase Field Modelling: The Materials Science, Mathematics and Computational Aspects (Metallurgy and Material Science)

Co-ordinators : Dr. M.P. Gururajan

Lecture 1 - Module 1 : Lecture 1 - Solution models

Lecture 2 - Module 1 : Lecture 2 - Summary of solution models

Lecture 3 - Module 1 : Lecture 3 - G vs X diagrams

Lecture 4 - Module 1 : Lecture 4 - Phase diagrams

Lecture 5 - Module 1 : Lecture 5 - Bond breaking model

Lecture 6 - Module 2 : Lecture 6 - Chemical potential

Lecture 7 - Module 1 : Tutorial 1

Lecture 8 - Module 1 : Tutorial 2

Lecture 9 - Module 1 : Tutorial 3

Lecture 10 - Module 1 : Tutorial 4

Lecture 11 - Module 1 : Tutorial 5

Lecture 12 - Module 2 : Tutorial 6

Lecture 13 - Module 2 : Lecture 7 - Diffusion and chemical potential

Lecture 14 - Module 2 : Lecture 8 - Fick's law

Lecture 15 - Module 2 : Lecture 9 - Failure of classical diffusion equation

Lecture 16 - Module 2 : Lecture 10 - Some references

Lecture 17 - Module 3 : Lecture 11 - Spinodal decomposition - some history

Lecture 18 - Module 3 : Lecture 12 - Spinodal decomposition

Lecture 19 - Module 3 : Lecture 13 - Stability

Lecture 20 - Module 3 : Lecture 14 - Thermodynamic property : composition dependence

Lecture 21 - Module 3 : Lecture 15 - Regions of stability

Lecture 22 - Module 3 : Lecture 16 - Understanding spinodal region

Lecture 23 - Module 2 : Tutorial 7

Lecture 24 - Module 4 : Lecture 17 - Solution to classical diffusion equation

Lecture 25 - Module 4 : Lecture 18 - Diffusion and mobility - I

Lecture 26 - Module 4 : Lecture 19 - Diffusion and mobility - II

Lecture 27 - Module 4 : Lecture 20 - Failure of classical diffusion equation

Lecture 28 - Module 4 : Lecture 21 - Non-classical diffusion equation

Lecture 29 - Module 5 : Lecture 22 - GNU Octave : Introduction

Lecture 30 - Module 5 : Lecture 23 - GNU Octave : interactive mode

Lecture 31 - Module 5 : Lecture 24 - GNU Octave : script mode

Lecture 32 - Module 6 : Lecture 25 - Ideal solution using octave

Lecture 33 - Module 6 : Lecture 26 - Regular solution using octave

Lecture 34 - Module 6 : Lecture 27 - Constructing phase diagram

Lecture 35 - Module 6 : Lecture 28 - Plotting spinodal

Lecture 36 - Module 7 : Lecture 29 - Non-dimensionalisation of diffusion equation

Lecture 37 - Module 7 : Lecture 30 - Diffusion and Fourier law of heat conduction

Lecture 38 - Module 8 : Lecture 31 - Diffusion equation : Analytical solution - I

Lecture 39 - Module 8 : Lecture 32 - Diffusion equation : Analytical solution - II

Lecture 40 - Module 8 : Lecture 33 - Diffusion equation : Error function solution - I

Lecture 41 - Module 8 : Lecture 34 - Diffusion equation: Error function solution - II

Lecture 42 - Module 9 : Lecture 35 - Diffusion equation : finite difference method

Lecture 43 - Module 9 : Lecture 36 - Diffusion equation : zero flux BC and explicit method

Lecture 44 - Module 9 : Lecture 37 - Diffusion equation : zero flux BC and implicit method

Lecture 45 - Module 9 : Lecture 38 - Diffusion equation : imposed concentration BC and explicit/implicit methods

Lecture 46 - Module 10 : Lecture 39 - Periodic boundary conditions (PBC)

Lecture 47 - Module 10 : Lecture 40 - Expicit method with PBC

Lecture 48 - Module 10 : Lecture 41 - Spectral Techniques - I

Lecture 49 - Module 10 : Lecture 42 - Spectral Techniques - II

Lecture 50 - Module 10 : Lecture 43 - Implicit spectral method

Lecture 51 - Module 11 : Lecture 44 - Scalars, vectors and tensors

Lecture 52 - Module 11 : Lecture 45 - Coordinate transformation

Lecture 53 - Module 11 : Lecture 46 - Transformation laws

Lecture 54 - Module 11 : Lecture 47 - II rank tensors and Neumann principle

Lecture 55 - Module 12 : Lecture 48 - Group theory

Lecture 56 - Module 12 : Lecture 49 - Crystal: symmetry elements - I

Lecture 57 - Module 12 : Lecture 50 - Crystal: symmetry elements - II

Lecture 58 - Module 12 : Lecture 51 - Understanding Neumann's principle

Lecture 59 - Module 12 : Lecture 52 - Representation quadric

Lecture 60 - Module 13 : Lecture 53 - Variational calculus

Lecture 61 - Module 13 : Lecture 54 - Optimization of functionals - I

Lecture 62 - Module 13 : Lecture 55 - Optimization of functionals - II

Lecture 63 - Module 13 : Lecture 56 - Variational derivative

Lecture 64 - Module 13 : Lecture 57 - Free energy functional

Lecture 65 - Module 14 : Lecture 58 - Derivation of Cahn-Hilliard (CH) equation - I

Lecture 66 - Module 14 : Lecture 59 - Derivation of Cahn-Hilliard (CH) equation - II

Lecture 67 - Module 14 : Lecture 60 - Free energy versus concentration curves

Lecture 68 - Module 14 : Lecture 61 - Diffusion equation versus CH

Lecture 69 - Module 15 : Lecture 62 - Numerical solution of CH: finite difference

Lecture 70 - Module 15 : Lecture 63 - Numerical solution of CH: spectral method

Lecture 71 - Module 16 : Lecture 64 - Interfacial energy in CH

Lecture 72 - Module 16 : Lecture 65 - CH: analytical solution

Lecture 73 - Module 16 : Lecture 66 - Interfacial energy in CH: analytical calculation

Lecture 74 - Module 16 : Lecture 67 - Interfacial energy: numerical versus analytical values

Lecture 75 - Module 17 : Lecture 68 - Order-disorder transition and Allen-Cahn equation

Lecture 76 - Module 17 : Lecture 69 - AC: numerical solution

Lecture 77 - Module 18 : Lecture 70 - Spinodal decomposition in 2D

Lecture 78 - Module 18 : Lecture 71 - Order-disorder transformation

Lecture 79 - Module 18 : Lecture 72 - Gibbs Thomson effect

Lecture 80 - Module 18 : Lecture 73 - Grain growth

Lecture 81 - Module 19 : Lecture 74 - Precipitate growth - I

Lecture 82 - Module 19 : Lecture 75 - Precipitate growth - II

Lecture 83 - Module 20 : Lecture 76 - Grain growth: Fan-Chen model - I

Lecture 84 - Module 20 : Lecture 77 - Grain growth: Fan-Chen model - II

Lecture 85 - Module 21 : Lecture 78 - Grain boundary grooving - I

Lecture 86 - Module 21 : Lecture 79 - Grain boundary grooving - II

Lecture 87 - Module 22 : Lecture 80 - Overview of phase field modelling

NPTEL : NOC:Dealing with Materials Data: Collection, Analysis and Interpretation (Metallurgy and Material Science)

Co-ordinators : Dr. M.P. Gururajan

Lecture 1 - Descriptive Statistics - I

Lecture 2 - Descriptive Statistics - II

Lecture 3 - Probability and Distribution

Lecture 4 - Random variable and Expectation - I

Lecture 5 - Random variable and Expectation - II

Lecture 6 - Random variable and Expectation - III

Lecture 7 - Random variable and Expectation - IV

Lecture 8 - Module: Introduction to R

Lecture 9 - R:Demos and getting help

Lecture 10 - R as calculator and plotter: Diffusivity, scaled temperatures

Lecture 11 - R as calculator and plotter: Diffraction, configurational entropy

Lecture 12 - Data in tabular form: Properties of elements

Lecture 13 - Tabular data in R: alternate methodology

Lecture 14 - Dataframe in R: Properties of elements

Lecture 15 - R libraries for plotting

Lecture 16 - Importing and plotting data

Lecture 17 - Property charts: Importing and plotting data

Lecture 18 - Introduction to R: Summary of the module

Lecture 19 - Descriptive statistics

Lecture 20 - Presenting experimental results: Data on conductivity of ETP copper

Lecture 21 - Property based reports, errors, significant digits

Lecture 22 - Dealing with distributions: Grain size data

Lecture 23 - Grain size data: Property and rank based reports

Lecture 24 - Case study: Grain size in a two phase steel

Lecture 25 - Grain size in a two phase steel: Descriptive statistics

Lecture 26 - Presenting experimental results: data with error bars

Lecture 27 - Errors and their propagation

Lecture 28 - Fitting experimental data to distributions

Lecture 29 - Combining uncertainties

Lecture 30 - Summary:Descriptive statistics

Lecture 31 - Special Random Variables - I

Lecture 32 - Special Random Variables - II

Lecture 33 - Special Random Variables - III

Lecture 34 - Special Random Variables - IV

Lecture 35 - Special Random Variables - V

Lecture 36 - Probabilty Plots

Lecture 37 - Probability distributions

Lecture 38 - Properties of probability distributions

Lecture 39 - Bernoulli trials and binomial distributions

Lecture 40 - Atom probe technique and negative binomial distribution

Lecture 41 - Atom probe and hypergeometric distribution

Lecture 42 - Atom probe: analysis of error

Lecture 43 - Nucleation and Poisson distribution

Lecture 44 - Normal distribution

Lecture 45 - Normal distribution and error function

Lecture 46 - Probability scale

Lecture 47 - Sampling Distribution - I

Lecture 48 - Sampling Distribution - II

Lecture 49 - Sampling Distribution - III

Lecture 50 - Parameter Estimation - I

Lecture 51 - Parameter Estimator - II

Lecture 52 - Parameter Estimator - III

Lecture 53 - Parameter Estimator - IV

Lecture 54 - Bayesian Estimation

Lecture 55 - Log normal distribution

Lecture 56 - Lorentz/Cauchy distribution

Lecture 57 - Lifetime and exponential distributions

Lecture 58 - Distributions from statistical mechanics

Lecture 59 - Uniform distribution and summary of probability distributions

Lecture 60 - Data processing: Introduction

Lecture 61 - Distribution function of a data series

Lecture 62 - Estimating mean and mean-square-deviation of data

Lecture 63 - Data with unequal weights

Lecture 64 - Robust estimates

Lecture 65 - From data to underlying distribution

Lecture 66 - Bootstrap method

Lecture 67 - Summary:Data processing

Lecture 68 - Hypothesis Testing - I

Lecture 69 - Hypothesis Testing - II

Lecture 70 - Hypothesis Testing - III

Lecture 71 - Hypothesis Testing - IV

Lecture 72 - Hypothesis Testing - V

Lecture 73 - Hypothesis Testing - VI

Lecture 74 - Graphical handling of data

Lecture 75 - Fitting and graphical handling of data: Introduction

Lecture 76 - Data transformable to linear

Lecture 77 - Data of known functional form

Lecture 78 - Calibration,Fitting, Hypotheses testing

Lecture 79 - Analysis of variance

Lecture 80 - Summary:Fittng and graphical handling of data

Lecture 81 - Regression Analysis - I

Lecture 82 - Regression Analysis - II

Lecture 83 - Regression Analysis - III

Lecture 84 - Regression Analysis - IV

Lecture 85 - Analysis of Variance - I

Lecture 86 - Analysis of Variance - II

Lecture 87 - Design of Experiment - I

Lecture 88 - Design of Experiment - II

Lecture 89 - Design of Experiment - III

Lecture 90 - Design of Experiment - IV

Lecture 91 - Summary of the course

Lecture 92 - Case studies: Introduction

Lecture 93 - Case study 1: Data smoothing - I

Lecture 94 - Case study 1: Data smoothing - II

Lecture 95 - Case study 2: Error analysis

Lecture 96 - Case study 3: Calibration

Lecture 97 - Case study 4: Design of experiment

Lecture 98 - Case study 5: Hypothesis testing

Lecture 99 - Course summary

NPTEL : NOC:Aqueous Corrosion and its Control (Metallurgy and Material Science)

Co-ordinators : Prof. V. S. Raja

Lecture 1 - Introduction to the course and corrosion implications

Lecture 2 - Can we predict if a metal corrodes? - Part I

Lecture 3 - Can we predict if a metal corrodes? - Part II

Lecture 4 - Can we calculate the rate of corrosion: Electrochemical kinetics - Tafel relation?

Lecture 5 - Can we calculate the rate of corrosion: Electrochemical kinetics - diffusion and mixed potential theory?

Lecture 6 - Can we calculate the corrosion rate of metals: Mixed potential theory and passivity?

Lecture 7 - Passivity (Continued...)

Lecture 8 - DC polarisation experiments and their relation to mixed potential theory/Evans diagram

Lecture 9 - Pourbaix diagram and electrochemical corrosion

Lecture 10 - Forms of corrosion: Uniform v/s localised corrosion

Lecture 11 - Forms of corrosion: Factors affecting uniform corrosion

Lecture 12 - Forms of corrosion: Preventive measures for uniform corrosion - Part I

Lecture 13 - Forms of corrosion: Preventive measures for uniform corrosion - Part II

Lecture 14 - Forms of corrosion: Galvanic or dissimilar metal corrosion - Part I

Lecture 15 - Forms of corrosion: Galvanic or dissimilar metal corrosion - Part II

Lecture 16 - Forms of corrosion: Galvanic or dissimilar metal corrosion - Part III

Lecture 17 - Forms of corrosion: Crevice corrosion - Part I

Lecture 18 - Forms of corrosion: Crevice corrosion - Part II

Lecture 19 - Forms of corrosion: Pitting corrosion - Part I

Lecture 20 - Forms of corrosion: Pitting corrosion - Part II

Lecture 21 - Forms of corrosion: Intergranular corrosion - Part I

Lecture 22 - Forms of corrosion: Intergranular corrosion - Part II

Lecture 23 - Forms of corrosion: Intergranular corrosion - Part III

Lecture 24 - Forms of corrosion: Intergranular corrosion - Part IV

Lecture 25 - Forms of corrosion: Selective leaching or dealloying

Lecture 26 - Forms of corrosion: Flow assisted corrosion and erosion corrosion - Part I

Lecture 27 - Forms of corrosion: Erosion corrosion - Part II

Lecture 28 - Forms of corrosion: Fretting corrosion

Lecture 29 - Forms of corrosion: Stress corrosion cracking - Part I

Lecture 30 - Forms of corrosion: Stress corrosion cracking - Part II

Lecture 31 - Forms of corrosion: Stress corrosion cracking - Part III

Lecture 32 - Forms of corrosion: Hydrogen damage

Lecture 33 - Forms of corrosion: Microbial corrosion

Lecture 34 - Effective corrosion management

NPTEL : NOC:Cathodic Protection Engineering (Metallurgy and Material Science)

Co-ordinators : Prof. V.S. Raja

Lecture 1 - Introduction to the course and understanding corrosion

Lecture 2 - External corrosion of pipelines

Lecture 3 - Electrochemical principles

Lecture 4 - Criteria

Lecture 5 - Assessment of pipeline condition through surveys - Part I

Lecture 6 - Assessment of pipeline condition through surveys - Part II

Lecture 7 - Anode ground bed for cathodic protection

Lecture 8 - Perspectives in storage tanks and off-shore structures

Lecture 9 - Anodes

Lecture 10 - Worked out examples

Lecture 11 - Stray current corrosion and its control

Lecture 12 - Coatings and rectifier selection

Lecture 13 - Internal corrosion of oil and steel gas pipelines

Lecture 14 - Anodic protection engineering

NPTEL : NOC:Introduction to Materials Science and Engineering (Metallurgy and Material Science)

Co-ordinators : Prof. Rajesh Prasad

Lecture 1 - Intoduction

Lecture 2 - Crystal geometry

Lecture 3 - Unit cell

Lecture 4 - Classification of lattices

Lecture 5 - Gaps in Bravais lattice list

Lecture 6 - Symmetry - I

Lecture 7 - Symmetry - II

Lecture 8 - Classification of lattices on the basis of symmetry

Lecture 9 - A symmetry based approach to Bravais lattices

Lecture 10 - Miller indices of directions

Lecture 11 - Miller indices for planes

Lecture 12 - Miller indices for plane and its normal in Cubic Crystal

Lecture 13 - Weiss Zone law and its applications

Lecture 14 - Inter-planar spacing

Lecture 15 - Braggâ€™s Law

Lecture 16 - Close-packing of hard spheres

Lecture 17 - Hexagonal Close-Packed (HCP) structure

Lecture 18 - Lattice and motif of HCP crystals

Lecture 19 - c/a ratio of an ideal HCP crystal

Lecture 20 - ABCABC stacking of close-packed spheres

Lecture 21 - Voids in close-packed structures

Lecture 22 - Solid solutions - I

Lecture 23 - Solid solutions - II

Lecture 24 - Hume-Rothery rules

Lecture 25 - Ordered and disordered solid solutions

Lecture 26 - Graphene

Lecture 27 - Structure of graphite

Lecture 28 - Structure of diamond

Lecture 29 - Carbon nanotubes (CNT)

Lecture 30 - Buckminsterfullerene (C60)

Lecture 31 - Ionic solids

Lecture 32 - NaCl

Lecture 33 - CsCl

Lecture 34 - ZnS

Lecture 35 - BCC vs CsCl

Lecture 36 - Amorphous Solids

Lecture 37 - Polymers

Lecture 38 - Vinyl Polymers

Lecture 39 - Thermoplasts and Thermosets

Lecture 40 - Tacticity

Lecture 41 - Copolymers

Lecture 42 - Crystallinity in Polymers

Lecture 43 - Defects in Crystals

Lecture 44 - Vacancies

Lecture 45 - Edge dislocation: Half plane

Lecture 46 - Edge dislocation: Slip

Lecture 47 - Characteristic vectors of a dislocation

Lecture 48 - Edge, screw and mixed dislocations

Lecture 49 - Screw dislocations

Lecture 50 - Burgers circuit

Lecture 51 - Elastic energy of a dislocation line

Lecture 52 - Burgers vector: Shortest lattice translation

Lecture 53 - Burgers vector of a dislocation is constant along the line

Lecture 54 - Geometrical properties of a dislocations: Dislocation cannot end abruptly in a crystal: Free surface

Lecture 55 - Dislocation cannot end abruptly in a crystal: Grain boundaries

Lecture 56 - Dislocation cannot end abruptly in a crystal: Dislocation nodes

Lecture 57 - Dislocation cannot end abruptly in a crystal: Dislocation loop

Lecture 58 - Dislocation motion

Lecture 59 - 2D defects: Surfaces or interfaces

Lecture 60 - Free surface or external surface of the crystal

Lecture 61 - Stacking faults

Lecture 62 - Twin boundary

Lecture 63 - Grain boundary

Lecture 64 - Small angle symmetric tilt boundary

Lecture 65 - Ball bearing model

Lecture 66 - Phase diagrams: Introduction

Lecture 67 - Phases and components

Lecture 68 - Uses of phase diagrams

Lecture 69 - Phases present in the system

Lecture 70 - Composition of phases present in the system

Lecture 71 - Proportion of phases present in the system

Lecture 72 - Microstructure evolution during solidification in isomorphous systems

Lecture 73 - Eutectic system

Lecture 74 - Eutectic reaction

Lecture 75 - Eutectic, hypoeutectic and hypereutectic alloys

Lecture 76 - Gibbsâ€™ phase rule

Lecture 77 - Fe-C phase diagram

Lecture 78 - Eutectoid, hypoeutectoid and hypereutectoid steels

Lecture 79 - Microstructure of a hypoeutectoid steel

Lecture 80 - Microstructure of a hypereutectoid steel

Lecture 81 - Diffusion: Introduction

Lecture 82 - Fickâ€™s first law

Lecture 83 - Fickâ€™s second law

Lecture 84 - Error function solution of Fickâ€™s second law

Lecture 85 - Atomic mechanisms of diffusion

Lecture 86 - Substitutional diffusion revisited

Lecture 87 - Diffusion paths

Lecture 88 - Steady and unsteady state diffusion

Lecture 89 - Phase Transformation

Lecture 90 - Nucleation

Lecture 91 - Nucleation and capillary rise

Lecture 92 - Nucleation, growth and overall transformation

Lecture 93 - Time-temperature-transformation (TTT) diagram

Lecture 94 - Homogeneus and heterogeneous nucleation

Lecture 95 - Heat treatment of steels

Lecture 96 - TTT diagram of Eutectoid Steels

Lecture 97 - Quenching and martensite

Lecture 98 - Austempering and bainite

Lecture 99 - Tempering

Lecture 100 - Residual stresses and Quench cracks

Lecture 101 - Marquenching and martempering

Lecture 102 - TTT diagram of hypoeutectoid and hypereutectoid steels

Lecture 103 - TTT diagram of alloy steel

Lecture 104 - hardenability of steels

Lecture 105 - Glass Ceramics

Lecture 106 - Tensile test

Lecture 107 - Plastic deformation and crystal structure

Lecture 108 - Shape change

Lecture 109 - Slip

Lecture 110 - Resolved shear stress

Lecture 111 - CRSS

Lecture 112 - Schmid's law

Lecture 113 - CRSS:Theory vs experiment

Lecture 114 - Why is experimental CRSS less than theoretical CRSS

Lecture 115 - Strengthening mechaniksms

Lecture 116 - Dislocation density

Lecture 117 - Frank-Read source

Lecture 118 - strain hardening

Lecture 119 - Dislocation interaction leading to strain hardening - I

Lecture 120 - Dislocation interaction leading to strain hardening - II

Lecture 121 - Solid solution hardening

Lecture 122 - Grain size hardening

Lecture 123 - Age hardening - I

Lecture 124 - Age hardening - II

Lecture 125 - Metastable precipitates

Lecture 126 - Annealing of cold-worked metals

Lecture 127 - Recovery

Lecture 128 - Recrystallization

Lecture 129 - Grain Growth

Lecture 130 - True stress and true strain

Lecture 131 - Creep

Lecture 132 - Effect of stress and temperature on creep

Lecture 133 - Creep Mechanisms

Lecture 134 - Composites

Lecture 135 - Isostrain modulus

Lecture 136 - Isostress modulus

Lecture 137 - Fracture

Lecture 138 - Ductile and Brittle Fracture

Lecture 139 - Role of crack size

Lecture 140 - Griffith's Criterion

Lecture 141 - Stress Concentration

Lecture 142 - Ductile to brittle transition

Lecture 143 - Enhancing fracture resistance

Lecture 144 - Toughening of glass: Tempering

Lecture 145 - Toughening of glass: Ion-Exchange

Lecture 146 - Fatigue

Lecture 147 - Sub-Critical crack growth

NPTEL : NOC:Crystals, Symmetry and Tensors (Metallurgy and Material Science)

Co-ordinators : Prof. Rajesh Prasad

Lecture 1 (1a)

Lecture 2 (1b)

Lecture 3 (1c)

Lecture 4 (1d)

Lecture 5 (1e)

Lecture 6 (2a)

Lecture 7 (2b)

Lecture 8 (2c)

Lecture 9 (2d)

Lecture 10 (3a)

Lecture 11 (3b)

Lecture 12 (3c)

Lecture 13 (4a)

Lecture 14 (4b)

Lecture 15 (5a)

Lecture 16 (5b)

Lecture 17 (5c)

Lecture 18 (6a)

Lecture 19 (6b)

Lecture 20 (6c)

Lecture 21 (6d)

Lecture 22 (7a)

Lecture 23 (7b)

Lecture 24 (7c)

Lecture 25 (8a)

Lecture 26 (8b)

Lecture 27 (9a)

Lecture 28 (9b)

Lecture 29 (9c)

Lecture 30 (9d)

Lecture 31 (10a)

Lecture 32 (10b)

Lecture 33 (11a)

Lecture 34 (11b)

Lecture 35 (11c)

Lecture 36 (11d)

Lecture 37 (12a)

Lecture 38 (12b)

Lecture 39 (13a)

Lecture 40 (13b)

Lecture 41 (14a)

Lecture 42 (14b)

Lecture 43 (15a)

Lecture 44 (15b)

Lecture 45 (15c)

Lecture 46 (16a)

Lecture 47 (16b)

Lecture 48 (17)

Lecture 49 (18a)

Lecture 50 (18b)

Lecture 51 (18c)

Lecture 52 (18d)

Lecture 53 (19a)

Lecture 54 (19b)

Lecture 55 (19c)

Lecture 56 (19d)

Lecture 57 (20a)

Lecture 58 (20b)

Lecture 59 (20c)

Lecture 60 (20d)

Lecture 61 (20e)

Lecture 62 (21a)

Lecture 63 (21b)

Lecture 64 (21c)

Lecture 65 (21d)

Lecture 66 (21e)

Lecture 67 (22a)

Lecture 68 (22b)

Lecture 69 (22c)

Lecture 70 (22d)

Lecture 71 (23a)

Lecture 72 (23b)

Lecture 73 (23c)

Lecture 74 (24a)

Lecture 75 (24b)

Lecture 76 (24c)

Lecture 77 (25a)

Lecture 78 (25b)

Lecture 79 (25c)

Lecture 80 (25d)

Lecture 81 (26a)

Lecture 82 (26b)

Lecture 83 (27a)

Lecture 84 (27b)

Lecture 85 (27c)

Lecture 86 (27d)

Lecture 87 (27e)

Lecture 88 (27f)

Lecture 89 (28a)

Lecture 90 (28b)

Lecture 91 (28c)

Lecture 92 (28d)

Lecture 93 (28e)

NPTEL : NOC:Corrosion-Environmental Degradation-Surface Engineering (Metallurgy and Material Science)

Co-ordinators : Prof. (Hag) Harish Hirani

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31

Lecture 32

Lecture 33

Lecture 34

Lecture 35

NPTEL : NOC:Introduction to Crystal Elasticity and Crystal Plasticity (Metallurgy and Material Science)

Co-ordinators : Prof. Swarup bag

Lecture 1 - Structure and properties of materials - Part I

Lecture 2 - Structure and properties of materials - Part II

Lecture 3 - Elasticity Isotropic elasticity of materials; Anisotropic elasticity - Part I

Lecture 4 - Elasticity Isotropic elasticity of materials; Anisotropic elasticity - Part II

Lecture 5 - Continuum Plasticity - I (Part A)

Lecture 6 - Continuum Plasticity - I (Part B)

Lecture 7 - Continuum Plasticity - II (Part A)

Lecture 8 - Continuum Plasticity - II (Part B)

Lecture 9 - Crystal Plasticity - I (Part A)

Lecture 10 - Crystal Plasticity - I (Part B)

Lecture 11 - Crystal Plasticity - II (Part A)

Lecture 12 - Crystal Plasticity - II (Part B)

Lecture 13 - Crystal Plasticity - II (Part C)

Lecture 14 - Hardening Mechanisms in Metals - Part I

Lecture 15 - Hardening Mechanisms in Metals - Part II

Lecture 16 - Hardening Mechanisms in Metals - Part III

Lecture 17 - Multi-Scale Approach to Materials Modelling

NPTEL : Advanced Characterization Techniques (Metallurgy and Material Science)

Co-ordinators : Dr. Krishanu Biswas, Prof.N.P.Gurao

Lecture 1 - Advanced Characterization Techniques

Lecture 2 - Advanced Characterization Techniques

Lecture 3 - Advanced Characterization Techniques

Lecture 4 - Advanced Characterization Techniques

Lecture 5 - Advanced Characterization Techniques

Lecture 6 - Advanced Characterization Techniques

Lecture 7 - Advanced Characterization Techniques

Lecture 8 - Advanced Characterization Techniques

Lecture 9 - Advanced Characterization Techniques

Lecture 10 - Advanced Characterization Techniques

Lecture 11 - Advanced Characterization Techniques

Lecture 12 - Advanced Characterization Techniques

Lecture 13 - Advanced Characterization Techniques

Lecture 14 - Advanced Characterization Techniques

Lecture 15 - Advanced Characterization Techniques

Lecture 16 - Advanced Characterization Techniques

Lecture 17 - Advanced Characterization Techniques

Lecture 18 - Advanced Characterization Techniques

Lecture 19 - Advanced Characterization Techniques

Lecture 20 - Advanced Characterization Techniques

Lecture 21 - Advanced Characterization Techniques

Lecture 22 - Advanced Characterization Techniques

Lecture 23 - Advanced Characterization Techniques

Lecture 24 - Advanced Characterization Techniques

Lecture 25 - Advanced Characterization Techniques

Lecture 26 - Advanced Characterization Techniques

Lecture 27 - Advanced Characterization Techniques

Lecture 28 - Advanced Characterization Techniques

Lecture 29 - Advanced Characterization Techniques

Lecture 30 - Advanced Characterization Techniques

Lecture 31 - Advanced Characterization Techniques

Lecture 32 - Advanced Characterization Techniques

Lecture 33 - Advanced Characterization Techniques

NPTEL : Electroceramics (Metallurgy and Material Science)

Co-ordinators : Dr. Ashish Garg

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31

Lecture 32

Lecture 33

Lecture 34

Lecture 35

Lecture 36

Lecture 37

Lecture 38

Lecture 39

Lecture 40

Lecture 41

NPTEL : Fuels Refractory and Furnaces (Metallurgy and Material Science)

Co-ordinators : Prof. Satish Ch. Koria

Lecture 1 - Energy Resources and Environment

Lecture 2 - Characterization of Fuels: Concepts

Lecture 3 - Characterization of Fuels: Concepts

Lecture 4 - Production of Secondary Fuels : Carbonization

Lecture 5 - Materials Balance in Coke-making

Lecture 6 - Heat Balance and Clean Development Mechanism

Lecture 7 - Production of Secondary Fuels: Gasification

Lecture 8 - Materials and Heat Balance in Gasification

Lecture 9 - Principles of combustion: Concepts and illustrations

Lecture 10 - Principles of combustion: Concepts and illustrations

Lecture 11 - Materials balance in combustion

Lecture 12 - Principles of Combustion: Flame Temperature

Lecture 13 - Flame Temperature Calculations

Lecture 14 - Refractory in Furnaces

Lecture 15 - Refractory in Furnaces

Lecture 16 - Furnace: Types and Classification

Lecture 17 - Heat Utilization in furnaces, energy flow diagrams

Lecture 18 - Heat Utilization in furnaces, energy flow diagrams

Lecture 19 - Heat Utilization in Furnaces: Heat Recovery Concepts and Illustrations

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 - hermal 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

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

NPTEL : Materials and Energy balance in Metallurgical Processes (Metallurgy and Material Science)

Co-ordinators : Prof. Satish Ch. Koria

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 ExtractionUnit Processes

Lecture 15 - Predominance Area Diagram

Lecture 16 - Material Balance in Roasting;illustration

Lecture 17 - Heat Balance in Roasting illustration

Lecture 18 - Exersises 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

Lecture 34 - Exercise in Converting

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

NPTEL : Optoelectronic Materials and Devices (Metallurgy and Material Science)

Co-ordinators : Prof. Deepak Gupta, Prof. Monica Katiyar

Lecture 1 - Conductivity of materials, Drudeâ€™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 Braggâ€™s diffraction condition

Lecture 6 - Electrons in a crystal, Blochâ€™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: Fresnal 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

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31

Lecture 32

Lecture 33

Lecture 34

Lecture 35

Lecture 36

Lecture 37

Lecture 38

Lecture 39

Lecture 40

Lecture 41

Lecture 42

NPTEL : Structure of Materials (Metallurgy and Material Science)

Co-ordinators : Dr. Anandh Subramaniam

Lecture 1 - Overview

Lecture 2 - Geometry of Crystals: Symmetry, Lattices

Lecture 3 - Geometry of Crystals: Symmetry, Lattices

Lecture 4 - Geometry of Crystals: Symmetry, Lattices

Lecture 5 - Geometry of Crystals: Symmetry, Lattices

Lecture 6 - Geometry of Crystals: Symmetry, Lattices

Lecture 7 - Geometry of Crystals: Symmetry, Lattices

Lecture 8 - Geometry of Crystals: Symmetry, Lattices

Lecture 9 - Geometry of Crystals: Symmetry, Lattices

Lecture 10 - Geometry of Crystals: Symmetry, Lattices

Lecture 11 - Geometry of Crystals: Symmetry, Lattices

Lecture 12 - Geometry of Crystals: Symmetry, Lattices (Continued...) and Miller Indices

Lecture 13 - Miller Indices

Lecture 14 - Miller Indices (Continued...) and Crystal Structures

Lecture 15 - Crystal Structures

Lecture 16 - Crystal Structures

Lecture 17 - Crystal Structures

Lecture 18 - Crystal Structures

Lecture 19 - Crystal Structures

Lecture 20 - Crystal Structures

Lecture 21 - Crystal Structures (Continued...) and Defects in Crystals

Lecture 22 - Defects in Crystals

Lecture 23 - Defects in Crystals

Lecture 24 - Defects in Crystals

Lecture 25 - Defects in Crystals

Lecture 26 - Defects in Crystals

Lecture 27 - Defects in Crystals

Lecture 28 - Defects in Crystals

Lecture 29 - Defects in Crystals

Lecture 30 - Diffusion in Solids

Lecture 31 - Diffusion in Solids

Lecture 32 - Phase Diagrams

Lecture 33 - Phase Diagrams

Lecture 34 - Phase Diagrams

Lecture 35 - Phase Diagrams

Lecture 36 - Phase Diagrams

Lecture 37 - Phase Transformations

Lecture 38 - Phase Transformations

Lecture 39 - Phase Transformations

Lecture 40 - Phase Transformations

Lecture 41 - Phase Transformations

Lecture 42 - Phase Transformations

Lecture 43 - Phase Transformations

Lecture 44 - Phase Transformations

Lecture 45 - Phase Transformations

NPTEL : Environmental Degradation of Materials (Metallurgy and Material Science)

Co-ordinators : Dr. Kallol Mondal

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

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

NPTEL : NOC:Phase Diagrams in Materials Science and Engineering (Metallurgy and Material Science)

Co-ordinators : Dr. Krishanu Biswas

Lecture 1 - Introduction to the course

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 Ispmorphous 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

Lecture 22 - Quasichemical theory - I

Lecture 23 - Quasichemical theory - II

Lecture 24 - Quasichemical theory Free enegy formalism

Lecture 25 - Solid state reaction

Lecture 26 - Introduction to Iron-Carbon phase diagram

Lecture 27 - Eutectoid transformation in Iron-Carbon phase diagram

Lecture 28 - Austenite to pearlite transformation in Iron-Carbon phase diagram

Lecture 29 - Hypo-eutectoid steels

Lecture 30 - Pearlite Transformation

Lecture 31 - Martensite Transformation - I

Lecture 32 - Martensite Transformation - II

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

Lecture 54 - Ternary Four Phase Equilibria - I

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

NPTEL : NOC:Fundamentals of Material Processing - I (Metallurgy and Material Science)

Co-ordinators : Prof. Shashank Shekhar

Lecture 1 - Introduction

Lecture 2 - Solidification (Casting)

Lecture 3 - Solidification (Welding)

Lecture 4 - Thermodynamics of Solidification

Lecture 5 - Kinetics of Solidification (Homogeneous)

Lecture 6 - Kinetics of Solidification (Heterogeneous)

Lecture 7 - Heat Flow

Lecture 8 - Heat Flow (Continued...)

Lecture 9 - Heat Flow (Insulating Mold Condition)

Lecture 10 - Heat Flow (Insulating Mold Condition) (Continued...)

Lecture 11 - Heat Flow (Interface Resistance Controlled Solidification)

Lecture 12 - Heat Flow (Effect of Superheat)

Lecture 13 - Heat Flow (Solidification of Alloys)

Lecture 14 - Composition Variation

Lecture 15 - Composition Variation (Continued...)

Lecture 16 - Complete and Limited Liquid Diffusion

Lecture 17 - Mixed Mode Solidification

Lecture 18 - Mixed Mode Solidification and Zone Refining

Lecture 19 - Zone Refining (Continued...)

Lecture 20 - Cellular Solidification of Single Phase Alloy

Lecture 21 - Cellular Solidification of Single Phase Alloy (Continued...)

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

Lecture 23 - Plane Front Solidification of Multiphase Alloy

Lecture 24 - Plane Front Solidification of Multiphase Alloy (Continued...)

Lecture 25 - Fluid Flow Considerations

Lecture 26 - Introduction to Powder Processing

Lecture 27 - Introduction to Powder Processing (Continued...)

Lecture 28 - Powder characterization

Lecture 29 - Powder Characterization Techniques

Lecture 30 - Powder Characterization using Surface Area

Lecture 31 - Powder Characterization using Gas Permeability Method

Lecture 32 - Powder Manufacturing

Lecture 33 - Powder Manufacturing (Continued...)

Lecture 34 - Powder Manufacturing (Continued...)

Lecture 35 - Powder Consolidation

Lecture 36 - Powder Consolidation (Continued...)

Lecture 37 - Particle Packing

Lecture 38 - Powder Compaction

Lecture 39 - Powder Compaction (Continued...)

Lecture 40 - Sintering Theory

NPTEL : NOC:Heat Treatment and Surface Hardening - I (Metallurgy and Material Science)

Co-ordinators : Dr. Kallol Mondal, Prof. Sandeep Sangal

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 (?G) and Single Component (liquid-solid)

Lecture 8 - Finding Value of Driving Force (?G) 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 ?sl Physical Concept & Interfacial Energy

Lecture 12 - How to determine the value of ?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

Lecture 20 - Phase Diagram and G vs X plot - II

Lecture 21 - Phase Diagram and G vs X plot - III

Lecture 22 - Introduction to Kinetics of Phase Transformation

Lecture 23 - Variation of ?G* 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

Lecture 30 - Interface controlled growth

Lecture 31 - Diffusion controlled growth

Lecture 32 - Avrami Kinetics - I

Lecture 33 - Avrami Kinetics - II

Lecture 34 - Avrami Kinetics - III

Lecture 35 - Time-Temperature-Transformation (TTT) diagram

Lecture 36 - Diffusion in Solids - I

Lecture 37 - Diffusion in Solids - II

Lecture 38 - Diffusion in Solids - III

Lecture 39 - Diffusion in Solids - IV

Lecture 40 - Applications of heat treatment

NPTEL : NOC:Fundamentals of Material Processing - Part 2 (Metallurgy and Material Science)

Co-ordinators : Prof. Shashank Shekhar, Prof. Jitesh J Thakkar

Lecture 1 - Introduction to Metal Working

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

Lecture 16 - Upper-Bound Analysis

Lecture 17 - Plane Strain Indentation

Lecture 18 - Strain Calculation Models and Friction

Lecture 19 - Types of Friction

Lecture 20 - Effect of Friction in Rolling

Lecture 21 - Vacuum Technology

Lecture 22 - Vacuum Technology (Continued...)

Lecture 23 - Thermal Evaporation

Lecture 24 - Thermal Evaporation (Continued...)

Lecture 25 - Thermal Evaporation (Continued...)

Lecture 26 - Plasma Physics

Lecture 27 - Plasma Physics (Continued...)

Lecture 28 - Sputtering

Lecture 29 - Sputtering (Continued...)

Lecture 30 - Sputtering (Continued...)

Lecture 31 - Chemical Vapor Deposition

Lecture 32 - Chemical Vapor Deposition (Continued...)

Lecture 33 - Chemical Vapor Deposition (Continued...)

Lecture 34 - Chemical Vapor Deposition (Continued...)

Lecture 35 - Epitaxy, Molecular Beam Epitaxy and Atomic Layer Deposition

Lecture 36 - Adsorption and Nucleation

Lecture 37 - Thin Film Growth

Lecture 38 - Kinetics of Thin Film Growth

Lecture 39 - Thin Film Morphology- Zone Structure Model

Lecture 40 - Thin Film Characterization

Lecture 41 - Thin Film Characterization

NPTEL : NOC:Nature and Properties of Materials - An Introductory Course (Metallurgy and Material Science)

Co-ordinators : Dr. Ashish Garg

Lecture 1 - Material Evolution

Lecture 2 - Bonding in Materials

Lecture 3 - Correlation between bond and physical properties

Lecture 4 - Crystal Structure: Lattice and Basis

Lecture 5 - Unit Cell (Primitive and Non-primitive)

Lecture 6 - Crystal Systems and Bravais Lattices

Lecture 7 - Bravais Lattice and Symmetry in Crystals

Lecture 8 - Symmetry in Crystals

Lecture 9 - Symmetry and Correlation with the Bravais Lattice

Lecture 10 - Miller Indices (Planes and Directions)

Lecture 11 - Miller Indices - Part 2

Lecture 12 - Miller Indices - Part 3

Lecture 13 - Miller Indices and Weiss Zone Law

Lecture 14 - Structure of Metals and Alloys

Lecture 15 - Structure of Metals, Packing, Co-ordination and Interstices

Lecture 16 - Interstices, Solid Solutions and Alloys

Lecture 17 - Solid Solutions: Alloys

Lecture 18 - Solid Solutions: Alloy (Continued...)

Lecture 19 - Covalent Solids

Lecture 20 - Covalent Solids (Continued...) and Ionic Solids

Lecture 21 - Ionic Solids: Stability and Rules of Formation

Lecture 22 - Ionic solids (Continued...) : Formation of structure

Lecture 23 - ionic Solids (Continued...) : Close Packing of anions

Lecture 24 - Ionic Solids (Continued...) : Other cubic structures

Lecture 25 - Ionic Solids (Ceramics) : Remaining cubic and non-cubic structures

Lecture 26 - HCP based Structure

Lecture 27 - Structure of Non-crystalline Solids (glasses)

Lecture 28 - Structure of Non-Crystalline Solids:Glasses (Continued...)

Lecture 29 - Structure of Non-Crystalline Solids (Polymers)

Lecture 30 - Structure of Polymers

Lecture 31 - Structure of Polymers (Continued...)

Lecture 32 - Structure Determination (X-ray Diffraction)

Lecture 33 - X-ray Diffraction

Lecture 34 - X-ray Diffraction (Continued...)

Lecture 35 - X-ray Diffraction (Continued...)

Lecture 36 - X-ray Diffraction (Continued...)

Lecture 37 - X-ray Diffraction (Continued...)

Lecture 38 - Defects in Solids (Point Defects)

Lecture 39 - Point Defect Concentration

Lecture 40 - 2-D Defects

NPTEL : NOC:Defects in Crystalline Solids - Part I (Metallurgy and Material Science)

Co-ordinators : Prof. Shashank Shekhar

Lecture 1 - Introduction to Defects

Lecture 2 - Equilibrium Points Defects

Lecture 3 - Energy of Vacancy Formation

Lecture 4 - Vacancy Concentration Measurement Techniques

Lecture 5 - Self-interstitial Defects+Frenkel Defects

Lecture 6 - Schottky Defects+Extrinsic Defects

Lecture 7 - Interstitials in Iron

Lecture 8 - Defects Reaction+Kroger-Vink Notation

Lecture 9 - Defects Reaction and its Thermodynamics

Lecture 10 - Equilibrium Concentration using Defects Reaction

Lecture 11 - Examples on defect reaction

Lecture 12 - Diffusion (Interstitial Diffusion)

Lecture 13 - Non-steady state diffusion

Lecture 14 - Self-diffusion + Examples

Lecture 15 - Diffusion in substitutional alloys+Diffusion along defects

Lecture 16 - History of Dislocations

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

Lecture 21 - Stress and Strain Fields

Lecture 22 - Stress State around Edge Dislocations+Elastic Energy of Dislocations

Lecture 23 - Glide Forces on Dislocations+Line Tension on Dislocations

Lecture 24 - Climb Forces on Dislocations+Interaction Between Dislocations

Lecture 25 - Image Forces on Dislocations

Lecture 26 - Resistance to Dislocation Motion+Peierl Nebarro Valley

Lecture 27 - Slip System+Examples

Lecture 28 - Dislocations and Slips+Examples

Lecture 29 - Critical resolved Shear Stress+Examples (Continued...)

Lecture 30 - Glide+Kinks

Lecture 31 - Cross-slip+Climb

Lecture 32 - Climb+Jogs

Lecture 33 - Examples on Jogs+Dislocation Intersection

Lecture 34 - Dislocation Intersection and step characteristics+Superjogs

Lecture 35 - Strain and strain-rate due to dislocation motion+Velocity of dislocations+Observation of dislocations

Lecture 36 - Observation of dislocation (Continued...) + Dislocation Dynamics

Lecture 37 - Dislocations in FCC+Partial dislocations

Lecture 38 - Partial dislocations (Continued...) +Stacking Fault

Lecture 39 - Thompson's Tetrahedron+Examples

Lecture 40 - Dislocations in BCC+Asymmetry of Slip

NPTEL : NOC:Corrosion - Part I (Metallurgy and Material Science)

Co-ordinators : Dr. Kallol Mondal

Lecture 1 - Introduction to corrosion - I

Lecture 2 - Introduction to corrosion - II

Lecture 3 - Types and forms of corrosion

Lecture 4 - Uniform and Galvanic corrosion

Lecture 5 - Crevice and Pitting corrosion

Lecture 6 - Forms of corrosion: Explanation with Examples

Lecture 7 - Electrochemical Nature of Corrosion and its Thermodynamics

Lecture 8 - Thermodynamics aspects of corrosion - I

Lecture 9 - Thermodynamics aspects of corrosion - II

Lecture 10 - Thermodynamics aspects ofcorrosion - III

Lecture 11 - Relation Between Free Energy and Equilibrium Constant

Lecture 12 - Derivation of Nernst Equation

Lecture 13 - Standard Reduction Potential Series for Pure Metals

Lecture 14 - Reduction Potentials in Acidic and Neutral Solutions

Lecture 15 - Nernst equation in terms of pH

Lecture 16 - Limitations of Standard Reduction Potential Series of Pure Metals

Lecture 17 - Concentration Cell Formation and Galvanic Series

Lecture 18 - Examples of Concentration cell and Spontaneity of Corrosion Process

Lecture 19 - Spontaneity of Corrosion Process and Introduction to Pourbaix Diagram

Lecture 20 - Construction of Pourbaix Diagram

Lecture 21 - Construction of Pourbaix diagram for Ni-H2O system - I

Lecture 22 - Construction of Pourbaix diagram for Ni-H2O system - II

Lecture 23 - Construction of Pourbaix diagram for Ni-H2O system - III

Lecture 24 - Pourbaix diagram of Ni-H2O and AI-H2O

Lecture 25 - Inferences from Pourbaix diagram of Fe-H2O and AI-H2O

Lecture 26 - Estimation of Corrosion Rate - I

Lecture 27 - Estimation of Corrosion Rate - II

Lecture 28 - Estimation of Corrosion Rate - III

Lecture 29 - Exchange Current Density

Lecture 30 - Exchange Current Density and Standard Hydrogen Electrode

Lecture 31 - Electrical Double Layer and Polarization

Lecture 32 - Correlation between Current Density and Overvoltage

Lecture 33 - Introduction to Buttler-Volmer Equation

Lecture 34 - Derivation of Tafel Equation

Lecture 35 - Tafel Plot and Activation Polarization

Lecture 36 - Activation polarization, concentration polarization and total polarization

Lecture 37 - Summary of concentration polarization (CP) and introduction to mixed potential theory - I

Lecture 38 - Mixed potential theory - II

Lecture 39 - Understanding of mixed potential theory through the case studies and events of corrosion - I

Lecture 40 - Understanding of mixed potential theory through the case studies and events of corrosion - II

Lecture 41 - Understanding of mixed potential theory through the case studies and events of corrosion - III

NPTEL : NOC:Solar Photovoltaics: Principles, Technologies and Material (Metallurgy and Material Science)

Co-ordinators : Dr. Ashish Garg

Lecture 1 - Introduction to Solar Energy

Lecture 2 - Solar Radiation

Lecture 3 - Atmospheric Effects on Solar Radiation

Lecture 4 - Effect of Location on Time

Lecture 5 - Sun-Earth Angular Relations

Lecture 6 - Solar Radiation Measurements

Lecture 7 - Introduction to Band Theory

Lecture 8 - Semiconductor Basics - I

Lecture 9 - Semiconductor Basics - II

Lecture 10 - Electrical Properties of Semiconductors

Lecture 11 - Carrier Transport

Lecture 12 - Carrier Transport, Generation and Recombination

Lecture 13 - Recombinaton-Generation statistics

Lecture 14 - Recombinaton-Generation statistics (Continued...)

Lecture 15 - Recombinaton-Generation statistics (Continued...)

Lecture 16 - P-N Junction basics

Lecture 17 - P-N Junction Characterisitics

Lecture 18 - P-N Junction: Effect of Bias

Lecture 19 - P-N Junction Analysis (Dark)

Lecture 20 - P-N Junction Analysis (Dark)

Lecture 21 - P-N Junction Analysis (Light)

Lecture 22 - P-N Junction Analysis (Light)

Lecture 23 - P-N Junction Analysis (Light)

Lecture 24 - P-N Junction Analysis (Light)

Lecture 25 - Solar Cell Device Parameters

Lecture 26 - Solar Cell Device Parameters

Lecture 27 - Solar PV Technologies: Introduction

Lecture 28 - Generation-I Technologies (Mono Silicon Solar Cells)

Lecture 29 - Generation-I Technologies (Mono Silicon Solar Cells)

Lecture 30 - Generation-I Technologies (Poly Silicon Solar Cells)

Lecture 31 - Manufacturing of Si

Lecture 32 - Generation I Technologies: GaAs Solar Cells

Lecture 33 - Generation II Technologies: a-Si Solar Cells

Lecture 34 - Generation II Technologies: CdTe Solar Cells

Lecture 35 - Generation II Technologies: CdTe Solar Cells

Lecture 36 - Generation II Technologies: CIGS Solar Cells

Lecture 37 - Generation II Technologies: CIGS and Multijunction Solar Cells

Lecture 38 - Generation III Technologies: Organic Solar Cells

Lecture 39 - Generation III Technologies: Organic Solar Cells

Lecture 40 - Generation III Technologies: Organic and Dye Sensitized Solar Cells

Lecture 41 - Generation III Technologies: Perovskite and CZTS Solar Cells

NPTEL : NOC:Defects in Crystalline Solids - Part II (Metallurgy and Material Science)

Co-ordinators : Prof. Shashank Shekhar

Lecture 1 - Dislocation structure in FCC

Lecture 2 - Partial dislocations in FCC

Lecture 3 - Thompsons Tetrahedron

Lecture 4 - Dislocation lock in FCC

Lecture 5 - Other defects in FCC (Twins and Frank Partial)

Lecture 6 - Dislocation structure in BCC

Lecture 7 - Soft core and Hard core for Screw dislocation in BCC

Lecture 8 - Dislocation structure in HCP

Lecture 9 - Burger vector and partial dislocation in HCP

Lecture 10 - Dislocation structure in ionic crystal

Lecture 11 - Dislocation structure in superlattices

Lecture 12 - Stacking fault and Kear-Wilsdorf lock in superlattices

Lecture 13 - Dislocation interaction & Strain hardening

Lecture 14 - Origin and Nucleation of dislocations

Lecture 15 - Multiplication of dislocations

Lecture 16 - Interactin of point defects and dislocation - Solid Solution Strengthening

Lecture 17 - Cottrell atmosphere and Yield-point phenomenon

NPTEL : NOC:Corrosion - Part II (Metallurgy and Material Science)

Co-ordinators : Dr. Kallol Mondal

Lecture 1 - Recap of Electrochemical Polarization

Lecture 2 - Recap of Electrochemical Polarization - Activation and Concentration Polarization

Lecture 3 - Electrochemical Polarization: Activation and Concentration Polarization, Tafel Equation

Lecture 4 - Activation and Concentration Polarization: Mixed Potential Theory

Lecture 5 - Concentration Polarization and Mixed Potential Theory

Lecture 6 - Explanation of Corrosion Processes on the basis of Mixed Potential Theory - Introduction

Lecture 7 - Explanation of Corrosion Processes on the basis of Mixed Potential Theory - Part 1

Lecture 8 - Explanation of Corrosion Processes on the basis of Mixed Potential Theory - Part 2

Lecture 9 - Explanation of Corrosion Processes on the basis of Mixed Potential Theory - Part 2 (Continued...)

Lecture 10 - Explanation of Corrosion Processes on the basis of Mixed Potential Theory - Part 3

Lecture 11 - Effect of Exchange Current Density on Corrosion Rate of an Active Metal

Lecture 12 - Area Effect of the Cathodic and Anodic Component - I

Lecture 13 - Area Effect of the Cathodic and Anodic Component - II

Lecture 14 - Explanation of Corrosion Processess on the Basis of Mixed Potential Theory: Numerical Analysis

Lecture 15 - Galvanic Coupling between Two Active Metals

Lecture 16 - Theory of Sacrificial Anode for the Protection of Steel Objects

Lecture 17 - Effect of two Active Metals on Fe-corrosion when they are Galvanically Coupled

Lecture 18 - Corrosion of Metals when Cathodic Protection is Concentration Controlled

Lecture 19 - Effect of Velocity on the Corrosion Rate of an Active Metal

Lecture 20 - Concentration Polarization and Activation Polarization: Numerical Analysis

Lecture 21 - Numerical Problems and Passivation

Lecture 22 - Theory of Passivation - I

Lecture 23 - Theory of Passivation - II

Lecture 24 - Interaction between Passivation and Pourbaix Diagram - I

Lecture 25 - Interaction between Passivation and Pourbaix Diagram - II

Lecture 26 - Passivity

Lecture 27 - Interaction of Cathodic Polarization with an Active-Passive Metal

Lecture 28 - Interaction of Anodic Polarization with an Active-Passive Metal

Lecture 29 - Passivation and Mixed Potential Theory: Case Studies

Lecture 30 - Passivation and Mixed Potential Theory: Case Studies (Continued...)

Lecture 31 - Effect of Galvanic Coupling between an Active-Passive Metal and a Noble Metal

Lecture 32 - Anodic Protection of an Active-Passive Metal and an Introduction of Linear Polarization

Lecture 33 - Linear Polarization and Understanding Relative Corrosion Resistance of a Metal

Lecture 34 - Oxidation of Metals and Alloys

Lecture 35 - Different Stages of Oxidation and Pilling Bedworth Ratio

Lecture 36 - Pilling Bedworth Ratio of Different Metal Oxides

Lecture 37 - Thermodynamics of Oxidation

Lecture 38 - Construction of Ellingham Diagram - I

Lecture 39 - Construction of Ellingham Diagram - II

Lecture 40 - Kinetics of Oxidation

Lecture 41 - Oxide Structure and Oxidation Mechanism

NPTEL : NOC:Fundamentals and Applications of Dielectric Ceramics (Metallurgy and Material Science)

Co-ordinators : Dr. Ashish Garg

Lecture 1 - Outline of the Course

Lecture 2 - Basics of Crystal Structure

Lecture 3 - Basics of Crystallography and Bonding

Lecture 4 - Arrangement of Atoms in Crystal Lattice

Lecture 5 - Structure Formation: Ionic Solids

Lecture 6 - Pauling's Rule and Crystal Structure of Ceramics

Lecture 7 - Ceramic Materials: Crystal Structure

Lecture 8 - Defect Chemistry

Lecture 9 - Defect Chemistry: Non-Stoichiometric Oxides

Lecture 10 - Concentration and Effect of Intrinsic Impurities

Lecture 11 - Intrinsic and Extrinsic Defects

Lecture 12 - Defect Concentration: Non-Stoichiometric Oxides

Lecture 13 - Intrinsic Ionization in Metal Oxides

Lecture 14 - Brouwer's Diagram

Lecture 15 - Introduction to Dielectrics

Lecture 16 - Dielectric Displacement and Polarization Mechanism

Lecture 17 - Polarization Mechanisms

Lecture 18 - Dielectric Polarizability - 1

Lecture 19 - Dielectric Polarizability - 2

Lecture 20 - Frequency Dependence of Dielectrics

Lecture 21 - Losses in Dielectric Materials

Lecture 22 - Frequency Dependence of Dielectric Constant

Lecture 23 - Dipolar Relaxation

Lecture 24 - Debye Equations for Dipolar Relaxation

Lecture 25 - Impedance Spectroscopy

Lecture 26 - Impedance Spectroscopy and Dielectric Breakdown

Lecture 27 - Basics of Non-linear Dielectrics

Lecture 28 - Piezoelectric Effect

Lecture 29 - Pyroelectric Effect and Electrostriction

Lecture 30 - Thermodynamics of Piezoelectric and Pyroelectric Materials

Lecture 31 - Basics of Ferroelectric Materials

Lecture 32 - Ferroelectric Phase Transitions

Lecture 33 - Thermodynamics of Phase Transition in Ferroelectrics

Lecture 34 - Second Order Phase Transition in Ferroelectric Materials

Lecture 35 - First Order Phase Transition in Ferroelectric Materials

Lecture 36 - Domain Walls in Ferroelectric Materials

Lecture 37 - Domain Structure and Properties of Ferroelectric Materials

Lecture 38 - Phase Diagram and Measurements of Ferroelectric Materials

Lecture 39 - Principal of Measurements and Applications of Piezoelectric and Pyroelectric Materials

Lecture 40 - Applications of Piezoelectric and Pyroelectric Materials

NPTEL : NOC:Properties of Materials (Nature and Properties of Materials-III) (Metallurgy and Material Science)

Co-ordinators : Dr. Ashish Garg

Lecture 1 - Introduction to the Course

Lecture 2 - Basic Material Properties - Stress and Strain Tensor

Lecture 3 - Normal and Shear Stress and Transformation of Axes

Lecture 4 - Transformation of Axes and Principle Stresses

Lecture 5 - True and Engineering Stress and Strain

Lecture 6 - Illustration to True and Engineering Stress and Strain

Lecture 7 - Tensor Notation of Strain

Lecture 8 - Introduction to Elasticity and Elastic Properties

Lecture 9 - Theory of Elasticity

Lecture 10 - Atomic Basis of Elasticity

Lecture 11 - Elasticity of Different Materials, Design of Composites

Lecture 12 - Composites, Anelastic Behaviour

Lecture 13 - Stress-Strain Curve and Anelasticity

Lecture 14 - Mechanism of Anelasticity

Lecture 15 - Relaxation Time and Damping Capacity

Lecture 16 - Plastic Deformation of Materials

Lecture 17 - True and Engineering Stress-Strain Curves

Lecture 18 - Necking Phenomenon During Tension Test

Lecture 19 - Microscopic Mechanism of Plastic Deformation

Lecture 20 - Introduction to Slip

Lecture 21 - Slip Systems

Lecture 22 - Resolved Shear Stress

Lecture 23 - Critical Resolved Shear Stress

Lecture 24 - Theoretical Strength and Role of Dislocations

Lecture 25 - Dislocations and Slip - I

Lecture 26 - Dislocations and Slip - II

Lecture 27 - Dislocations and Peirells Nabarro Stress

Lecture 28 - Dislocation Generation: Frank Read Source

Lecture 29 - Dislocations and Strengthening

Lecture 30 - Strain Hardening

Lecture 31 - Grain Boundary Strengthening

Lecture 32 - Solid Solution Strengthening

Lecture 33 - Precipitation Hardening

Lecture 34 - Electrical Conduction in Metals

Lecture 35 - Free Electron Theory

Lecture 36 - Fermi-Dirac Statistics and Electronic conductivity of Metals

Lecture 37 - Fundamental of Semiconductors

Lecture 38 - Band Theory

Lecture 39 - Intrinsic Semiconductors

Lecture 40 - Extrinsic Semiconductors

NPTEL : NOC:Diffusion in Multicomponent Solids (Metallurgy and Material Science)

Co-ordinators : Prof. Kaustubh Kulkarni

Lecture 1 - Introduction to the Course and Thermodynamics Refresher

Lecture 2 - The Second law of Thermodynamics

Lecture 3 - Application of Second law and Illustration of Intermixing as Irreversible Process

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

Lecture 7 - Entropy of mixing of Multicomponent Ideal Solution

Lecture 8 - Regular Solution Model: Application to Ternary System

Lecture 9 - Gibbs Free Energy-Composition Curves, Phase Diagrams and Gibbs Phase rule

Lecture 10 - Exercise: Solution Thermodynamics

Lecture 11 - Driving force for Diffusion, Chemical Potentials and Concentrations

Lecture 12 - Diffusion flux and Frames of Reference

Lecture 13 - Fickâ€™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

Lecture 18 - Refresher on Laplace Transform

Lecture 19 - Error Function and Its Laplace transform

Lecture 20 - Instantaneous Planar Source: Solution to Diffusion Equation and Its Applications

Lecture 21 - Solution to Diffusion Equation for Semi-Infinite Slab and Its Application in Carburizing of Steel

Lecture 22 - Solution to Diffusion Equation for Binary Diffusion Couple

Lecture 23 - Solution to Diffusion Equation for Multicomponent Diffusion Couple

Lecture 24 - Nature of Concentration Profiles in Binary and Multicomponent Diffusion Couples

Lecture 25 - Numerical Problems

Lecture 26 - Homogenization of Multicomponent alloys

Lecture 27 - Solution to Diffusion Equation: Periodic Boundary Conditions

Lecture 28 - Energetics of Vacancy Formation

Lecture 29 - Experimental Determination of Enthalpy of Vacancy Formation

Lecture 30 - Mechanisms of Diffusion in Metals and Alloys

Lecture 31 - Point Defects in Intermetallics and Ionic Compounds

Lecture 32 - Diffusion Mechanisms in Intermetallics

Lecture 33 - Theory of Random Walk: Mean Squared Displacement

Lecture 34 - Physical Significance of Diffusivity: Einstein-Smoluchowski Equation

Lecture 35 - Derivation of Correlation Factors in Cubic Crystals by Vacancy Mechanism

Lecture 36 - Correlation Factors for Substitutional Diffusion by Vacancy Mechanism in FCC Crystal

Lecture 37 - Correlation Effects in BCC and Diamond Cubic for Vacancy Mechanism

Lecture 38 - Practice Problems

Lecture 39 - Deriving Relation Between Diffusion Flux and Chemical Potential Gradients

Lecture 40 - Atomic Mobility, Diffusivity and Diffusion Under External Driving Force

Lecture 41 - Non-Ideality as Driving Force

Lecture 42 - Theory of diffusion

Lecture 43 - Experimental Determination of Interdiffusion Coefficients: Boltzmann Matano Analysis

Lecture 44 - Analysis of Interdiffusion Fluxes in Multicomponent Diffusion Couples

Lecture 45 - Various Techniques for Experimental Determination of Multicomponent Interdiffusion Coefficients

Lecture 46 - Experiement Determination of Interdiffusion Coefficients: Examples from Literature

Lecture 47 - Intrinsic Diffusion and Kirkendall Effect

Lecture 48 - Experiemental Determination of Intrinsic Diffusion Coefficients

Lecture 49 - A Brief Introduction to Ternary Phase Diagram

Lecture 50 - Multiphase Diffusion: Diffusion Paths and Diffusion Structures

Lecture 51 - Interdiffusion Analysis of Multiphase Diffusion Couples

NPTEL : NOC:Corrosion Failures and Analysis (Metallurgy and Material Science)

Co-ordinators : Prof. Kallol Mondal

Lecture 1 - An introduction to corrosion failure and analysis

Lecture 2 - Various forms of corrosion

Lecture 3 - Discussion of various factors affecting corrosion

Lecture 4 - Forms of corrosion: Uniform corrosion - Part 1

Lecture 5 - Forms of corrosion: Uniform corrosion - Part 2

Lecture 6 - Galvanic corrosion - I

Lecture 7 - Galvanic corrosion - II

Lecture 8 - Galvanic corrosion - III

Lecture 9 - Galvanic corrosion - IV

Lecture 10 - Importance of galvanic series

Lecture 11 - Factors associated with galvanic corrosion: Case study 1

Lecture 12 - Factors associated with galvanic corrosion: Case study 2

Lecture 13 - Factors associated with galvanic corrosion: Case study 3

Lecture 14 - Preventive measures and advantages of galvanic corrosion

Lecture 15 - Dealloying/Selective leaching

Lecture 16 - Dealloying or selective leaching: Mechanism

Lecture 17 - Dealloying or selective leaching: Applications and protection methods

Lecture 18 - Graphitic corrosion and protection from dezincification

Lecture 19 - Intergranular Corrosion

Lecture 20 - Intergranular corrosion in case of 304, 321 and 347 stainless steel

Lecture 21 - Intergranular Corrosion: Sensitization and Weld Decay

Lecture 22 - Intergranular Corrosion: Control of Sensitization - Weld Decay

Lecture 23 - Intergranular Corrosion: Knife Line Attack and Prevention Methods

Lecture 24 - Crevice Corrosion: Introduction

Lecture 25 - Crevice Corrosion: Mechanism

Lecture 26 - Crevice corrosion: Mechanism and Various stages

Lecture 27 - Crevice corrosion: Case studies and Protection methods

Lecture 28 - Pitting corrosion: Introduction and Case studies

Lecture 29 - Various conditions favouring pitting corrosion - I

Lecture 30 - Various conditions favouring pitting corrosion - II

Lecture 31 - Various conditions favouring pitting corrosion - III

Lecture 32 - Pitting Corrosion: Mechanism and Protection

Lecture 33 - Erosion Corrosion: Introduction

Lecture 34 - Erosion Corrosion: Characteristics

Lecture 35 - Erosion Corrosion: Protection methods and cavitation corrosion

Lecture 36 - Cavitation corrosion and its case studies

Lecture 37 - Cavitation corrosion, Fretting corrosion and their preventive measures

Lecture 38 - Environmental cracking or stress assisted corrosion failures

Lecture 39 - Stress corrosion cracking: Mechanism - I

Lecture 40 - Stress corrosion cracking: Mechanism - II

Lecture 41 - Stress corrosion cracking: Mechanism - III

Lecture 42 - Stress corrosion cracking: Corrosion fatigue and protection methods

NPTEL : NOC:Nanomaterials and their Properties (Metallurgy and Material Science)

Co-ordinators : Prof. Krishanu Biswas

Lecture 1 - Nanomaterials: An Overview - Part I

Lecture 2 - Nanomaterials: An Overview - Part II

Lecture 3 - Nanomaterials: Hierarchial Nanostructures - I

Lecture 4 - Nanomaterials: Hierarchial Nanostructures - II

Lecture 5 - Nanomaterials: Surfaces and Interfaces - I

Lecture 6 - Nanomaterials: Surfaces and Interfaces - I (Continued...)

Lecture 7 - Nanomaterials: Surfaces - I

Lecture 8 - Nanomaterials: Magic Numbers

Lecture 9 - Thermodynamics of Nanomaterials

Lecture 10 - Surfaces and Interfaces - II

Lecture 11 - Thermodynamics of Nanomaterials

Lecture 12 - Surfaces and Interfaces - II (Continued...)

Lecture 13 - Nanophase Diagrams

Lecture 14 - Effect of Size on Phase Diagrams

Lecture 15 - Synthesis of Nanomaterials

Lecture 16 - Synthesis Routes of Nanomaterials - II

Lecture 17 - Mechanical Properties of Nanomaterials - I

Lecture 18 - Mechanical Properties of Nanomaterials - II

Lecture 19 - Thermal Properties of Nanomaterials - I

Lecture 20 - Thermal Properties of Nanomaterials - II

Lecture 21 - Thermal Properties of Nanomaterials - III

Lecture 22 - Thermal Properties of Nanomaterials - III (Continued...)

Lecture 23 - Electrical Property of Nanomaterials

Lecture 24 - Magnetic Properties of Nanomaterials - I

Lecture 25 - Magnetic Properties of Nanomaterials - II

Lecture 26 - Optical Properties of Nanomaterials - I

Lecture 27 - Optical Properties of Nanomaterials - II

Lecture 28 - Special Cases: Carbon-Based Nanomaterials

Lecture 29 - Special Cases: Polymer-Based Nanomaterials

NPTEL : NOC:Mechanical Behaviour of Materials - Part I (Metallurgy and Material Science)

Co-ordinators : Prof. Shashank Shekhar, Prof. Sudhanshu Shekhar Singh

Lecture 1 - Introduction

Lecture 2 - Origin of Elasticity

Lecture 3 - Stress as a Tensor

Lecture 4 - Principal Stress

Lecture 5 - Mohr's Circle

Lecture 6 - Stress-Strain Relation

Lecture 7 - Viscoelasticity

Lecture 8 - Tensile Testing

Lecture 9 - Universal Testing Machine

Lecture 10 - Flow Stress

Lecture 11 - Yield Criterions: Basics

Lecture 12 - Yield Criterions: Tresca, Von-Mises

Lecture 13 - Effective Stress_Effective Strain

Lecture 14 - Plastic Instability

Lecture 15 - Effect of Strain-rate and Temperature

Lecture 16 - Dislocations: Discovery

Lecture 17 - Dislocations: Fundamentals

Lecture 18 - Dislocations: Characteristics

Lecture 19 - Stress and Strain Fields of Dislocations

Lecture 20 - Energy of Dislocations

Lecture 21 - Dislocation Motion Glide

Lecture 22 - Cross-slip of Dislocations

Lecture 23 - Climb motion of Dislocations

Lecture 24 - Steps in Dislocations

Lecture 25 - Slip Systems

Lecture 26 - More on Slip Systems

Lecture 27 - Critical Resolved Shear Stress

Lecture 28 - Dislocation Interactions

Lecture 29 - Image Forces

Lecture 30 - Partial Dislocations

Lecture 31 - Strengthening Mechanisms

Lecture 32 - Precipitation Strengthening: Basic Criteria

Lecture 33 - Precipitation Strengthening: Precipitate Characteristics

Lecture 34 - Precipitation Strengthening: Mechanisms

Lecture 35 - Effect of Temperature: Dispersion Strengthening

Lecture 36 - Solid Solution Strengthening: Basics

Lecture 37 - Solid Solution Strengthening: Interaction with Dislocations

Lecture 38 - Solid Solution Strengthening: Yield Point Phenomenon

Lecture 39 - Grain Boundary Strengthening

Lecture 40 - Strain Hardening: Single Xtal and Poly Crystal Deformation, Tylor Hardening

Lecture 41 - Strain Hardening: Dislocation Multiplication, Intersection and Locks

Lecture 42 - Summary of Strengthening Mechanisms

Lecture 43 - Hardness Testing

Lecture 44 - Impact Testing

Lecture 45 - Mechanical Behaviour of Composites

NPTEL : NOC:Mechanical Behaviour of Materials - Part II (Metallurgy and Material Science)

Co-ordinators : Prof. Sudhanshu Shekhar Singh, Prof. Shashank Shekhar

Lecture 1 - Theoretical Strength

Lecture 2 - Stress Based Approach (Inglis)

Lecture 3 - Energy Based Approach (Griifith)

Lecture 4 - Mode of Deformation and Stress Distribution Ahead of Crack Tip

Lecture 5 - Stress Triaxiality

Lecture 6 - Plastic Zone Size

Lecture 7 - Plastic Zone Size and Shape (Continued...)

Lecture 8 - Stress Intensity Factors for Different Geometries

Lecture 9 - Fracture Toughness

Lecture 10 - Fracture Toughness Measurement

Lecture 11 - Fracture Mechanisms

Lecture 12 - Ductile Fracture Mechanisms

Lecture 13 - Ductile Fracture Mechanisms_Tunneling

Lecture 14 - Cleavage Fracture

Lecture 15 - Fracture Mechanisms (Images)

Lecture 16 - Fatigue (Stress Parameters)

Lecture 17 - Fatigue Testing (S-N curve)

Lecture 18 - Low and High Cycle Fatigue

Lecture 19 - Fatigue Crack Initiation

Lecture 20 - Fatigue Crack Propagation

Lecture 21 - Fatigue Striations, Beachmarks and Images

Lecture 22 - Deformation of Composites

Lecture 23 - Deformation of Composites (Continued...)

Lecture 24 - Toughening of Ceramics

Lecture 25 - Fracture in Polymers

Lecture 26 - Creep Fundamentals

Lecture 27 - Creep Models

NPTEL : NOC:Electronic Properties of the Materials: Computational Approach (Metallurgy and Material Science)

Co-ordinators : Prof. Somnath Bhowmick

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31

Lecture 32

Lecture 33

Lecture 34

Lecture 35

Lecture 36

Lecture 37

Lecture 38

Lecture 39

NPTEL : NOC:Corrosion Protection Methods (Metallurgy and Material Science)

Co-ordinators : Prof. Kallol Mondal

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31

Lecture 32

Lecture 33

Lecture 34

Lecture 35

Lecture 36

Lecture 37

Lecture 38

Lecture 39

Lecture 40 (Part 1)

Lecture 41 (Part 2)

NPTEL : NOC:Phase Diagrams in Single Component and Binary Systems in Bengali (Metallurgy and Material Science)

Co-ordinators : Prof. Kallol Mondal

Lecture 1 - Introduction to phase diagram

Lecture 2 - Definition of important terms

Lecture 3 - Understanding of thermodynamic equilibrium - I

Lecture 4 - Understanding of thermodynamic equilibrium - II

Lecture 5 - Understanding of thermodynamic equilibrium - III

Lecture 6 - Understanding of thermodynamic equilibrium - IV

Lecture 7 - Significance of chemical potential in phase equilibrium

Lecture 8 - Phase equilibrium in H2O system - Part 1

Lecture 9 - Phase equilibrium in H2O system - Part 2

Lecture 10 - Part A - Phase equilibrium in H2O system - Part 3

Lecture 11 - Part B - Phase equilibrium in H2O system - Part 4

Lecture 12 - Practical importance of water phase diagram

Lecture 13 - Solution thermodynamics - Part I

Lecture 14 - Solution thermodynamics - Part II

Lecture 15 - Solution thermodynamics - Part III

Lecture 16 - Solution thermodynamics - Part IV

Lecture 17 - Solution thermodynamics - Part V

Lecture 18 - Solution thermodynamics - part VI

Lecture 19 - solution thermodynamics - part VII

Lecture 20 - Graphical understanding of free energy and composition of condensed solutions - Part 1

Lecture 21 - Graphical understanding of free energy and composition of condensed solutions - Part 2

Lecture 22 - Free energy composition plots and evolution of phase diagram for condensed solution - I

Lecture 23 - Free energy composition plots and evolution of phase diagram for condensed solution - II

Lecture 24 - Free energy composition plots and evolution of phase diagram for condensed solution - III

Lecture 25 - Free energy composition plots and evolution of phase diagram for condensed solution - IV

Lecture 26 - Free energy composition plots and evolution of phase diagram for condensed solution - V

Lecture 27 - Isomorphous phase diagram, tie line, and lever rule

Lecture 28 - Calculation of phase diagram - Part I

Lecture 29 - Calculation of phase diagram - Part II

Lecture 30 - Introduction to the non-ideal solutions

Lecture 31 - The quasi-chemical approach

Lecture 32 - Quasi-chemical approach to obtain change in enthalpy in regular solutions

Lecture 33 - Effect of enthalpy change in change in Gibbs free energy - Part 1

Lecture 34 - Effect of enthalpy change in change in Gibbs free energy - Part 2

Lecture 35 - Effect of enthalpy change in change in Gibbs free energy and final Gibbs free energy - I

Lecture 36 - Effect of enthalpy change in change in Gibbs free energy and final Gibbs free energy - II

Lecture 37 - Effect of enthalpy change in change in Gibbs free energy and final Gibbs free energy - III

Lecture 38 - Free energies of liquid and solid solutions

Lecture 39 - Phase diagram on the basis of enthalpy of mixing of solid and liquid solutions - I

Lecture 40 - Phase diagram on the basis of enthalpy of mixing of solid and liquid solutions - II

Lecture 41 - Phase diagram on the basis of enthalpy of mixing of solid and liquid solutions - III

Lecture 42 - Eutectic, peritectic, and eutectoid phase diagrams - Part 1

Lecture 43 - Eutectic, peritectic, and eutectoid phase diagrams - Part 2

Lecture 44 - Phase rule - Part I

Lecture 45 - Derivation of phase rule

NPTEL : NOC:Artificial Intelligence and Machine Learning in Materials Engineering (Metallurgy and Material Science)

Co-ordinators : Prof. Krishanu Biswas

Lecture 1 - Introduction to the course - I

Lecture 2 - Introduction to the course - II

Lecture 3 - Introduction to AI - I

Lecture 4 - Introduction to AI - II

Lecture 5 - Basics of Materials Science - I

Lecture 6 - Basics of Materials Science - II

Lecture 7 - Basics of Materials Science - III

Lecture 8 - Basics of Materials Science - IV

Lecture 9 - Part 1 - Basics of Materials Science - V

Lecture 10 - Part 2 - Basics of Materials Science - VI

Lecture 11 - Part 1 - Basics of Materials Science - VII

Lecture 12 - Part 2 - Basics of Materials Science - VIII

Lecture 13 - Part 1 - Basics of Materials Science - IX

Lecture 14 - Part 2 - Basics of Materials Science - X

Lecture 15 - Part 1 - Basics of Materials Science - XI

Lecture 16 - Part 2 - Basics of Materials Science - XII

Lecture 17 - Part 1 - Basics of Materials Science - XIII

Lecture 18 - Part 2 - Basics of Materials Science - XIV

Lecture 19 - Part 1 - Basics of Materials Science - XV

Lecture 20 - Part 2 - Basics of Materials Science - XVI

Lecture 21 - Part 1 - Basics of Materials Science - XVII

Lecture 22 - Part 2 - Basics of Materials Science - XVIII

Lecture 23 - Part 1 - Basics of Materials Science - XIX

Lecture 24 - Part 2 - Basics of Materials Science - X

Lecture 25 - Part 1 - Basics of Materials Science - XI

Lecture 26 - Part 2 - Basics of Materials Science - XII

Lecture 27 - Part 1 - Basics of Materials Science - XIII

Lecture 28 - Part 2 - Basics of Materials Science - XIV

Lecture 29 - Part 1 - Machine Learning Algorithms - I

Lecture 30 - Part 2 - Machine Learning Algorithms - II

Lecture 31 - Part 1 - Machine Learning Algorithms - III

Lecture 32 - Part 2 - Machine Learning Algorithms - IV

Lecture 33 - Part 1 - Machine Learning Algorithms - V

Lecture 34 - Part 2 - Machine Learning Algorithms - VI

Lecture 35 - Part 1 - Machine Learning Algorithms - VII

Lecture 36 - Part 2 - Machine Learning Algorithms - VIII

Lecture 37 - Part 1 - Machine Learning Algorithms - IX

Lecture 38 - Part 2 - Machine Learning Algorithms - X

Lecture 39 - Part 1 - Machine Learning Algorithms - XI

Lecture 40 - Part 2 - Machine Learning Algorithms - XII

Lecture 41 - Part 1 - Machine Learning Algorithms - XIII

Lecture 42 - Part 2 - Machine Learning Algorithms - XIV

Lecture 43 - Part 1 - Machine Learning Algorithms - XV

Lecture 44 - Part 2 - Machine Learning Algorithms - XVI

Lecture 45 - Part 1 - Machine Learning Algorithms - XVII

Lecture 46 - Part 2 - Machine Learning Algorithms - XVIII

Lecture 47 - Part 1 - Deep Learning Methods - I

Lecture 48 - Part 2 - Deep Learning Methods - II

Lecture 49 - Part 1 - Deep Learning Methods - III

Lecture 50 - Part 2 - Deep Learning Methods - IV

Lecture 51 - Part 1 - Deep Learning Methods - V

Lecture 52 - Part 2 - Deep Learning Methods - VI

Lecture 53 - Part 1 - Deep Learning Methods - VII

Lecture 54 - Part 2 - Deep Learning Methods - VIII

Lecture 55 - Part 1 - Materials Design at Different Length Scale - I

Lecture 56 - Part 2 - Materials Design at Different Length Scale - II

Lecture 57 - Part 1 - Materials Design at Different Length Scale - III

Lecture 58 - Part 2 - Materials Design at Different Length Scale - IV

Lecture 59 - Part 1 - Materials Design at Different Length Scale - V

Lecture 60 - Part 2 - Materials Design at Different Length Scale - VI

Lecture 61 - Part 1 - Molecular Dynamic Simulation

Lecture 62 - Part 2 - Molecular Dynamic Simulation

Lecture 63 - Part 1 - Density Function Theory (DFT)

Lecture 64 - Part 2 - Density Function Theory (DFT)

Lecture 65 - Part 1 - Advanced Deep Learning - I

Lecture 66 - Part 2 - Advanced Deep Learning - II

Lecture 67 - Part 1 - Advanced Deep Learning - III

Lecture 68 - Part 2 - Advanced Deep Learning - IV

Lecture 69 - Part 1 - Data Preprocessing and Error Analyses - I

Lecture 70 - Part 2 - Data Preprocessing and Error Analyses - II

Lecture 71 - Part 1 - Material Informatics - I

Lecture 72 - Part 2 - Material Informatics - II

Lecture 73 - Part 1 - Materials Knowledge and Materials Data Science, Material Informatics - I

Lecture 74 - Part 2 - Materials Knowledge and Materials Data Science, Material Informatics - II

Lecture 75 - Part 1 - Materials knowledge and materials data science, Material informatics - III

Lecture 76 - Part 2 - Materials Knowledge and Materials Data Science, Material Informatics - IV

Lecture 77 - Part 1 - Materials Knowledge and Materials Data Science, Material Informatics - V

Lecture 78 - Part 2 - Conclusion

NPTEL : NOC:Metallurgical and Electronic Waste Recycling (Metallurgy and Material Science)

Co-ordinators : Prof. Arunabh Meshram

Lecture 1 - Introduction to Materials Recycling

Lecture 2 - Classification of Metallurgical and Electronic Wastes - Part 1

Lecture 3 - Classification of Metallurgical and Electronic Wastes - Part 2

Lecture 4 - Importance of Unit Operations - Part 1

Lecture 5 - Importance of Unit Operations - Part 2

Lecture 6 - Pretreatments in Recycling

Lecture 7 - Pyrometallurgy

Lecture 8 - Electrometallurgy

Lecture 9 - Hydrometallurgy

Lecture 10 - Refining

Lecture 11 - Aluminium dross recycling

Lecture 12 - Spent pot lining recycling

Lecture 13 - Red mud recycling

Lecture 14 - Aluminium scrap recycling

Lecture 15 - Salt slag recycling

Lecture 16 - Copper Smelter Slag recycling

Lecture 17 - Copper Smelter Slag and Raffinate recycling

Lecture 18 - Raffinate recycling (Continued...)

Lecture 19 - Spent Electrolyte recycling

Lecture 20 - Copper scrap recycling

Lecture 21 - Zinc ash recycling

Lecture 22 - Zinc ash and zinc dross recycling

Lecture 23 - Zinc dross recycling (Continued...)

Lecture 24 - Zinc dust recycling

Lecture 25 - Zinc dust and zinc scrap recycling

Lecture 26 - Ironmaking slag recycling

Lecture 27 - Ironmaking and steelmaking slag recycling

Lecture 28 - Steelmaking slag recycling (Continued...)

Lecture 29 - Steel scrap recycling

Lecture 30 - Wastewater recycling

Lecture 31 - Recycling of E-Waste

Lecture 32 - Waste Printed Circuit Boards (WPCBs) recycling

Lecture 33 - WPCBs recycling: Delamination

Lecture 34 - WPCBs recycling: Pyrometallurgical processes

Lecture 35 - WPCBs recycling: Hydrometallurgical processes

Lecture 36 - Battery Recycling: Ni-based batteries

Lecture 37 - Battery Recycling: Lead-acid batteries

Lecture 38 - Battery Recycling: Zinc-based batteries

Lecture 39 - Battery Recycling: Li-ion batteries

Lecture 40 - Environmental Impacts of Recycling

Lecture 41 - Conclusion

NPTEL : NOC:Crystal Symmetry, X-Ray Diffraction and Physical Properties (Metallurgy and Material Science)

Co-ordinators : Prof. Sandeep Sangal

Lecture 1 - Lattice and Translation Symmetry

Lecture 2 - Lattice, Motif, Crystals and Unit Cells

Lecture 3 - Crystallographic Patterns

Lecture 4 - Crystal Systems in 3D

Lecture 5 - Crystals Based on 3D

Lecture 6 - Miller Indices for Directions in Lattice Space

Lecture 7 - Miller Indices for Planes in Lattice Space

Lecture 8 - Interplanar Spacing

Lecture 9 - Properties of Planes and Directions in a Cubic Unic Cell

Lecture 10 - Weiss Zone Law

Lecture 11 - Translation and Point Symmetries

Lecture 12 - Restrictions on Rotational Symmetries

Lecture 13 - 2D Crystal Systems and Lattices - I

Lecture 14 - 2D Crystal Systems and Lattices - II

Lecture 15 - What is a Group ?

Lecture 16 - Point Groups - I

Lecture 17 - Point Groups - II

Lecture 18 - Matrix Representations of Rotation Operation

Lecture 19 - Matrix Operation of Reflection Operation

Lecture 20 - Combination of two mirrors

Lecture 21 - The 10 2D Point Groups and their notations

Lecture 22 - Combining Translation with Point Symmetries - I

Lecture 23 - Combining Translation with Point Symmetries - II

Lecture 24 - Combining Rotation and Translation Symmetries

Lecture 25 - Plane Groups - I

Lecture 26 - Plane Groups - II : Glide Planes

Lecture 27 - Plane Groups - III : Glide Planes

Lecture 28 - Hexagonal Plane Groups based on the Point Symmetry 3m

Lecture 29 - Derivation of the Remaining Plane Groups

Lecture 30 - Decoding the International Tables - I

Lecture 31 - Combination of Three Rotation Axes in 3D

Lecture 32 - Combination of Three Rotation Axes in 3D - I

Lecture 33 - Combination of Three Rotation Axes in 3D - II

Lecture 34 - Stereographic Projection: Stereograms of Point Groups

Lecture 35 - The 32 Point Groups in 3D

Lecture 36 - Derivation of 3D - Bravais Lattices

Lecture 37 - Introduction to Space Groups

Lecture 38 - Space Groups: Screw Axes

Lecture 39 - Space Groups: Glide Planes

Lecture 40 - Decoding the International Tables - II

Lecture 41 - DVD as a Diffraction Grating

Lecture 42 - X-Ray Diffraction: Bragg's Law

Lecture 43 - Scattering of X-Rays: The Laue Equations - I

Lecture 44 - Scattering of X-Rays: The Laue Equations - II

Lecture 45 - The Structure Factor

Lecture 46 - Structure Factor Calculations

Lecture 47 - Structure Factor Calculations

Lecture 48 - The Reciprocal Lattice

Lecture 49 - Application of Reciprocal Lattice in Crystal Geometry

Lecture 50 - Reciprocal Lattice Examples

Lecture 51 - Reciprocal Lattice and Diffraction

Lecture 52 - X-Ray Diffraction Techniques

Lecture 53 - Analysis of Diffraction Pattern for a Cubic Crystal - I

Lecture 54 - Analysis of Diffraction Pattern for a Cubic Crystal - II

Lecture 55 - Decoding the International Tables - III

Lecture 56 - Tensor Representation of Physical Properties

Lecture 57 - Tensor Properties, Symmetry and Neumann's Principle

Lecture 58 - Transformation of Second Rank Tensor

Lecture 59 - Effect of Crystal Symmetry on Second Rank Property Tensor - I

Lecture 60 - Effect of Crystal Symmetry on Second Rank Property Tensor - II

Lecture 61 - Effect of Crystal Symmetry on Second Rank Property Tensor - III

Lecture 62 - Third Rank Piezoelectric Property Tensor - I

Lecture 63 - Third Rank Piezoelectric Property Tensor - II

Lecture 64 - Fourth Rank Elasticity Tensor

NPTEL : NOC:Mechanical Behavior of Materials (Hindi) (Metallurgy and Material Science)

Co-ordinators : Prof. Niraj Mohan Chawake

Lecture 1 - Elasticity: Introduction Definition and Units

Lecture 2 - Engineering Stress Strain Curve and Measures of Strength

Lecture 3 - Measures of Ductility, UTS and Necking

Lecture 4 - True Stress - True Strain Curve and Necking Criterion

Lecture 5 - Atomistic Basis of Elasticity

Lecture 6 - Stress at a point and Poissonâ€™s Ratio

Lecture 7 - Normal Stresses and Shear Stresses

Lecture 8 - Independence of stress components

Lecture 9 - Plane stress transformation equations in 2D

Lecture 10 - Mohrâ€™s Circle of stress

Lecture 11 - Principal stresses and Principal planes

Lecture 12 - Principal stresses in 3D and stress invariants

Lecture 13 - Stress Tensor: Transformation and Hydrostatic and Deviatoric stress state

Lecture 14 - Concept of Strain - Normal strain and shear strain

Lecture 15 - State of Strain at a Point - Displacement, Rotation and Strain Tensors

Lecture 16 - Elastic Constants and Elastic Stress - Strain Relations

Lecture 17 - Anisotropy of Elastic Behavior

Lecture 18 - Elastic Constants and Symmetry

Lecture 19 - Yielding Criteria

Lecture 20 - Atomistic Mechanisms of Yielding and Slip

Lecture 21 - Resolved Shear Stress and Schmidâ€™s law

Lecture 22 - Maximum Shear Strength of Crystalline Materials

Lecture 23 - Dislocations: Edge and Screw

Lecture 24 - Mixed Dislocation and Burgers Circuit

Lecture 25 - Peierls-Nabarro Stress

Lecture 26 - Geometrical Properties of Dislocations

Lecture 27 - Dislocation Motions: Glide, Cross-Slip and Climb

Lecture 28 - Plastic Strain and Dislocation Motion

Lecture 29 - Forces on dislocations: Peach Kohler Equation

Lecture 30 - Stress Field around a Screw Dislocations

Lecture 31 - Stress Field around an Edge Dislocation

Lecture 32 - Strain Energy of a Dislocation

Lecture 33 - Dislocation Dissociation and Dislocation Line Tension

Lecture 34 - Strain Hardening and Dislocations Interactions

Lecture 35 - Dislocation Interaction: Stable Configurations and Strain Hardening

Lecture 36 - Dislocation: Nucleation and Frank Read Source

Lecture 37 - Partial Dislocations and Stacking Faults in FCC

Lecture 38 - Dislocation Locks: Lomer-Cottrell Lock

Lecture 39 - Ordered Structures: Superlattice Dislocations and APBs

Lecture 40 - Dislocation and Stacking Sequence in BCC

Lecture 41 - Intersection of Dislocations: Jogs and Kinks

Lecture 42 - Strain Hardening stages in an FCC Single Crystal

Lecture 43 - Independent Slip Systems: Von Mises Criterion for Plasticity

Lecture 44 - Solid Soloutions Strengthening (SSS)

Lecture 45 - Solid Soloutions Strengthening: Interaction of Solutes and Defects

Lecture 46 - Cottrell Atmosphere and Yield Point Phenomenon

Lecture 47 - Precipitation Hardening and Dispersion Strengthening

Lecture 48 - Grain Size Strengthening

Lecture 49 - Dislocation model for grain boundaries

Lecture 50 - Twinning in Crystalline Materials

Lecture 51 - Fracture and Theoretical Cohesive Strength of Materials

Lecture 52 - Fracture and Theoretical Cohesive Strength of Materials

Lecture 53 - Fracture modes and Stress Concentration

Lecture 54 - Fracture Mechanics - LEFM vs EPFM and J-Integral

Lecture 55 - Creep Deformation of Materials

Lecture 56 - Deformation Mechanics Map and Superplasticity

Lecture 57 - Fatigue of Materials: Introduction and SN Curve

Lecture 58 - Fatigue Stages and Paris Law

Lecture 59 - Cyclic Stress-Strain Curve and Strain Life Curve

Lecture 60 - Effect of Mean Stress and Stress Amplitude

Lecture 61 - Hardness of Materials

Lecture 62 - Impact Testing of Materials

Lecture 63 - Anelastic Behaviour and Composite Materials

NPTEL : Advanced ceramics for strategic applications (Metallurgy and Material Science)

Co-ordinators : Prof. H.S. Maiti

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Crystal Structure

Lecture 4 - Crystal Structure (Continued...)

Lecture 5 - Crystal Structure (Continued...)

Lecture 6 - Crystal Structure (Continued...)

Lecture 7 - Defects in crystalline solids

Lecture 8 - Defects in crystalline solids (Continued...)

Lecture 9 - Dislocation

Lecture 10 - Two and Three Dimensional Defects

Lecture 11 - Electrical Conduction in ceramics

Lecture 12 - Electrical Conduction in Ceramics (Continued...)

Lecture 13 - Electrical Conduction in Ceramics (Continued...)

Lecture 14 - Electrical Conduction in Ceramics (Continued...)

Lecture 15 - Electrical Conduction in Ceramics (Continued...)

Lecture 16 - Electrical Conduction in Ceramics (Continued...)

Lecture 17 - Electrical Phenomenon in Insulators

Lecture 18 - Electrical Phenomenon in Insulators (Continued...)

Lecture 19 - Ferroelectric , Piezoelectric and Pyroelectric Ceramics

Lecture 20 - Ferroelectric , Piezoelectric and Pyroelectric Ceramics (Continued...)

Lecture 21 - Ferroelectric , Piezoelectric and Pyroelectric Ceramics (Continued...)

Lecture 22 - Ferroelectric , Piezoelectric and Pyroelectric Ceramics (Continued...)

Lecture 23 - Relaxor Ferroelectric

Lecture 24 - Superconductivity

Lecture 25 - Superconductivity (Continued...)

Lecture 26 - Ceramic Gas Sensor

Lecture 27 - Ceramic Gas Sensor (Continued...)

Lecture 28 - Solid Oxide Fuel Cell

Lecture 29 - Solid Oxide Fuel Cell (Continued...)

Lecture 30 - Solid Oxide Fuel Cell (Continued...)

Lecture 31 - Hydrogen Generation through MIEC Reactor

Lecture 32 - Lithium Ion Battery

Lecture 33 - Lithium Ion Battery (Continued...)

Lecture 34 - Magnetic Ceramics

Lecture 35 - Magnetic Ceramics (Continued...)

Lecture 36 - Magnetic Ceramics (Continued...)

Lecture 37 - Magnetic Ceramics (Continued...)

Lecture 38 - Sintering of Ceramics

Lecture 39 - Sintering of Ceramics (Continued...)

Lecture 40 - Sintering of Ceramics (Continued...)

Lecture 41 - Sintering of Ceramics (Continued...)

Lecture 42 - Mechanical Properties of Ceramic Materials

Lecture 43 - Mechanical Properties of Ceramic Materials (Continued...)

Lecture 44 - Mechanical Properties of Ceramic Materials (Continued...)

Lecture 45 - Mechanical Properties of Ceramic Materials (Continued...)

Lecture 46 - Structural Ceramics Materials

Lecture 47 - Bioceramics

NPTEL : Non-ferrous Extractive Metallurgy (Metallurgy and Material Science)

Co-ordinators : Prof. H.S. Ray, Mr. L. Pugazhenthy

Lecture 1 - Brief History of Non-ferrous Metal

Lecture 2 - Brief History of Non-ferrous Metal (Continued...)

Lecture 3 - Sources of Non-ferrous Metal

Lecture 4 - Mineral Benefication Techniques

Lecture 5 - General Methods of Metal Extraction

Lecture 6 - Principles of Carbon Reduction

Lecture 7 - Principles of Hydrometalling

Lecture 8 - Principles of Electrometallurgy

Lecture 9 - Electrometallurgy (Continued...) and Temkin Model for Fused Salts

Lecture 10 - Refining of Metals - Chemical Methods

Lecture 11 - Refining of Metals - Physical Methods

Lecture 12 - Concluding part of Module - 4

Lecture 13 - Concluding part of Module - 4 (Continued...)

Lecture 14 - Module - 5 Extraction of Metals from Oxides, Extraction of Magnesium

Lecture 15 - Extraction Aluminium

Lecture 16 - Extraction Aluminium (Continued...1)

Lecture 17 - Extraction Aluminium (Continued...2)

Lecture 18 - Extraction Aluminium (Continued...3)

Lecture 19 - Extraction of Tin

Lecture 20 - Extraction of Ferro Alloys

Lecture 21 - Module - 6 Extraction of Metals from Sulphides Extraction of Copper

Lecture 22 - Extraction of Copper (Continued...)

Lecture 23 - Hydrometallurgy of Copper

Lecture 24 - Extraction of Lead

Lecture 25 - Extraction of Zinc-Imperial Smelting Process

Lecture 26 - Module - 7 Extraction of metals from halides, Extraction of reactor metals

Lecture 27 - Extraction of reactor metals (Continued...1)

Lecture 28 - Extraction of reactor metals (Continued...2)

Lecture 29 - Extraction of Titanium

Lecture 30 - Extraction of Precious Metals

Lecture 31 - Production of Secondary Metals and Treatment of Wastes

Lecture 32 - Energy and Environment Related Issues in Nonferrous Metals Production

Lecture 33 - Energy and Environment Related Issues in Nonferrous Metals Production (Continued...1)

Lecture 34 - Energy and Environment Related Issues in Nonferrous Metals Production (Continued...2)

Lecture 35 - Energy and Environment Related Issues in Nonferrous Metals Production (Continued...3)

Lecture 36 - Energy and Environment Related Issues in Nonferrous Metals Production (Continued...4)

Lecture 37 - Energy and Environment Related Issues in Nonferrous Metals Production (Continued...5)

Lecture 38 - Energy and Environment Related Issues in Nonferrous Metals Production (Continued...6)

Lecture 39 - Nonferrous Metals in India - Unleashing its true potential

Lecture 40 - Nonferrous Metals in India - Unleashing its true potential (Continued...)

Lecture 41 - Review and Summary

Lecture 42 - Review and Summary (Continued...1)

Lecture 43 - Review and Summary (Continued...2)

NPTEL : Principles of Physical Metallurgy (Metallurgy and Material Science)

Co-ordinators : Prof. R.N. Ghosh

Lecture 1 - Introduction

Lecture 2 - Atomic Bond and Crystal Structure

Lecture 3 - Atomic Bond and Crystal Structure (Continued...1)

Lecture 4 - Atomic Bond and Crystal Structure (Continued...2)

Lecture 5 - Experimental Tools & Techniques

Lecture 6 - Experimental Tools & Techniques (Continued...)

Lecture 7 - Solidification of Pure Metal

Lecture 8 - Plastic Deformation of Pure Metal

Lecture 9 - Plastic Deformation of Pure Metal (Continued...)

Lecture 10 - Crystal Defects in Metals

Lecture 11 - Crystal Defects in Metals (Continued...1)

Lecture 12 - Crystal Defects in Metals (Continued...2)

Lecture 13 - Crystal Defects in Metals (Continued...3)

Lecture 14 - Crystal Defects in Metals (Continued...4)

Lecture 15 - Diffusion in Solids

Lecture 16 - Diffusion in Solids (Continued...)

Lecture 17 - Numerical Examples in Diffusion

Lecture 18 - Solidification of Binary Alloys

Lecture 19 - Solidification of Binary Alloys (Continued...1)

Lecture 20 - Solidification of Binary Alloys (Continued...2)

Lecture 21 - Solidification of Binary Alloys (Continued...3)

Lecture 22 - Solidification of Binary Alloys (Continued...4)

Lecture 23 - Iron-Carbon Phase Diagram

Lecture 24 - Iron-Carbon Phase Diagram (Continued...)

Lecture 25 - Ternary Phase Diagram

Lecture 26 - Common Binary Alloys

Lecture 27 - Metal Working : Deformation Processing

Lecture 28 - Metal Working : Deformation Processing (Continued...)

Lecture 29 - Precipitation for Solid Solution

Lecture 30 - Precipitation for Solid Solution (Continued...)

Lecture 31 - Heat Treatment of Steel

Lecture 32 - Heat Treatment of Steel (Continued...1)

Lecture 33 - Heat Treatment of Steel (Continued...2)

Lecture 34 - Heat Treatment of Steel (Continued...3)

Lecture 35 - Heat Treatment of Steel (Continued...4)

Lecture 36 - Heat Treatment of Steel (Continued...5)

Lecture 37 - Surface Hardening

Lecture 38 - Structural Steel

Lecture 39 - Structural Steel (Continued...)

Lecture 40 - Ultra High Strength Steel

Lecture 41 - Preferred Orientation: Application

Lecture 42 - Metal Joining

NPTEL : Processing of Semiconducting Materials (Metallurgy and Material Science)

Co-ordinators : Dr. Pallab Banerji

Lecture 1 - Introduction to Electronics Materials

Lecture 2 - Electrical Conductivity of Materials

Lecture 3 - Direct and Indirect Band Semiconductors

Lecture 4 - Doping in Semiconductors

Lecture 5 - Semiconductor Statistics

Lecture 6 - Importance of Doping

Lecture 7 - Diffusion and Ion Implantation - I

Lecture 8 - Diffusion and Ion Implantation - II

Lecture 9 - Diffusion and Ion Implantation - III

Lecture 10 - Elemental Semiconductors

Lecture 11 - Compound Semiconductors

Lecture 12 - Bulk Crystal Growth - I

Lecture 13 - Bulk Crystal Growth - II

Lecture 14 - Ga As Crystal Growth

Lecture 15 - Defects in Crystals - I

Lecture 16 - Defects in Crystals - II

Lecture 17 - Band Gap Engineering - I

Lecture 18 - Band Gap Engineering - II

Lecture 19 - Chemical Vapour Deposition - I

Lecture 20 - Chemical Vapour Deposition - II

Lecture 21 - MOCVD

Lecture 22 - Molecular Beam Epitaxy - I

Lecture 23 - Molecular Beam Epitaxy - II

Lecture 24 - p - n Junction

Lecture 25 - Carrier Transport in P - N Junction

Lecture 26 - Characterization - I

Lecture 27 - Characterization - II

Lecture 28 - Optical Characterization - I

Lecture 29 - Metal-Semiconductor Contact - I

Lecture 30 - Metal-Semiconductor Contact - II

Lecture 31 - Applications of Metal-Semiconductor Contact

Lecture 32 - Oxidation - I

Lecture 33 - Oxidation - II

Lecture 34 - Different Types of Semiconductor - I

Lecture 35 - Oxidation - I

Lecture 36 - Oxidation - II

Lecture 37 - Dielectric Films

Lecture 38 - Low - K and High - K materials

Lecture 39 - Metallization

Lecture 40 - Materials for Photovoltaics

NPTEL : Science and Technology of Polymers (Metallurgy and Material Science)

Co-ordinators : Prof. B. Adhikari

Lecture 1 - Basic Concepts on Polymers

Lecture 2 - Basic Concepts on Polymers (Continued...)

Lecture 3 - Basic Concepts on Polymers (Continued...)

Lecture 4 - Polymer Raw Materials

Lecture 5 - Principles of Polymer Synthesis

Lecture 6 - Principles of Polymer Synthesis (Continued...)

Lecture 7 - Principles of Polymer Synthesis (Continued...)

Lecture 8 - Principles of Polymer Synthesis (Continued...)

Lecture 9 - Principles of Polymer Synthesis (Continued...)

Lecture 10 - Principles of Polymer Synthesis (Continued...)

Lecture 11 - Structure and Properties of Polymers (Continued...)

Lecture 12 - Structure and Properties of Polymers (Continued...)

Lecture 13 - Structure and Properties of Polymers (Continued...)

Lecture 14 - Structure and Properties of Polymers (Continued...)

Lecture 15 - Polymerization Techniques

Lecture 16 - Polymerization Techniques (Continued...)

Lecture 17 - Polymerization Techniques (Continued...)

Lecture 18 - Polymer Products

Lecture 19 - Polymer Products (Continued...)

Lecture 20 - Rubber Products

Lecture 21 - Rubber Products (Continued...)

Lecture 22 - Conducting Polymers

Lecture 23 - Conducting Polymers (Continued...)

Lecture 24 - Liquid Crystalline Polymers

Lecture 25 - Stimuli Responsive Polymer and its application

Lecture 26 - Stimuli Responsive Polymer and its application (Continued...)

Lecture 27 - Polymeric Nanomaterials and Devices (Continued...)

Lecture 28 - Polymeric Nanomaterials and Devices (Continued...)

Lecture 29 - Polymeric Nanomaterials and Devices (Continued...)

Lecture 30 - Environmental Degradation of Polymers

Lecture 31 - Environmental Degradation of Polymers (Continued...)

Lecture 32 - Polymer Composites

Lecture 33 - Polymer Composites (Continued...)

Lecture 34 - Polymer Composites (Continued...)

Lecture 35 - Multicomponent Polymeric Materials

Lecture 36 - Multicomponent Polymeric Materials (Continued...)

Lecture 37 - Multicomponent Polymeric Materials (Continued...)

Lecture 38 - Viscoelasticity

Lecture 39 - Engineering and Speciality Polymers

Lecture 40 - Engineering and Speciality Polymers (Continued...)

NPTEL : Advanced Materials and Processes (Metallurgy and Material Science)

Co-ordinators : Prof. B.S. Murty

Lecture 1 - Structure of Materials - Part I

Lecture 2 - Structure of Materials - Part II

Lecture 3 - Nano Crystalline Materials - Part I

Lecture 4 - Nano Crystalline Materials - Part II

Lecture 5 - Nano Crystalline Materials - Part III

Lecture 6 - Nano Crystalline Materials - Part IV

Lecture 7 - Amorphous Materials - Part I

Lecture 8 - Amorphous Materials - Part II

Lecture 9 - Amorphous Materials - Part III

Lecture 10 - Amorphous Materials - Part IV

Lecture 11 - Amorphous Materials - Part V

Lecture 12 - Quasicrystals - Part I

Lecture 13 - Quasicrystals - Part II

Lecture 14 - Nano Quasicrystals - Part I

Lecture 15 - Nano Quasicrystals - Part II

Lecture 16 - Rapid Solidification Processing

Lecture 17 - Mechanical Alloying

Lecture 18 - Advanced AI Alloys - Part I

Lecture 19 - Advanced AI Alloys - Part II

Lecture 20 - Advanced AI Alloys - Part III

Lecture 21 - Advanced AI Alloys - Part IV and Ti Alloys

Lecture 22 - Shape Memory Alloys

Lecture 23 - Strengthening Mechanisms - Part I

Lecture 24 - Strengthening Mechanisms - Part II

Lecture 25 - Superalloys

Lecture 26 - In-Situ Composites - Part I

NPTEL : NOC:Principles of Polymer Synthesis (Metallurgy and Material Science)

Co-ordinators : Prof. Rajat K Das

Lecture 1 - Historical development of polymer science

Lecture 2 - Molecular Weight Determination Of Polymers

Lecture 3 - Molecular Weight Determination Of Polymers (Continued...)

Lecture 4 - Molecular Weight Determination of Polymers (Continued...)

Lecture 5 - Molecular Weight Determination of Polymers (Continued...)

Lecture 6 - Principles of step growth polymerization

Lecture 7 - Principles of step growth polymerization (Continued...)

Lecture 8 - Principles of step growth polymerization (Continued...)

Lecture 9 - Principles of step growth polymerization (Continued...)

Lecture 10 - Principles of step growth polymerization (Continued...)

Lecture 11 - Principles of radical chain polymerization

Lecture 12 - Principles of radical chain polymerization (Continued...)

Lecture 13 - Principles of radical chain polymerization (Continued...)

Lecture 14 - Principles of radical chain polymerization (Continued...)

Lecture 15 - Principles of radical chain polymerization (Continued...)

Lecture 16 - Principles of radical chain polymerization (Continued...)

Lecture 17 - Principles of Chain Copolymerization

Lecture 18 - Principles of Chain Copolymerization (Continued...)

Lecture 19 - Principles of Chain Copolymerization (Continued...)

Lecture 20 - Principles of Living Chain polymerization

Lecture 21 - Principles of Living Chain polymerization (Continued...)

Lecture 22 - Design of Chemical Reactors

Lecture 23 - Design of Chemical Reactors (Continued...)

Lecture 24 - Design of Chemical Reactors (Continued...)

Lecture 25 - Design of Chemical Reactors (Continued...)

Lecture 26 - Design of Chemical Reactors (Continued...)

Lecture 27 - Design of Chemical Reactors (Continued...)

Lecture 28 - Design of Chemical Reactors (Continued...)

Lecture 29 - Design of Chemical Reactors (Continued...)

Lecture 30 - Design of Chemical Reactors (Continued...)

Lecture 31 - Design of Chemical Reactors (Continued...)

Lecture 32 - Synthesis of industrial polymers

Lecture 33 - Synthesis of industrial polymers (Continued...)

Lecture 34 - Synthesis of industrial polymers (Continued...)

Lecture 35 - Synthesis of industrial polymers (Continued...)

Lecture 36 - Synthesis of industrial polymers (Continued...)

Lecture 37 - Synthesis of industrial polymers (Continued...)

Lecture 38 - Synthesis of industrial polymers (Continued...)

Lecture 39 - Synthesis of industrial polymers (Continued...)

Lecture 40 - Synthesis of industrial polymers (Continued...)

Lecture 41 - Synthesis of industrial polymers (Continued...)

Lecture 42 - Synthesis of industrial polymers (Continued...)

Lecture 43 - Synthesis of industrial polymers (Continued...)

Lecture 44 - Synthesis of industrial polymers (Continued...)

Lecture 45 - Synthesis of industrial polymers (Continued...)

Lecture 46 - Synthesis of industrial polymers (Continued...)

Lecture 47 - Synthesis of industrial polymers (Continued...)

NPTEL : NOC:Advanced Materials and Processes (Metallurgy and Material Science)

Co-ordinators : Prof. Jayanta Das

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Introduction (Continued...)

Lecture 4 - Introduction (Continued...)

Lecture 5 - Introduction (Continued...)

Lecture 6 - Bulk Metallic Glass, Glassy and Amorphous Materials

Lecture 7 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 8 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 9 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 10 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 11 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 12 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 13 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 14 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 15 - Bulk Metallic Glass, Glassy and Amorphous Materials (Continued...)

Lecture 16 - Shape Memory Alloys

Lecture 17 - Shape Memory Alloys (Continued...)

Lecture 18 - Shape Memory Alloys (Continued...)

Lecture 19 - Shape Memory Alloys (Continued...)

Lecture 20 - Shape Memory Alloys (Continued...)

Lecture 21 - Shape Memory Alloys: Case Studies and Applications

Lecture 22 - Shape Memory Alloys: Case Studies and Applications (Continued...)

Lecture 23 - Shape Memory Alloys: Case Studies and Applications (Continued...)

Lecture 24 - Shape Memory Alloys: Case Studies and Applications (Continued...)

Lecture 25 - Shape Memory Alloys: Case Studies and Applications (Continued...)

Lecture 26 - Introduction of High Temperature Materials

Lecture 27 - Introduction of High Temperature Materials (Continued...)

Lecture 28 - Introduction of High Temperature Materials (Continued...)

Lecture 29 - Introduction of High Temperature Materials (Continued...)

Lecture 30 - Introduction of High Temperature Materials (Continued...)

Lecture 31 - Supearalloys

Lecture 32 - Supearalloys (Continued...)

Lecture 33 - Supearalloys (Continued...)

Lecture 34 - Supearalloys (Continued...)

Lecture 35 - Supearalloys (Continued...)

Lecture 36 - Nanomaterials: Part I

Lecture 37 - Nanomaterials: Part I (Continued...)

Lecture 38 - Nanomaterials: Part I (Continued...)

Lecture 39 - Nanomaterials: Part I (Continued...)

Lecture 40 - Nanomaterials: Part I (Continued...)

Lecture 41 - Nanomaterials: Part II

Lecture 42 - Nanomaterials: Part II (Continued...)

Lecture 43 - Nanomaterials: Part II (Continued...)

Lecture 44 - Nanomaterials: Part II (Continued...)

Lecture 45 - Nanomaterials: Part II (Continued...)

Lecture 46 - Soft and Hard Magnetic Materials

Lecture 47 - Soft and Hard Magnetic Materials (Continued...)

Lecture 48 - Soft and Hard Magnetic Materials (Continued...)

Lecture 49 - Soft and Hard Magnetic Materials (Continued...)

Lecture 50 - Soft and Hard Magnetic Materials (Continued...)

Lecture 51 - Advanced Processes

Lecture 52 - Advanced Processes (Continued...)

Lecture 53 - Advanced Processes (Continued...)

Lecture 54 - Advanced Processes (Continued...)

Lecture 55 - Advanced Processes (Continued...)

Lecture 56 - Advanced Functional Alloys

Lecture 57 - Advanced Functional Alloys (Continued...)

Lecture 58 - Advanced Functional Alloys (Continued...)

Lecture 59 - Advanced Functional Alloys (Continued...)

Lecture 60 - Advanced Functional Alloys (Continued...)

NPTEL : NOC:Surface Engineering for Corrosion and Wear Resistance Application (Metallurgy and Material Science)

Co-ordinators : Prof. Jyotsna Dutta Majumder, Prof. I. Manna

Lecture 1 - Structure of Solids

Lecture 2 - Microstructure of Solids

Lecture 3 - Defects in Crystalline Solids

Lecture 4 - Surface and Surface Energy

Lecture 5 - Surface Properties-due to mechanical activation

Lecture 6 - Surface dependent physical and chemical property

Lecture 7 - Surface Dependent Properties and Surface initiated Degradation

Lecture 8 - Fatigue

Lecture 9 - Wear Part - I

Lecture 10 - Wear Part - II

Lecture 11 - Wear Part - III

Lecture 12 - Corrosion - I

Lecture 13 - Corrosion - II

Lecture 14 - Corrosion - III

Lecture 15 - Corrosion - IV

Lecture 16 - Corrosion - V

Lecture 17 - Classification of Surface engineering

Lecture 18 - Strengthening of metals

Lecture 19 - Strengthening of Non-Metals

Lecture 20 - Diffusive transformation in Steel

Lecture 21 - Non-Diffusive transformation in Steel

Lecture 22 - Shot Peening

Lecture 23 - Shot Peening and Rolling

Lecture 24 - Flame Hardening and Induction Hardening

Lecture 25 - Case Carburizing

Lecture 26 - Liquid Carburizing and Gas Carburizing

Lecture 27 - Gas Nitriding

Lecture 28 - Liquid and Salt Bath Nitriding

Lecture 29 - Plasma Nitriding and Ion Implantation

Lecture 30 - Heat treatment after carburizing and Nitriding

Lecture 31 - Diffusion Coating Principle

Lecture 32 - Diffusion Coating Processes

Lecture 33 - Thick Coating by Cladding

Lecture 34 - High Temperature Degradation

Lecture 35 - Corrosion Prevention

Lecture 36 - Chemical Conversion Coating

Lecture 37 - Electroconversion Coating

Lecture 38 - Electro and Electroless Deposition Process

Lecture 39 - Hot Dipping - I

Lecture 40 - Hot Dipping - II

Lecture 41 - Thermal Spray Deposition - I

Lecture 42 - Thermal Spray Deposition - II

Lecture 43 - Thermal Spray Deposition - III

Lecture 44 - Thermal Spray Deposition - IV

Lecture 45 - Physical Vapur Deposition (PVD)

Lecture 46 - Sputtering

Lecture 47 - Chemical Vapor Deposition (CVD)

Lecture 48 - Composite Coating

Lecture 49 - Ion Implantation - I

Lecture 50 - Ion Implantation - II

Lecture 51 - Electron Beam Welding

Lecture 52 - Electron Beam Surface engineering

Lecture 53 - Laser Materials Processing: Introduction

Lecture 54 - Laser Assisted Materials Processing:Processes

Lecture 55 - Laser Surface Engineering:Hardening and Melting

Lecture 56 - Laser Surface Engineering with Laser surface hardening and laser surface melting

Lecture 57 - Laser Surface Alloying

Lecture 58 - Laser Surface Cladding

Lecture 59 - Surface Damage - Case Studies

Lecture 60 - Overview and Conclusion

NPTEL : NOC:Ironmaking and Steelmaking (Metallurgy and Material Science)

Co-ordinators : Prof. Gour Gopal Roy

Lecture 1 - Introduction

Lecture 2 - Various Routes of steelmaking

Lecture 3 - The Iron Blast Furnace

Lecture 4 - Thermodynamics of BF ironmaking

Lecture 5 - Thermodynamics of BF Ironmaking (Continued...)

Lecture 6 - Overall Heat and Material Balance in Blast Furnace

Lecture 7 - RIST Diagram based on overall heat and material balance

Lecture 8 - RIST Diagram based on heat and material balance in the Wustite Reserve Zone

Lecture 9 - Kinetics of gas solid reaction: Iron oxide reduction - Part 1

Lecture 10 - Kinetics of gas solid reaction: Iron oxide reduction - Part 2

Lecture 11 - Aerodynamics in Blast Furnace - Part 1

Lecture 12 - Aerodynamics in Blast Furnace - Part 2: Channeling

Lecture 13 - Aerodynamics in Blast Furnace - Part 3: Flooding

Lecture 14 - Coke rate and Fuel efficiency in Blast Furnace

Lecture 15 - oxygen enrichment of blast

Lecture 16 - Blast Furnace and it's Raw Material

Lecture 17 - Sintering of Iron Ore

Lecture 18 - Pelletization of Iron Ore

Lecture 19 - Coking Process

Lecture 20 - Testing of Burden Material

Lecture 21 - Burden Distribution

Lecture 22 - Blast Furnace products and their utilization

Lecture 23 - Blast Furnace Productivity

Lecture 24 - Modeling of Blast Furnace

Lecture 25 - New Potential Technologies for Blast Furnace

Lecture 26 - History of Steelmaking

Lecture 27 - Properties of slag

Lecture 28 - The Reaction Equilibria Unlisted

Lecture 29 - Dephosphorization of liquid steel

Lecture 30 - Kinetics of slag metal reaction

Lecture 31 - LD steelmaking: Basics, process steps, emulsion formation and stabilization

Lecture 32 - LD Steel making: Oxygen lance and jet action and decarburization

Lecture 33 - Evolution of impurities in steel and slag constituents during LD processing

Lecture 34 - Hybrid Processes

Lecture 35 - Electric steel making

Lecture 36 - Secondary Steel making: Introduction and de-oxidation

Lecture 37 - Secondary Steel making: Introduction and de-oxidation (Continued...)

Lecture 38 - Secondary Steel making: Vacuum Techniques for refining steel

Lecture 39 - Homogenization and Gas stirred ladle

Lecture 40 - Ladle de-sulphurization, alloying, stainless steel making

Lecture 41 - Inclusion and its control

Lecture 42 - Injection Metallurgy: Submerged injection of calcium powder

Lecture 43 - Cored wire injection-Modeling, melting sequence, effect of operating parameters

Lecture 44 - IM: Cored wire injection: Industrial implications

Lecture 45 - IM: Tundish metallurgy and design

Lecture 46 - Casting fundamentals- Heat Transfer

Lecture 47 - Casting fundamentals- segregation

Lecture 48 - Morphology of solidification structure and Ingot casting

Lecture 49 - Continuous casting

Lecture 50 - Downstream processing and near net shape casting

Lecture 51 - Introduction to Direct Reduction (DR) and smelting Reduction (SR) Processes

Lecture 52 - Introduction to Direct Reduction (DR) and smelting Reduction (SR) Processes (Continued...)

Lecture 53 - Coal Based DR Processes

Lecture 54 - Coal Based DR Processes (Continued...)

Lecture 55 - Gas based DR Processes

Lecture 56 - Gas based DR Processes (Continued...)

Lecture 57 - Smelting Reduction (SR) Processes

Lecture 58 - Smelting Reduction (SR) Processes (Continued...)

Lecture 59 - Ironmaking and Steelmaking in India

Lecture 60 - Ironmaking and Steelmaking in India (Continued...)

NPTEL : NOC:Non-Metallic Materials (Metallurgy and Material Science)

Co-ordinators : Prof. Subhasish Basu Majumder

Lecture 1 - Classification and applications of non-metallic materials

Lecture 2 - Understanding on polymer structures

Lecture 3 - Characteristics of polymers and advanced polymeric materials

Lecture 4 - Processing of polymers

Lecture 5 - Polymer composites and issues related to recycling

Lecture 6 - Defects in crystalline materials:point, line, planar and three dimensional defects

Lecture 7 - Non- stoichiometry in non-metallic materials

Lecture 8 - Laws of thermodynamics, reaction kinetics - Part 1

Lecture 9 - Laws of thermodynamics, reaction kinetics - Part 2

Lecture 10 - Phase diagram and microstructure evolution in non-metallic materials

Lecture 11 - Carbonaceous materials

Lecture 12 - Fundamental of diffusion, Fickâ€™s laws, their solution and applications - Part 1

Lecture 13 - Fundamental of diffusion, Fickâ€™s laws, their solution and applications - Part 2

Lecture 14 - Phase transformation of non-metallic materials

Lecture 15 - Introduction to glass and amorphous solids

Lecture 16 - Understanding on conventional glass and amorphous solids

Lecture 17 - Glass-ceramics and specialty glasses

Lecture 18 - Mechanical properties of non-metallic materials, stress-strain response, elastic, and plastic deformation

Lecture 19 - Brittle and ductile materials, introduction to fracture mechanics, strength of brittle materials

Lecture 20 - Strengthening of materials, fatigue, and creep

Lecture 21 - Composite materials: Particle-reinforced composites, and fiber reinforced composites

Lecture 22 - Structural Composite

Lecture 23 - Dielectric and piezoelectric behavior

Lecture 24 - Ferroelectric Behaviour of Non-Metallic Materials and Ferroelectric thin film for Non-Volatile Memory Applications

Lecture 25 - Magnetic Properties : Origin of Magnetism, Para, Dia, Ferro, and Ferrimagnetism

Lecture 26 - Ceramic Magnets and their Applications

Lecture 27 - Thermal Properties : Specific Heat, Heat Conduction, Thermal Diffusivity, Thermal expansion

Lecture 28 - Thermoelectric Effect and Magnetocaloric Effect

Lecture 29 - Optical properties: Refractive index, absorption and transmission of electromagnetic radiation, LASERS

Lecture 30 - Introduction to electrochemistry, Galvanic cells, Cell potentials and Gibbs Energy, Concentration dependence

Lecture 31 - Electrochemical storage, rechargeable batteries

Lecture 32 - Introduction to electrochemical methods; cyclic voltammetry and other related techniques

Lecture 33 - Fuel Cell and Energy harvesting

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

NPTEL : NOC:Scanning Electron-Ion-Probe Microscopy in Materials Characterization (Metallurgy and Material Science)

Co-ordinators : Prof. Debabrata Pradhan

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

Lecture 31 - Operating Modes

Lecture 32 - Scanning Tunneling Spectroscopy

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

NPTEL : NOC:Techniques of Material Characterization (Metallurgy and Material Science)

Co-ordinators : Prof. Shibayan Roy

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)

NPTEL : NOC:Electrochemical Energy Storage (Metallurgy and Material Science)

Co-ordinators : Prof. Subhasish Basu Majumder

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 Nernstâ€™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 Commerical 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 pseudocapacitative 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

NPTEL : NOC:Texture in Materials (Metallurgy and Material Science)

Co-ordinators : Prof. Somjeet Biswas

Lecture 1 - Introduction

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

Lecture 50 - Texture in BCC polycrystals - II

Lecture 51 - Texture in HCP polycrystals - I

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

NPTEL : NOC:Bulk Material Transport and Handling Systems (Metallurgy and Material Science)

Co-ordinators : Prof. Khanindra Pathak

Lecture 1 - Classification of Mining and Bulk Sold 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

Lecture 34 - Froth Flotation Techniques, Magnetic Separation, Jigs and Thickeners

Lecture 35 - Jigs and Thickeners

Lecture 36 - Coal Washery Equipment and Practices

Lecture 37 - Classification and Selection

Lecture 38 - Crusher Selection and Application

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

Lecture 40 - Off-Highway trucks and Haul Roads - 2

Lecture 41 - Recent Developments in Truck Transportation

Lecture 42 - RopeCon Transportation

Lecture 43 - Aerial Ropeways: Introduction

Lecture 44 - Aerial Ropeways Calculation

Lecture 45 - Pipe Conveyor Belt: Enclosed Material Transport

Lecture 46 - Underground Mine Transport System

Lecture 47 - Rope Haulage for Underground Mine Transport

Lecture 48 - Main and Tail and Endless Rope Haulage

Lecture 49 - Pit Top and Pit Bottom Layout

Lecture 50 - Haulage calculation

Lecture 51 - Locomotive

Lecture 52 - Low Profile Dumper

Lecture 53 - Load Haul Dumper

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

NPTEL : NOC:Environmental Degradation and Surface Engineering (Metallurgy and Material Science)

Co-ordinators : Prof. Indranil Manna, Prof. Jyotsna Dutta Majumdar

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

Lecture 8 - Aqueous corrosion-Classification - Part II

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 â€“ 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

NPTEL : NOC:Fracture, Fatigue and Failure of Materials (Metallurgy and Material Science)

Co-ordinators : Prof. Indrani Sen

Lecture 1 - Modes of Fracture

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

Lecture 10 - Plane stress and plane strain fracture toughness (Continued...)

Lecture 11 - Plane Strain Fracture Toughness Testing

Lecture 12 - Plane Strain-Plane Stress Fracture Toughness Testing

Lecture 13 - Plane Stress Fracture Toughness

Lecture 14 - Plane Stress fracture toughness-J integral

Lecture 15 - Experimental determination of JIC

Lecture 16 - J-integral and JIC

Lecture 17 - Impact Toughness

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...)

Lecture 26 - Fracture Toughness (Continued...)

Lecture 27 - Environment Assisted Fracture

Lecture 28 - Environment Assisted Fracture (Continued...)

Lecture 29 - Environment Assisted Fracture (Continued...)

Lecture 30 - Introduction to Fatigue

Lecture 31 - Stress Controlled Fatigue

Lecture 32 - Stress Controlled Fatigue (Continued...)

Lecture 33 - Stress Controlled Fatigue (Continued...)

Lecture 34 - Stress Controlled Fatigue (Continued...)

Lecture 35 - Strain Controlled Fatigue (Continued...)

Lecture 36 - Strain Controlled Fatigue (Continued...)

Lecture 37 - Strain Controlled Fatigue (Continued...)

Lecture 38 - Strain Controlled Fatigue (Continued...)

Lecture 39 - Fatigue Crack Nucleation

Lecture 40 - Notch Effect

Lecture 41 - Crack in Fatigue

Lecture 42 - Fatigue Crack Propagation

Lecture 43 - Fatigue Crack Propagation (Continued...)

Lecture 44 - Fatigue Crack Propagation (Continued...)

Lecture 45 - Fatigue Crack Propagation (Continued...)

Lecture 46 - Fatigue Crack Propagation (Continued...)

Lecture 47 - Fatigue Crack Propagation (Continued...)

Lecture 48 - Fatigue in Materials

Lecture 49 - Fatigue in Materials (Continued...)

Lecture 50 - Effect of Temperature on Fatigue

Lecture 51 - Failure Analysis

Lecture 52 - Failure Analysis (Continued...)

Lecture 53 - Failure Analysis (Continued...)

Lecture 54 - Failure Analysis - Case study - Titanic

Lecture 55 - Failure Analysis - Case Study - ALK

Lecture 56 - Failure Analysis - Case study - Point Pleasant Bridge

Lecture 57 - Failure Analysis - Case Study - Rail Crash

Lecture 58 - Failure Analysis - Case Study - Comet

Lecture 59 - Failure Analysis - Case Study - Columbia

Lecture 60 - Failure Analysis - Summary

NPTEL : NOC:Mine Closure and Sustainability Planning (Metallurgy and Material Science)

Co-ordinators : Prof. Khanindra Pathak

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

Lecture 28 - Integration of Interdepartmental work and phase operations - Part 2

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

Lecture 42 - Framework of Sustainability reporting

Lecture 43 - Sustainable accounting

Lecture 44 - Case studies on Sustainability initiatives in Mining Industry

Lecture 45 - Data Analytics for Sustainability management

Lecture 46 - Cleaner Production Based Closure Management

Lecture 47 - Regenerative environment design for sustainable Mine Closure

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

NPTEL : NOC:Fundamentals of Composite and Cellular Materials (Metallurgy and Material Science)

Co-ordinators : Dr. Siddhartha Roy, Dr. Tapas Laha

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

Lecture 24 - Processing of metal foams (Continued...)

Lecture 25 - Processing of metal foams (Continued...)

Lecture 26 - Polymer foams - Processing and properties

Lecture 27 - Additive manufacturing - Definition and Prospects

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

Lecture 38 - Mechanics: Fiber-reinforced composites - Transverse Loading

Lecture 39 - Mechanics: Fiber-reinforced composites - Problem Solving

Lecture 40 - Mechanics: Fiber-reinforced composites - Discontinuous fibers

Lecture 41 - Mechanics of Composites - Discontinuous fibers

Lecture 42 - Dependence of properties on pore structure

Lecture 43 - Mechanics of cellular solids

Lecture 44 - Mechanics of cellular solids (Continued...)

Lecture 45 - Deformation behavior of honeycomb and foams

Lecture 46 - Deformation behaviour of Foams

Lecture 47 - Deformation behaviour of Foams (Continued...)

Lecture 48 - Deformation behaviour of Foams (Continued...)

Lecture 49 - Thermal properties of foams

Lecture 50 - Other important properties of foams (Continued...)

Lecture 51 - Advanced composites - MMCs

Lecture 52 - Advanced composites - MMCs (Continued...)

Lecture 53 - Advanced composites - CMCs

Lecture 54 - Advanced composites - Advanced Processing Techniques

Lecture 55 - Advanced composites - Advanced Processing Techniques (Continued...)

Lecture 56 - Advanced composites - Advanced Processing Techniques (Continued...)

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...)

NPTEL : NOC:Principles of Extractive Metallurgy (Metallurgy and Material Science)

Co-ordinators : Prof. Tarun Kumar Kundu

Lecture 1 - Introduction, Classification and Uses of Metals

Lecture 2 - Introduction, Classification and Uses of Metals (Continued...)

Lecture 3 - Occurrence/Source of Metals

Lecture 4 - Metal Extraction Process Overview

Lecture 5 - Mineral Beneficiation: Overview and Mass Balances

Lecture 6 - Crushing and Grinding (Comminution)

Lecture 7 - Mineral Classification: Separation in Flowing Fluid

Lecture 8 - Mineral Concentration by Froth Flotation

Lecture 9 - Mineral Concentration by Froth Flotation

Lecture 10 - Magnetic and Electric Separation/Concentration

Lecture 11 - Sensor-based/Automatic Ore Sorting

Lecture 12 - Solid-Liquid Separation

Lecture 13 - Particle Size Estimation and Screening

Lecture 14 - Fuels in Metallurgical Processes and Coal Characteritics

Lecture 15 - Calorific Value and Caking Properties of Coal

Lecture 16 - Coke: Making and Properties

Lecture 17 - Combustion of Fuels

Lecture 18 - Combustion: Mass and Heat Balance

Lecture 19 - Combustion Heat Balance: Flame Temperature

Lecture 20 - Combustion Heat Utilization in Furnace

Lecture 21 - Heat Utilization in Furnace: Numerical Examples

Lecture 22 - Classification of Furnaces

Lecture 23 - Refractories for Furnace Linings

Lecture 24 - Refractories: Testing and Production

Lecture 25 - Agglomeration of Fines: Pelletization and Briquetting

Lecture 26 - Agglomeration of Fines: Sintering

Lecture 27 - Extraction of Metal from Sulfides: Roasting

Lecture 28 - Roasting Reactors and Heat Balance

Lecture 29 - Roasting: Predominance Area Diagram

Lecture 30 - Roasting: Application of Predominance Area Diagram

Lecture 31 - Reduction Smelting and Matte Smelting

Lecture 32 - Metallurgical Slag

Lecture 33 - Slag Viscosity, Surface Tention and Theories

Lecture 34 - Slag: Masson and Molecular Theory, Numerical Examples

Lecture 35 - Copper Extraction: Matte Smelting

Lecture 36 - Copper Extraction: Flash Smelting

Lecture 37 - Cu Extraction: Cyclone Flash Smelting and Numerical Examples

Lecture 38 - Cu Extraction: Conversion

Lecture 39 - Conversion of Nickel Sulphide and Numerical Examples

Lecture 40 - TSL Smelting, Continuous Conversion and Direct Cu-Production

Lecture 41 - Reduction Smelting: Lead Extraction

Lecture 42 - Reduction Smelting: Zinc Extraction and ISP

Lecture 43 - Extraction of Thin, Tungsten, Molybdenum and Numerical Examples

Lecture 44 - Extraction of Nb, V, Ferroalloys and Titania (from llmenite)

Lecture 45 - Silicothermy: Pyrometallurgical Magnesium Extraction

Lecture 46 - Reduction Smelting: Iron Extraction in Blast Furnace

Lecture 47 - Alternative Routes of Iron Extraction

Lecture 48 - Halide Metallurgy: Extraction of Ti, Zr, Hf, U, Si Purification

Lecture 49 - Purification of Bulk Metals: Chemical Refining

Lecture 50 - Chemical Refining: Purification of Lead

Lecture 51 - Chemical Refining of Zinc, Tin, Nickel, Ti (Zr, Hf, Th)

Lecture 52 - Physical Refining: Vacuum De-gassing, Zone Melting and Distillation

Lecture 53 - Hydrometallurgy: Unit Steps, Leaching Reagents and Methods

Lecture 54 - Physiochemical Aspect of Leaching, Bacterial Leaching, S/L Separation

Lecture 55 - Hydrometallurgy: Solution Purification and Metal Ion Reduction

Lecture 56 - Hydrometallurgy: Cementation, Electrowinning, Au Extraction and Bayer Process

Lecture 57 - Electrometallurgy: Electrowinning, Electrorefining, Current and Energy Efficiency

Lecture 58 - Electrometallurgy: Extraction of Mg and Al

Lecture 59 - Environmental Concern and Sustainable Metal Extraction

Lecture 60 - New Development in Metal Extraction: Solvometallurgy, Bio-Metallurgy, Membrane Technology

NPTEL : NOC:Clean Coal Technology (Metallurgy and Material Science)

Co-ordinators : Prof. Barun Kumar Nandi

Lecture 1 - Coal Quality Parameters

Lecture 2 - Coal Quality Parameters (Continued...)

Lecture 3 - Coal Quality Parameters (Continued...)

Lecture 4 - Coal Quality Parameters (Continued...)

Lecture 5 - Coal Quality Parameters (Continued...)

Lecture 6 - Coal Cleaning

Lecture 7 - Coal Cleaning (Continued...)

Lecture 8 - Coal Cleaning (Continued...)

Lecture 9 - Coal Cleaning (Continued...)

Lecture 10 - Coal Cleaning (Continued...)

Lecture 11 - Coal Cleaning Methods

Lecture 12 - Coal Cleaning Methods (Continued...)

Lecture 13 - Coal Cleaning Methods (Continued...)

Lecture 14 - Coal Cleaning Methods (Continued...)

Lecture 15 - Coal Cleaning Methods (Continued...)

Lecture 16 - Coal Combustion Fundamentals

Lecture 17 - Coal Combustion Fundamentals (Continued...)

Lecture 18 - Coal Combustion Fundamentals (Continued...)

Lecture 19 - Coal Combustion Fundamentals (Continued...)

Lecture 20 - Coal Combustion Fundamentals (Continued...)

Lecture 21 - Effects of Coal Properties on Combustion

Lecture 22 - Effects of Coal Properties on Combustion (Continued...)

Lecture 23 - Effects of Coal Properties on Combustion (Continued...)

Lecture 24 - Effects of Coal Properties on Combustion (Continued...)

Lecture 25 - Effects of Coal Properties on Combustion (Continued...)

Lecture 26 - Industrial Coal Combustion Methods

Lecture 27 - Industrial Coal Combustion Methods (Continued...)

Lecture 28 - Industrial Coal Combustion Methods (Continued...)

Lecture 29 - Industrial Coal Combustion Methods (Continued...)

Lecture 30 - Industrial Coal Combustion Methods (Continued...)

Lecture 31 - Emission Control from Combustion Utilities

Lecture 32 - Emission Control from Combustion Utilities (Continued...)

Lecture 33 - Emission Control from Combustion Utilities (Continued...)

Lecture 34 - Emission Control from Combustion Utilities (Continued...)

Lecture 35 - Emission Control from Combustion Utilities (Continued...)

Lecture 36 - SOx Control Strategies

Lecture 37 - NOx Emission Control

Lecture 38 - Oxy Fuel Combustion

Lecture 39 - Carbon Dioxide Capture and Storage

Lecture 40 - Carbon Dioxide Capture and Storage (Continued...)

Lecture 41 - Fundamentals of Coal Gasification

Lecture 42 - Chemical Reactions in Coal Gasification

Lecture 43 - Fundamentals of Coal Gasification (Continued...)

Lecture 44 - Fuel Properties and Gasification

Lecture 45 - Scope of Coal Gasification

Lecture 46 - Updraft and Down Draft Gasifier

Lecture 47 - Lurgi Gasifier

Lecture 48 - Fluidized Bed and other Gasifier

Lecture 49 - Syn Gas Cleaning

Lecture 50 - Coal Gasification Downstream Plants

Lecture 51 - Coal Based Power Generation

Lecture 52 - Coal Based Power Generation (Continued...)

Lecture 53 - Coal Based Power Generation (Continued...)

Lecture 54 - Coal Based Power Generation (Continued...)

Lecture 55 - Combined Cycle Power Generation and IGCC

Lecture 56 - Underground Coal Gasification

Lecture 57 - Coal Bed Methane

Lecture 58 - Coal Mine Methane

Lecture 59 - Clean Coal Technology : Case Studies

Lecture 60 - Clean Coal Technology : Case Studies (Continued...)

NPTEL : Advanced Metallurgical Thermodynamics (Metallurgy and Material Science)

Co-ordinators : Prof. B.S. Murty

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 - Eutectioid reaction

Lecture 23 - Eutectioid 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...)

NPTEL : Materials Characterization (Metallurgy and Material Science)

Co-ordinators : Dr. S. Sankaran

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 brodening

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 - Fundementals 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

NPTEL : Physics of Materials (Metallurgy and Material Science)

Co-ordinators : Dr. Prathap Haridoss

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

Lecture 38 - Superconductivity

Lecture 39 - Bose-Einstein Statistics

Lecture 40 - Physics of Nano Scale Materials; Course Summary

NPTEL : Electronic materials, devices, and fabrication (Metallurgy and Material Science)

Co-ordinators : Prof. Parasuraman S

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 - Assigment 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

Lecture 33 - Lithography

Lecture 34 - Etching and deposition (growth)

Lecture 35 - Metallization and polishing

Lecture 36 - Process and device evaluation

Lecture 37 - Productivity and process yield

Lecture 38 - Clean room design and contamination control

Lecture 39 - Devices and IC formation

Lecture 40 - IC circuit logic and packaging

NPTEL : NOC:Fundamentals of optical and scanning electron microscopy (Metallurgy and Material Science)

Co-ordinators : Dr. S. Sankaran

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 10 - Tutorial problems

Lecture 11 - Tutorial problems (Continued...)

Lecture 12 - Introduction to scanning electron Microscopy

Lecture 13 - Lens aberrations, Object resolution, Image quality

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

Lecture 15 - SEM and its mode of operation, Effect of aperture size,Working distance,condenser lens strength

Lecture 16 - SEM and its mode of operation- continuation, Relation between probe current and probe diameter, Summary

Lecture 17 - Factors affecting Interaction volume, Demonstration of SEM

Lecture 18 - Image formation and interpretation

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

NPTEL : NOC:Fundamentals of electronic materials and devices (Metallurgy and Material Science)

Co-ordinators : Prof. Parasuraman S

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

NPTEL : NOC:Introduction to Reciprocal Space and its use in Solids (Metallurgy and Material Science)

Co-ordinators : Dr. Prathap Haridoss

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

NPTEL : NOC:Analysis and Modeling of Welding (Metallurgy and Material Science)

Co-ordinators : Dr. G. Phanikumar

Lecture 1 - Introduction to fusion welding processes: Part 1/2

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

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

NPTEL : NOC:Fundamentals of X-ray Diffraction and Transmission Electron Microscopy (Metallurgy and Material Science)

Co-ordinators : Dr. S. Sankaran

Lecture 1 - Basics of X-ray emission from source, electron excitation and X-ray interaction with materials in general

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 brodening

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

Lecture 13 - XRD Tutorial - 1

Lecture 14 - XRD tutorial - 2

Lecture 15 - Introduction to Transmission Electron Microscopy (TEM)

Lecture 16 - Fundamentals of Transmission Electron Microscopy (TEM)

Lecture 17 - Basics of Diffraction - 1

Lecture 18 - Basics of Diffraction - 2

Lecture 19 - TEM Imaging - 1

Lecture 20 - TEM Imaging - 2

Lecture 21 - TEM instrument demonstration

Lecture 22 - TEM sample preparation - 1

Lecture 23 - TEM sample preparation - 2

Lecture 24 - TEM Tutorial - 1

Lecture 25 - TEM Tutorial - 2

Lecture 26 - TEM Tutorial - 3

Lecture 27 - TEM Tutorial - 4

NPTEL : NOC:Theory and Practice of Non Destructive Testing (Metallurgy and Material Science)

Co-ordinators : Dr. Ranjit Bauri

Lecture 1 - Visual optical method

Lecture 2 - Dye Penetrant Testing - 1

Lecture 3 - Dye Penetrant Testing - 2

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

Lecture 12 - Eddy current testing - 2

Lecture 13 - Eddy current testing - 3

Lecture 14 - Eddy current testing - 4

Lecture 15 - Eddy current testing - 5

Lecture 16 - Ultrasonic testing - 1

Lecture 17 - Ultrasonic testing - 2

Lecture 18 - Ultrasonic testing - 3

Lecture 19 - Ultrasonic testing - 4

Lecture 20 - Ultrasonic testing - 5

Lecture 21 - Ultrasonic testing - 6

Lecture 22 - Ultrasonic testing - 7

Lecture 23 - Ultrasonic testing - 8

Lecture 24 - Ultrasonic testing - 9

Lecture 25 - Ultrasonic testing - 10

Lecture 26 - Acoustic Emission Testing - 1

Lecture 27 - Acoustic Emission Testing - 2

Lecture 28 - Acoustic Emission Testing - 3

Lecture 29 - Acoustic Emission Testing - 4

Lecture 30 - Acoustic Emission Testing - 5

Lecture 31 - Radiography - 1

Lecture 32 - Radiography - 2

Lecture 33 - Radiography - 3

Lecture 34 - Radiography - 4

Lecture 35 - Radiography - 5

Lecture 36 - Radiography - 6

Lecture 37 - Radiography - 7

Lecture 38 - Radiography - 8

Lecture 39 - Radiography - 9

Lecture 40 - Radiography - 10

NPTEL : NOC:Defects in Materials (Metallurgy and Material Science)

Co-ordinators : Prof. Sundararaman M

Lecture 1 - Introduction to defects in materials

Lecture 2 - 1-D Lattice

Lecture 3 - 2-D Lattice

Lecture 4 - 3-D Lattice - a

Lecture 5 - 3-D Lattice - b

Lecture 6 - 3-D Lattice - c

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 - Transforamtion of co-ordinates

Lecture 13 - Tensor - 1

Lecture 14 - Tensor - 2

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 - Instrinsic Stacking Faults in FCC

Lecture 26 - Extrinsic Faults and Thompson Tetrahedron in FCC

Lecture 27 - Dislocations in BCC and HCP

Lecture 28 - Dislocations in Ordered Alloys and Dislocation Dislocation Interaction

Lecture 29 - Twinning - 1

Lecture 30 - Twinning - 2

Lecture 31 - Martensitic Transformation - 1

Lecture 32 - Martensitic Transformation - 2

Lecture 33 - Interfaces - 1

Lecture 34 - Interfaces - 2

Lecture 35 - Defect Interaction and Strength

NPTEL : NOC:Elementary Stereology for Quantitative Metallography (Metallurgy and Material Science)

Co-ordinators : Dr. S. Sankaran

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

Lecture 8 - Volume Fraction and Particle Size - Part 4

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

NPTEL : NOC:Welding of Advanced High Strength Steels for Automotive Applications (Metallurgy and Material Science)

Co-ordinators : Prof. Murugaiyan Amirthalingam

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

NPTEL : NOC:Welding Processes (Metallurgy and Material Science)

Co-ordinators : Prof. Murugaiyan Amirthalingam

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

NPTEL : NOC:Creep Deformation of Materials (Metallurgy and Material Science)

Co-ordinators : Prof. Srikant Gollapudi

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

Lecture 14 - Mechanisms of Creep - Part 4

Lecture 15 - Mechanisms of Creep - Part 5

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

NPTEL : NOC:Nanotechnology, Science and Applications (Metallurgy and Material Science)

Co-ordinators : Dr. Prathap Haridoss

Lecture 1 - Nanotechnology Science and Applications - Introduction

Lecture 2 - Nanotechnology : A Walk through History

Lecture 3 - Discussion on Feynmanâ€™s talk on Nanotechnology - Part I

Lecture 4 - Discussion on Feynmanâ€™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

NPTEL : NOC:Powder Metallurgy (Metallurgy and Material Science)

Co-ordinators : Dr. Ranjit Bauri

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

Lecture 24 - Dynamic Light Scattering - 1

Lecture 25 - Dynamic Light Scattering - 2

Lecture 26 - Particle size measurement - Other methods

Lecture 27 - Surface Area Analysis - 1

Lecture 28 - Surface Area Analysis - 2

Lecture 29 - BET Surface Area Analysis

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

Lecture 42 - Sintering - 2

Lecture 43 - Sintering - 3

Lecture 44 - Sintering - 4

Lecture 45 - Sintering - 5

Lecture 46 - Sintering - 6

Lecture 47 - Sintering - 7

Lecture 48 - Sintering - 8

Lecture 49 - Sintering - 9

Lecture 50 - Sintering - 10

Lecture 51 - Liquid Phase Sintering - 1

Lecture 52 - Liquid Phase Sintering - 2

Lecture 53 - Liquid Phase Sintering - 3

Lecture 54 - Liquid Phase Sintering - 4

Lecture 55 - Liquid Phase Sintering - 5

Lecture 56 - Full Density Processing - 1

Lecture 57 - Full Density Processing - 2

Lecture 58 - Full Density Processing - 3

Lecture 59 - Full Density Processing - 4

Lecture 60 - Spark Plasma Sintering (SPS)

NPTEL : NOC:Carbon Materials and Manufacturing (Metallurgy and Material Science)

Co-ordinators : Prof. Swati Sharma

Lecture 1 - Introduction to Materials and Manufacturing

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

Lecture 6 - Hybridization in Carbon Atoms

Lecture 7 - sp3, sp2 and sp Hybridization: Diamond, Graphite and Carbyne

Lecture 8 - sp(2+n) Hybridization: Curved Carbon

Lecture 9 - Allotropes of Carbon and Their Classification

Lecture 10 - Carbon Allotrpoe Conversion

Lecture 11 - Phase Diagram of Carbon

Lecture 12 - Introduction to Engineering Carbons

Lecture 13 - Graphite Crystal Structure

Lecture 14 - Rhombohedral Graphite and Stacking Faults

Lecture 15 - Graphite Ore Processing

Lecture 16 - Synthetic Graphite Production from Needle Coke

Lecture 17 - Kish Graphite and PVC-Derived Graphite

Lecture 18 - Highly Oriented Pyrolytic Graphite

Lecture 19 - Pyrolysis of Gaseous Hydrocarbons

Lecture 20 - Polymer-derived Carbon: Coking and Charring Mechanism

Lecture 21 - Kinetics of Graphitization

Lecture 22 - Microstructure of Non-Graphitizing Carbon

Lecture 23 - Glass-Like Carbon: Introduction and Properties

Lecture 24 - Glass-Like Carbon: Industrial Manufacturing

Lecture 25 - Microfabrication with Glass-Like Carbon

Lecture 26 - Carbon Materials and Manufacturing

Lecture 27 - X-Ray and Nano-Imprint Lithography

Lecture 28 - Activated Carbon: Introduction and Properties

Lecture 29 - Activated Carbon: Industrial Manufacturing

Lecture 30 - Carbon Black: Introduction and Properties

Lecture 31 - Carbon Black: Industrial Manufacturing

Lecture 32 - Carbon Fiber: Introduction and Properties

Lecture 33 - Melt Spinning of Petroleum Pitches

Lecture 34 - Electrospinning and Viscoelasticity

Lecture 35 - Carbonization of Polyacrylonitrile (PAN) Fibers

Lecture 36 - Mechanical Property Testing Methods for Carbon Fibers

Lecture 37 - Defects in Carbon Fibers

Lecture 38 - Introduction to Carbon Fiber Reinforced Plastic (CFRP)

Lecture 39 - Machining of Carbon Fiber Reinforced Plastic

Lecture 40 - Carbon/Carbon Composite

Lecture 41 - Carbon/Metal and Carbon/Concrete Composites: Manufacture and Properties

Lecture 42 - Graphene: Introduction and Crystal Structure

Lecture 43 - Graphene: History and Nomenclature

Lecture 44 - Chemical Vapor Deposition of Graphene - I

Lecture 45 - Chemical Vapor Deposition of Graphene - II

Lecture 46 - Defects in Graphene and the (n,m) Notations

Lecture 47 - Carbon Nanotube: Introduction and Properties

Lecture 48 - Vapor Phase Growth of Carbon Nanotube

Lecture 49 - Vapor Deposited Diamond

Lecture 50 - Diamond Like Carbon

Lecture 51 - X-Ray Diffraction Analysis of Carbon Materials

Lecture 52 - Raman Spectroscopy of Carbon Materials

Lecture 53 - Transmission Electron Microscopy of Carbon Materials

Lecture 54 - Surface Area Analysis of Carbon Materials

Lecture 55 - Numerical Problems: Carbon Manufacturing and Characterization

Lecture 56 - Large Scale Industrial Applications of Carbon Materials

Lecture 57 - Micro and Nano Scale Applications of Carbon Materials: Rigid and flexible carbon devices

Lecture 58 - Supply Chain of Industrial Carbons

Lecture 59 - Summary of NPTEL Course on Carbon Materials and Manufacturing

NPTEL : NOC:Mechanical Behavior of Materials (Metallurgy and Material Science)

Co-ordinators : Prof. S. Sankaran

Lecture 1 - Introduction

Lecture 2 - Chemical Bonding in Materials

Lecture 3 - Strength of materials - A Short Overview - Part I

Lecture 4 - Strength of materials - A Short Overview - Part II

Lecture 5 - Strength of materials - A Short Overview - Part III

Lecture 6 - Strength of materials - A Short Overview - Part IV

Lecture 7 - Strength of materials - A Short Overview - Part V

Lecture 8 - Elastic Stress- Strain Relations - Part I

Lecture 9 - Elastic Stress- Strain Relations - Part II

Lecture 10 - Elastic properties - Part I

Lecture 11 - Elastic properties - Part II

Lecture 12 - Anelasticity

Lecture 13 - Introduction to Dislocations - I

Lecture 14 - Introduction to Dislocations - II

Lecture 15 - Introduction to Dislocations - III

Lecture 16 - Introduction to Dislocations - IV

Lecture 17 - Introduction to Dislocations - V

Lecture 18 - Introduction to Dislocations - VI

Lecture 19 - Introduction to Dislocations - VII

Lecture 20 - Introduction to Dislocations - VIII

Lecture 21 - Introduction to Dislocations - IX

Lecture 22 - Introduction to Plastic deformation - I

Lecture 23 - Introduction to Plastic deformation - II

Lecture 24 - Introduction to Plastic Deformation - III

Lecture 25 - Introduction to Plastic Deformation - IV

Lecture 26 - Introduction to Plastic Deformation - V

Lecture 27 - Introduction to Plastic Deformation - VI

Lecture 28 - Strengthening Mechanisms in Crystalline Materials - I

Lecture 29 - Strengthening Mechanisms in Crystalline Materials - II

Lecture 30 - Strengthening Mechanisms in Crystalline Materials - III

Lecture 31 - Strengthening Mechanisms in Crystalline Materials - IV

Lecture 32 - Strengthening Mechanisms in Crystalline Materials - V

Lecture 33 - Mechanical Testing - I

Lecture 34 - Mechanical Testing - II

Lecture 35 - Mechanical Testing - III

Lecture 36 - Mechanical Testing - IV

Lecture 37 - Mechanical Testing - V

Lecture 38 - Mechanical Testing - VI

Lecture 39 - Mechanical Testing - VII

Lecture 40 - Mechanical Testing - VIII

Lecture 41 - Mechanical Testing - IX

Lecture 42 - Mechanical Testing - X

Lecture 43 - Creep - I

Lecture 44 - Creep - II

Lecture 45 - Creep - III

Lecture 46 - Creep - IV

Lecture 47 - Creep - V

Lecture 48 - Creep - VI

Lecture 49 - Fracture Mechanics - I

Lecture 50 - Fracture Mechanics - II

Lecture 51 - Fracture Mechanics - III

Lecture 52 - Fracture Mechanics - IV

Lecture 53 - Fracture Mechanics - V

Lecture 54 - Fracture Mechanics - VI

Lecture 55 - Fracture Mechanics - VII

Lecture 56 - Fracture Mechanics - VIII

Lecture 57 - Fracture Mechanics - IX

Lecture 58 - Fracture Mechanics - X

Lecture 59 - Fracture Mechanics - XI

Lecture 60 - Fatigue - I

Lecture 61 - Fatigue - II

Lecture 62 - Fatigue - III

Lecture 63 - Fatigue - IV

Lecture 64 - Fatigue - V

NPTEL : NOC:Aluminium based Alloys and Metal Matrix Composites (Metallurgy and Material Science)

Co-ordinators : Prof. Ranjit Bauri

Lecture 1 - Pure Aluminium

Lecture 2 - Extraction of Aluminium

Lecture 3 - Alloy Designations

Lecture 4 - Cast Aluminium Alloys

Lecture 5 - Hypo and Hyper eutectic alloys

Lecture 6 - Modifying Al-Si alloys and Decoding Alloy Designation

Lecture 7 - Solid Solution Hardening - 1

Lecture 8 - Solid Solution Hardening - 2

Lecture 9 - Yield point phenomena and Strain aging

Lecture 10 - Cottrel-Bilby theory of strain aging

Lecture 11 - Portevinâ€“Le Chatelier (PLC) effect

Lecture 12 - Dynamic Strain Aging (DSA)

Lecture 13 - Features of Serrrated Flow - 1

Lecture 14 - Features of Serrrated Flow - 2

Lecture 15 - Precipitation hardening - 1

Lecture 16 - Precipitation hardening - 2

Lecture 17 - Precipitation hardening - 3

Lecture 18 - Precipitation hardening - 4

Lecture 19 - Precipitation hardening - 5

Lecture 20 - Precipitation hardening - 6

Lecture 21 - 7XXX and 8XXX Series Alloys

Lecture 22 - Strain Hardening - 1

Lecture 23 - Strain Hardening - 2

Lecture 24 - Recovery and Recrystallization

Lecture 25 - Recrystallization Mechanism

Lecture 26 - Recrystallization: Nucleation and Growth

Lecture 27 - Dynamic Recrystallization

Lecture 28 - Discontinuous and Continuous Dynamic Recrystallization

Lecture 29 - Continuous Dynamic Recrystallization

Lecture 30 - Geometric Dynamic Recrystallization (GDRX)

Lecture 31 - Grain boundary strenthening

Lecture 32 - Grain refinement methods

Lecture 33 - Homogeneous vs Heterogeneous Nucleation

Lecture 34 - Grain refinement by Melt inoculation

Lecture 35 - Mechanisms of grain refinement by melt inoculation - 1

Lecture 36 - Mechanisms of grain refinement by melt inoculation - 2

Lecture 37 - Melt inoculation: Fading and Poisoning

Lecture 38 - Grain refinement by melt vibration

Lecture 39 - Severe Plastic Deformation (SPD)

Lecture 40 - Dynamic recrystallization in SPD

Lecture 41 - Metal Matrix Composites

Lecture 42 - Processing of Metal Matrix Composites

Lecture 43 - Two-phase process, Insitu composites

Lecture 44 - Particle wetting and Bonding

Lecture 45 - Particle Distribution in MMCs - 1

Lecture 46 - Particle Distribution in MMCs - 2

Lecture 47 - Rule of Mixture - 1

Lecture 48 - Rule of Mixture - 2

Lecture 49 - Strengthening Mechanism in MMCs - 1

Lecture 50 - Strengthening Mechanism in MMCs - 2

Lecture 51 - Fracture Behavior of Fiber Reinforced Composites

Lecture 52 - Ductile Fracture of Metals

Lecture 53 - Fracture Behavior of Discontinuously Reinforced Composites

Lecture 54 - Fatigue

Lecture 55 - Fatigue Crack propagation and Growth

Lecture 56 - Fatigue Behavior of MMCs - 1

Lecture 57 - Fatigue Behavior of MMCs - 2

Lecture 58 - Fatigue Behavior of MMCs - 3

Lecture 59 - Fatigue Behavior of MMCs - 4

Lecture 60 - Fatigue Behavior of MMCs - 5

NPTEL : NOC:Welding Science and Technology (In Tamil) (Metallurgy and Material Science)

Co-ordinators : Prof. Murugaiyan Amirthalingam

Lecture 1 - Introduction and learning objectives

Lecture 2 - Definition of welding and necessity for welding

Lecture 3 - Classification of welding processes

Lecture 4 - Introduction to welding arc

Lecture 5 - Types of gas discharges

Lecture 6 - Characteristics of a welding arc

Lecture 7 - Role of polarity in a welding arc

Lecture 8 - Anode and cathode fall zones

Lecture 9 - Arc column - Part I

Lecture 10 - Arc column - Part II

Lecture 11 - Arc column - Part III

Lecture 12 - Characteristics of arc welding processes

Lecture 13 - Introduction to arc ignition and gas tungten arc welding

Lecture 14 - Gas tungsten arc welding - I

Lecture 15 - Shielding gases used for arc welding

Lecture 16 - Plasma welding

Lecture 17 - Consumable welding processes - I

Lecture 18 - Consumable welding processes - II

Lecture 19 - Fundamentals of resistance welding

Lecture 20 - Resistance spot welding - Part I

Lecture 21 - Resistance spot welding - Part II

Lecture 22 - Other resistance welding processes

Lecture 23 - High energy beam welding processes - Laser beam welding

Lecture 24 - High energy beam welding processes - Electron beam welding

Lecture 25 - Other welding processes - Part I

Lecture 26 - Other welding processes - Part II

NPTEL : NOC:Thermodynamics and Kinetics of Materials (Metallurgy and Material Science)

Co-ordinators : Prof. Saswata Bhattacharya

Lecture 1 - Basic Concepts

Lecture 2 - Energy, Heat and Work I - Part 1

Lecture 3 - Energy, Heat and Work II - Part 2

Lecture 4 - Heat capacity and Enthalpy

Lecture 5 - Heat capacity relations in materials

Lecture 6 - Introduction to the Second law of Thermodynamics

Lecture 7 - Clausius inequality and entropy of transformation

Lecture 8 - First and Second Laws Combined

Lecture 9 - Third Law, Absolute Zero, and Other Energy Functions

Lecture 10 - Axiomatic Approach and Thermodynamic Equilibrium in Simple Systems

Lecture 11 - Formulations of Equilibrium in Thermodynamic Systems

Lecture 12 - Fundamental relations and alternative formulations of equilibrium criterion

Lecture 13 - Maxwell relations and their application

Lecture 14 - Concepts of Statistical Thermodynamics - 1

Lecture 15 - Concepts of Statistical Thermodynamics - 2

Lecture 16 - Thermodynamic Equilibrium in Statistical Thermodynamics

Lecture 17 - Phase equilibria and phase transition in unary systems - 1

Lecture 18 - Phase equilibria and phase transition in unary systems - 2

Lecture 19 - Phase equilibria and phase transition in unary systems - 3

Lecture 20 - Applications of Clausius-Clapeyron Equation

Lecture 21 - Thermodynamics of solutions - 1

Lecture 22 - Thermodynamics of solutions - 2

Lecture 23 - Multicomponent solutions and mixing process

Lecture 24 - Thermodynamic properties due to mixing

Lecture 25 - Ideal and Real Solutions

Lecture 26 - Regular solutions and thermodynamic properties of mixing

Lecture 27 - Colligative Properties

Lecture 28 - Quasichemical Approach and regular solutions

Lecture 29 - Quasichemical solution model for ordered phases - I

Lecture 30 - Quasichemical solution model for ordered phases - II

Lecture 31 - Phase equilibria in multiphase, multicomponent, non-reacting systems

Lecture 32 - Binary phase diagrams and lever rule

Lecture 33 - Binary alloy phase diagrams and invariant points

Lecture 34 - Binary alloy phase diagrams - intermediate phases and miscibility gap

Lecture 35 - Thermodynamics of phase diagrams - G-x curves

Lecture 36 - Thermodynamic Stability and Numerical Modeling

Lecture 37 - Thermodynamics of reacting systems

Lecture 38 - Elements of thermodynamics of interfaces and thermodynamics of irreversible processes

NPTEL : NOC:Diffusion in Solids (Metallurgy and Material Science)

Co-ordinators : Prof. Mayur Vaidya

Lecture 1 - Diffusion in materials world

Lecture 2 - Revisiting relevant mathematical concepts

Lecture 3 - Ficks law of Diffusion

Lecture 4 - Introduction to Laplace transform

Lecture 5 - Tutorial 1

Lecture 6 - Laplace transformation of Fick's second law

Lecture 7 - Solutions to Diffusion equations - 1

Lecture 8 - Solutions to Diffusion equations - 2

Lecture 9 - Solutions to Diffusion equations - 3

Lecture 10 - Tutorial 2

Lecture 11 - Demo of Scilab: Plotting the diffusion profile

Lecture 12 - Revisiting structure and defects in crystalline solids - 1

Lecture 13 - Revisiting structure and defects in crystalline solids - 2

Lecture 14 - Random walk and atomic jumps

Lecture 15 - Tutorial 3

Lecture 16 - Atomic mechanisms of diffusion

Lecture 17 - Correlation factors - 1

Lecture 18 - Correlation factors - 2

Lecture 19 - Temperature and pressure dependence of diffusion

Lecture 20 - Tutorial 4

Lecture 21 - Revisiting G-X curves and phase diagrams

Lecture 22 - Basics of Interdiffusion

Lecture 23 - Phase Formation in Interdiffusion Zone

Lecture 24 - Composition profiles in interdiffusion zone - 1

Lecture 25 - Tutorial 5

Lecture 26 - Composition profiles in interdiffusion zone - 2

Lecture 27 - Boltzmann-Matano Analysis

Lecture 28 - Kirkendall Effect

Lecture 29 - Intrinsic diffusion and Darkens analysis

Lecture 30 - Tutorial 6

Lecture 31 - Introduction to CALPHAD

Lecture 32 - CALPHAD implementation software and diffusion module

Lecture 33 - Thermodynamic and kinetic databases

Lecture 34 - Moving boundary and multiphase diffusion simulations

Lecture 35 - Tutorial 7

Lecture 36 - Techniques to measure diffusion coefficients, Radiotracer diffusion, Deviations from Gaussian profile

Lecture 37 - SIMS AND EPMA

Lecture 38 - Mechanical spectroscopy and Electrical Methods

Lecture 39 - Nuclear methods - 1

Lecture 40 - Tutorial 8

Lecture 41 - Nuclear Methods - 2

Lecture 42 - Grain boundary structure and fisher model

Lecture 43 - Kinetic regime of grain boundary diffusion

Lecture 44 - Disloaction pipe diffusion

Lecture 45 - Tutorial 9

Lecture 46 - Diffusion in Intermetallics

Lecture 47 - Diffusion in nanocrystalline materials

Lecture 48 - Diffusion in quasicrystalline alloys

Lecture 49 - Diffusion in metallic alloys - 1

Lecture 50 - Tutorial 10

Lecture 51 - Diffusion in metallic alloys - 2

Lecture 52 - Diffusion in high entropy alloys

Lecture 53 - Diffusion in semiconductors - 1

Lecture 54 - Diffusion in semiconductors - 2

Lecture 55 - Tutorial 11

Lecture 56 - Diffusion in glasses

Lecture 57 - Diffusion in ionic solids - 1

Lecture 58 - Diffusion in ionic solids - 2

Lecture 59 - Tutorial 12

Lecture 60 - Revision of important concepts

NPTEL : NOC:Surface Engineering of Nanomaterials (Metallurgy and Material Science)

Co-ordinators : Prof. Kaushik Pal

Lecture 1 - Tribology and Its Classification

Lecture 2 - Friction Tribology

Lecture 3 - Wear and Corrosion

Lecture 4 - Lubrication

Lecture 5 - Effect of Tribology on Surface of Nanomaterials

Lecture 6 - Conventional Surface Engineering

Lecture 7 - Types of Surface Modifications

Lecture 8 - Physical Modifications

Lecture 9 - Chemical Modifications

Lecture 10 - Applications of Surface Engineering towards Nanomaterials

Lecture 11 - Deposition and Surface Modification Methods

Lecture 12 - Physical Vapour Deposition (PVD)

Lecture 13 - Chemical Vapour Deposition (CVD)

Lecture 14 - Advanced Surface Modification Practices

Lecture 15 - Advantages of Deposition for Surface Modification

Lecture 16 - Synthesis, Processing and Characterization of Nano-structured Coatings

Lecture 17 - Functional Coatings

Lecture 18 - Advanced Coating Practices

Lecture 19 - Characterization of Nano-coatings

Lecture 20 - Applications of Nano-coatings

Lecture 21 - Need of Advanced Methods for Surface and Coating Testings

Lecture 22 - Size Dependency in Nanostructures of Nanocoatings

Lecture 23 - Size Effect in Electrochemical Properties of Nanostructured Coatings

Lecture 24 - Size Effect in Mechanical Properties of Nanostructured Coatings

Lecture 25 - Size Effect in Physical and Other Properties of Nanostructured Coatings

Lecture 26 - Thin Films for Surface Engineering of Nanomaterials

Lecture 27 - Sputtering Techniques

Lecture 28 - Evaporation Processes

Lecture 29 - Thin Film Deposition through Gas Phase Techniques

Lecture 30 - Liquid Phase Techniques

Lecture 31 - Microencapsulation Processes

Lecture 32 - Microencapsulation: Kinetics of release

Lecture 33 - Plating of Nanocomposite Coatings - I

Lecture 34 - Plating of Nanocomposite Coatings - II

Lecture 35 - Advantages of Microencapsulation over Other Conventional Methods

Lecture 36 - Current Trends in Surface Modification of Nanomaterials - Part-1

Lecture 37 - Current Trends in Surface Modification of Nanomaterials - Part-2

Lecture 38 - Current Trends in Surface Modification of Nanomaterials - Part-3

Lecture 39 - Modified Nanomaterials: In-use for consumer products

Lecture 40 - Main Problems in Synthesis of Modified Nanomaterials

NPTEL : NOC:Material Science and Engineering (Metallurgy and Material Science)

Co-ordinators : Dr. Vivek Pancholi

Lecture 1 - Introduction

Lecture 2 - Atomic structure and bonding

Lecture 3 - Crystal systems and structures: Lattice

Lecture 4 - X-ray diffraction: Crystal structure determination

Lecture 5 - Crystal planes and directions: Indexing

Lecture 6 - Optical microscope

Lecture 7 - Optical aberration

Lecture 8 - Metallography

Lecture 9 - Microstructure: Understanding

Lecture 10 - Quantitative metallography

Lecture 11 - Crystallographic defects

Lecture 12 - Diffusion

Lecture 13 - Phase diagram - 1

Lecture 14 - Phase diagram - 2

Lecture 15 - Eutectic phase diagram

Lecture 16 - Equilibrium and non-equilibrium cooling

Lecture 17 - Equilibrium cooling of eutectic system

Lecture 18 - Solidification structure

Lecture 19 - Iron-carbon phase diagram

Lecture 20 - Nucleation and growth

Lecture 21 - TTT and CCT curves

Lecture 22 - Heat treatment

Lecture 23 - Precipitation

Lecture 24 - Elastic behaviour

Lecture 25 - Tensile test

Lecture 26 - Engineering and true stress and strain

Lecture 27 - Plastic deformation - 1

Lecture 28 - Plastic deformation - 2

Lecture 29 - Strengthening mechanism - 1

Lecture 30 - Strengthening mechanism - 2

Lecture 31 - Strengthening mechanism - 3

Lecture 32 - Strengthening mechanism - 4

Lecture 33 - Fracture: Part - 1

Lecture 34 - Fracture: Part - 2

Lecture 35 - Fatigue

Lecture 36 - Creep

Lecture 37 - NDT: Hardness measurement

Lecture 38 - Ceramics, polymers, composites

Lecture 39 - Electrical and magnetic properties

Lecture 40 - Alloy designation and properties

NPTEL : NOC:Structural Analysis of Nanomaterials (Metallurgy and Material Science)

Co-ordinators : Prof. Kaushik Pal

Lecture 1 - Introduction

Lecture 2 - Structure of Materials

Lecture 3 - Imperfections in Structure of Materials

Lecture 4 - Phase Diagram: Determination of Phases

Lecture 5 - Transformation of Phases

Lecture 6 - Basic Properties: Metals - I

Lecture 7 - Basic Properties: Metals - II

Lecture 8 - Basic Properties: Ceramics

Lecture 9 - Basic Properties: Polymers

Lecture 10 - Selection of Nanomaterials based on Applications

Lecture 11 - Introduction to X-Ray Diffraction

Lecture 12 - Diffraction Methods and Directions of XRD

Lecture 13 - Determination of Crystal Structures by XRD Patterns

Lecture 14 - Precise Parameter Measurements

Lecture 15 - Orientation of Single Crystals

Lecture 16 - Qualitative Analysis by Diffraction

Lecture 17 - Quantitative Analysis by Diffraction

Lecture 18 - Microscopic Structural Analysis of Nanomaterials - I

Lecture 19 - Microscopic Structural Analysis of Nanomaterials - II

Lecture 20 - Other Characterization Techniques

NPTEL : NOC:Thermo-Mechanical and Thermo-Chemical Processes (Metallurgy and Material Science)

Co-ordinators : Prof. S. R. Meka

Lecture 1 - Introduction to Thermomechanical Processes

Lecture 2 - Conventional Thermomechanical Processes

Lecture 3 - Non-conventional Thermomechanical Processes

Lecture 4 - Stress and Strain

Lecture 5 - Effect of Strain Rate and Temperature

Lecture 6 - Microstructure Evolution

Lecture 7 - Dynamic Recovery

Lecture 8 - Discontinuous Dynamic Recrystallization

Lecture 9 - Dynamic Recrystallization : Critical Stress and Strain

Lecture 10 - Continuous Dynamic Recrystallization (CDRX) and Geometrical Dynamic Recrystallization (GDRX)

Lecture 11 - Stereographic Projection

Lecture 12 - Using Stereographic Projection

Lecture 13 - Crystallographic Texture

Lecture 14 - Crystallographic Texture: Texture Components

Lecture 15 - Crystallographic Texture: Application

Lecture 16 - Constitutive Analysis

Lecture 17 - Constitutive Analysis: Low Strain Rate

Lecture 18 - Higher Strain Rate: Hot Working

Lecture 19 - Constitutive Based Model : Physical Based Model

Lecture 20 - Constitutive analysis : Case Study

Lecture 21 - Processing Maps : Deformation Mechanism maps

Lecture 22 - Processing Maps : Dynamic Material Model

Lecture 23 - Microstructure and Application

Lecture 24 - Processing Maps : Different Models

Lecture 25 - Processing Maps : Case Study

Lecture 26 - Equal Channel Angular Pressing (ECAP)

Lecture 27 - Friction Stir Processing (FSP)

Lecture 28 - Accumulative Roll Bonding (ARB)

Lecture 29 - Multi Axial Forging (MAF)

Lecture 30 - Severe Plastic Deformation : Case Study

Lecture 31 - Overview on Thermo-Chemical treatments

Lecture 32 - Overview on Thermo-Chemical treatments (Continued...)

Lecture 33 - Thermodynamic aspects of thermo-chemical treatments: Preliminaries

Lecture 34 - Thermodynamics of Gaseous Nitriding - I

Lecture 35 - Thermodynamics of Gaseous Nitriding - II

Lecture 36 - Gaseous Nitriding of Pure Iron

Lecture 37 - Gaseous Nitriding of Iron based alloys

Lecture 38 - Duplex and Dual Phase microstructures through nitriding

Lecture 39 - Alloying element nitride precipitation during nitriding of iron based alloys

Lecture 40 - Kinetics of gaseous nitriding

NPTEL : NOC:Welding Metallurgy (Metallurgy and Material Science)

Co-ordinators : Dr. Pradeep K. Jha

Lecture 1 - Introduction to welding metallurgy

Lecture 2 - Overview of Welding Processes

Lecture 3 - Introduction to phase diagrams

Lecture 4 - Phase diagram of Iron Carbon system

Lecture 5 - Phase diagram of non ferrous metals and alloys

Lecture 6 - Phase Transformations

Lecture 7 - Time Temperature Transformation Diagrams

Lecture 8 - Continuous Cooling Transformation Diagrams

Lecture 9 - Carbon Equivalent, Schaeffler Diagrams

Lecture 10 - Problem solving on Phase Diagrams

Lecture 11 - Introduction to strengthening mechanism in metals

Lecture 12 - Solid solution strengthening and grain refinement

Lecture 13 - Precipitation Hardening and Martensite Strengthening

Lecture 14 - Strain Hardening and Strain Ageing

Lecture 15 - Problem solving on strengthening mechanism in metals

Lecture 16 - Introduction to Heat treatment Processes in Welding

Lecture 17 - Hardening and Hardenability

Lecture 18 - Martempering and Austempering

Lecture 19 - Case Hardening methods

Lecture 20 - Heat treatment of Non-Ferrous metals and alloys

Lecture 21 - Heat Sources in Welding

Lecture 22 - Heat Flow in Welding

Lecture 23 - Temperature Distribution in Welding

Lecture 24 - Effect of Welding Parameters

Lecture 25 - Metallurgical effect of Heat Flow on Welding

Lecture 26 - Principles of Solidification in Welding

Lecture 27 - Solute redistribution during Solidification

Lecture 28 - Constitutional Supercooling

Lecture 29 - Microsegregation and Banding

Lecture 30 - Grain Structure during Solidification in Welding

Lecture 31 - Distinct Zones in Fusion Welded Specimen

Lecture 32 - Heat Affected Zone

Lecture 33 - Properties of Heat Affect Zone

Lecture 34 - Microstructural Products in Weldments

Lecture 35 - Introduction to Preheat and Postweld Heat Treatment

Lecture 36 - Preheat and Postweld Heat Treatment of Different Materials

Lecture 37 - Residual Stresses in Welding

Lecture 38 - Causes of Residual Stress Development in Welding

Lecture 39 - Measurement of Residual Stresses in Weldments

Lecture 40 - Controlling Residual Stresses in Weldments

Lecture 41 - Introduction to Welding Distortion

Lecture 42 - Types of Welding Distortions

Lecture 43 - Angular Distortions in Welds

Lecture 44 - Bowing, Buckling and Twisting in Welds

Lecture 45 - Control of Distortion in Welds

Lecture 46 - Introduction to Cracks in Welds

Lecture 47 - Types of Weld Cracks

Lecture 48 - Specific Weld Cracks

Lecture 49 - Chevron Cracks and Reheat Cracks

Lecture 50 - Lamellar Cracks and Stress Corrosion Cracking

Lecture 51 - Introduction to Weldability of Metals

Lecture 52 - Weldability of Carbon Steels

Lecture 53 - Weldability of Alloy Steels

Lecture 54 - Weldability of Cast Iron

Lecture 55 - Weldability of Non Ferrous Metals and Alloys

Lecture 56 - Introduction to Welding Defects

Lecture 57 - Surface and Subsurface Welding Defects

Lecture 58 - Issues in Welding: Design for Static Loading

Lecture 59 - Considerations for Fatigue Loading in Welding

Lecture 60 - Design Features for Fatigue and Static Loading in Welding

NPTEL : NOC:Modeling of Tundish Steelmaking Process in Continuous Casting (Metallurgy and Material Science)

Co-ordinators : Dr. Pradeep K. Jha

Lecture 1 - Introduction to Continuous Casting Process

Lecture 2 - Role of Tundish in Continuous Casting

Lecture 3 - Types of Continuous Casting Machine

Lecture 4 - Components of Continuous Casting Unit

Lecture 5 - Tundish Metallurgy

Lecture 6 - Introduction to Physical Modeling

Lecture 7 - Concept of Similarity in Physical Modeling

Lecture 8 - Dimensional analysis

Lecture 9 - Physical Modeling of Isothermal and Non-Isothermal system

Lecture 10 - Consideration in Aqueous Modeling

Lecture 11 - Introduction to Stimulus Response Techniques

Lecture 12 - Characterization of Flow

Lecture 13 - Characterization of Flow in Actual Systems

Lecture 14 - Analysis of RTD Curves

Lecture 15 - Plug, Mixed and Dead Regions in Tundish

Lecture 16 - Fluid Flow Fundamentals

Lecture 17 - Mass Conservation Equation

Lecture 18 - Momentum Conservation Equation

Lecture 19 - Energy Conservation Equation

Lecture 20 - Navier Stokes Equations for Newtonian Fluid

Lecture 21 - Introduction to Turbulence in Fluid Flow

Lecture 22 - Characteristics of Turbulent Flow

Lecture 23 - RANS Equations

Lecture 24 - Turbulent Flow Calculations

Lecture 25 - Turbulence Modeling Using k-É› Model

Lecture 26 - Introduction to Heat Transfer Phenomena

Lecture 27 - Numerical Methods for Solving Governing Equation

Lecture 28 - Finite Volume Method for Convection and Diffusion Problems

Lecture 29 - Different Discretization Schemes

Lecture 30 - Assessment of Discretization Schemes

Lecture 31 - Elements of Mathematical Modeling in Tundish Steelmaking

Lecture 32 - Boundary Conditions

Lecture 33 - Flow Analysis in Tundish

Lecture 34 - Analysis of Fluid Flow and Mixing in Tundish

Lecture 35 - Non-isothermal Flow Considerations in Tundish

Lecture 36 - Intermixing in Tundish

Lecture 37 - Modeling Consideration For Inclusion Removal in Tundish - I

Lecture 38 - Modeling Consideration For Inclusion Removal in Tundish - II

Lecture 39 - Case Studies in Modeling of Tundish Steelmaking - 1

Lecture 40 - Case Studies in Modeling of Tundish Steelmaking - 2

NPTEL : NOC:Biomaterials for Bone Tissue Engineering Applications (Metallurgy and Material Science)

Co-ordinators : Prof. Bikramjit Basu

Lecture 1 - Introduction

Lecture 2 - Biomaterial

Lecture 3 - Biocompatibility

Lecture 4 - Host response

Lecture 5 - Tissue Eng

Lecture 6 - Scaffold

Lecture 7 - Bone structure

Lecture 8 - Bone properties

Lecture 9 - Implant - I

Lecture 10 - Implant - II

Lecture 11 - Proteins

Lecture 12 - Cell structure

Lecture 13 - Bacteria structure

Lecture 14 - Antibacterial assay

Lecture 15 - Cell fate processes

Lecture 16 - Cell division

Lecture 17 - Cell differentiation

Lecture 18 - Stem cells

Lecture 19 - Osseointegration

Lecture 20 - In vivo testing

Lecture 21 - Cell-material interaction

Lecture 22 - Cell-signalling

Lecture 23 - In vitro testing

Lecture 24 - Cytotoxicity assays

Lecture 25 - Biocompatibility assay

Lecture 26 - Clinical trials - I

Lecture 27 - Clinical trials - II

Lecture 28 - Metal manufacturing

Lecture 29 - Ceramics manufacturing

Lecture 30 - Polymers manufacturing

Lecture 31 - Additive manufacturing

Lecture 32 - HA-Ti-Toughness, Cell functionality

Lecture 33 - HA-CaTiO 3 development

Lecture 34 - HA- BaTiO 3 Functional Prop

Lecture 35 - HA-Ag antimicrob and cell viability

Lecture 36 - HA-ZnO, Cell fate and antimicrobial

Lecture 37 - Dental ceramics processing

Lecture 38 - Sr-based glass Ceramics

Lecture 39 - Acetabular socket (Compression mold)

Lecture 40 - ZTA femoral ball head fabrication

NPTEL : NOC:Iron Making (Metallurgy and Material Science)

Co-ordinators : Prof Govind S Gupta

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6

Lecture 7

Lecture 8

Lecture 9

Lecture 10

Lecture 11

Lecture 12

Lecture 13

Lecture 14

Lecture 15

Lecture 16

Lecture 17

Lecture 18

Lecture 19

Lecture 20

Lecture 21

Lecture 22

Lecture 23

Lecture 24

Lecture 25

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31

Lecture 32

Lecture 33

Lecture 34

Lecture 35

Lecture 36

Lecture 37

Lecture 38

Lecture 39 - Live Session

NPTEL : NOC:Friction and Wear of Materials: Principles and Case Studies (Metallurgy and Material Science)

Co-ordinators : Prof. Dr. B. V. Manoj Kumar, Prof. Bikramjit Basu

Lecture 1 - Tribology: Introduction

Lecture 2 - Surfaces and contacts

Lecture 3 - Friction: Laws and mechanisms

Lecture 4 - Contact temperature

Lecture 5 - Lubrication

Lecture 6 - Wear mechanisms: Adhesive wear

Lecture 7 - Wear mechanisms: Abrasive wear

Lecture 8 - Wear mechanisms: Tribochemical wear and Oxidative wear

Lecture 9 - Wear mechanisms: Fatigue wear and Fretting wear

Lecture 10 - Wear mechanisms: Erosive wear

Lecture 11 - Overview of tribological materials

Lecture 12 - Friction and wear of metal matrix composites

Lecture 13 - Overview: Bioceramics and Biocomposites

Lecture 14 - Fabrication of engineering polymers

Lecture 15 - Polymer Ceramic Composites for Orthopedic Applications

Lecture 16 - Processing concepts of ceramics

Lecture 17 - Mechanical properties of ceramics

Lecture 18 - Fracture and toughening of brittle solids

Lecture 19 - Sliding wear of SiC Ceramics

Lecture 20 - Sliding wear of SiC-WC Composites

Lecture 21 - Friction and wear of HDPE-HA-Al2O3

Lecture 22 - Wear behavior of bioceramics and biocomposites

Lecture 23 - Tribological behavior of dental restorative materials

Lecture 24 - Wear of transformation toughened zirconia

Lecture 25 - Fretting wear of SiAlON Ceramics

Lecture 26 - Tribochemistry in wear of cermets

Lecture 27 - Overview: nanoceramic composites

Lecture 28 - Wear of YSZ nanoceramics

Lecture 29 - Wear behavior of nanostructured WC-ZrO2 nanocomposites

Lecture 30 - Erosive wear of SiC-WC composites

Lecture 31 - Overview: Cryogenic wear properties of materials

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

NPTEL : NOC:Materials Design for Electronic, Electromechanical and Optical Functions (Metallurgy and Material Science)

Co-ordinators : Prof. Pavan Nukala

Lecture 1 - Description of material properties

Lecture 2 - Direct and Coupled properties

Lecture 3 - Tensor algebra and property tensor

Lecture 4 - Tensor algebra (Continued...)

Lecture 5 - Property tensor: higher rank tensor and nonlinear property

Lecture 6 - Property tensor (Continued...)

Lecture 7 - Field tensor: Stress and strain

Lecture 8 - Point symmetry operation: rotation and inversion

Lecture 9 - Point symmetry operation: rotoinversion

Lecture 10 - Point symmetry operation: examples in material system

Lecture 11 - Crystal Systems, Bravais Lattices and Symmetry

Lecture 12 - Crystal Systems, Bravais Lattices and Symmetry

Lecture 13 - Crystal Systems, Bravais Lattices and Symmetry

Lecture 14 - Crystal Systems, Bravais Lattices and Symmetry

Lecture 15 - Crystal Systems, Bravais Lattices and Symmetry

Lecture 16 - Development of point group - Part 1

Lecture 17 - Development of point group - Part 2

Lecture 18 - Development of point group - Part 3 : Some visualization in real crystals

Lecture 19 - Point groups, polar groups and consequences in property

Lecture 20 - Structure-symmetry- property correlation

Lecture 21 - Ferroelectricity, polar point groups - I

Lecture 22 - Ferroelectricity, polar point groups - II

Lecture 23 - Space Groups - I

Lecture 24 - Space Groups - II

Lecture 25 - Visualizing Important Crystals (A space group perspective)

Lecture 26 - Some more popular structures and their visualization

Lecture 27 - Symmetry-property correlation - Part 1

Lecture 28 - Symmetry-property correlation - Part 2

Lecture 29 - Symmetry-property correlation - Part 3

Lecture 30 - Thermodynamics and equilibrium properties - Part 1

Lecture 31 - Thermodynamics and equilibrium properties - Part 2

Lecture 32 - Thermodynamics and equilibrium properties - Part 3

Lecture 33 - Thermodynamics and equilibrium properties - Part 4

Lecture 34 - Statistical Mechanics

Lecture 35 - Title Statistical Mechanics (Continued...)

Lecture 36 - Properties as fluctuations and correlations of order parameter

Lecture 37 - Properties as fluctuations and correlations (Continued...)

Lecture 38 - Landau Theory and Phase Transitions

Lecture 39 - Landau Theory and Phase Transitions (Continued...)

Lecture 40 - Phase transitions and enhancement of fluctuations

Lecture 41 - Dissipative properties

Lecture 42 - Dissipative properties

Lecture 43 - Dissipative properties: Onsagers linear response theory

Lecture 44 - Onsagers linear response theory (Continued...)

Lecture 45 - Onsagers theory: A few case studies

Lecture 46 - Measurement of response function

Lecture 47 - Small Signal Measurement

Lecture 48 - Atomistic picture of Dielectric constant

Lecture 49 - Relaxation vs Resonance

Lecture 50 - Resonance

Lecture 51 - Causality

Lecture 52 - Kramers-Kronig relations

Lecture 53 - Kramers-Kronig and Spectroscopy

Lecture 54 - Spectroscopy at various time scale

Lecture 55 - Spectroscopy (Continued...)

Lecture 56 - Spectroscopy (Continued...)

NPTEL : NOC:Advanced Manufacturing and Process Modelling (Metallurgy and Material Science)

Co-ordinators : Prof. Prosenjit Das

Lecture 1 - Introduction to Manufacturing science

Lecture 2 - Finite difference method and Finite volume method

Lecture 3 - Introduction to Finite Element Methods

Lecture 4 - Introduction to Finite Element Methods

Lecture 5 - Introduction to Boundary element methods

Lecture 6 - Introduction to casting and solidification

Lecture 7 - Solidification of metal and alloys

Lecture 8 - Introduction to casting

Lecture 9 - Introduction to casting

Lecture 10 - Introduction to casting

Lecture 11 - Introduction to casting and its types

Lecture 12 - Types of casting and defects

Lecture 13 - Introduction to die filling analysis

Lecture 14 - Porosity Modelling and Gravity die casting

Lecture 15 - Rheology

Lecture 16 - Case studies on Die filling

Lecture 17 - Introduction to welding

Lecture 18 - Principle of fusion welding

Lecture 19 - Principle of fusion welding

Lecture 20 - Welding Mechanics

Lecture 21 - Welding Mechanics, Types of welding

Lecture 22 - Types of welding

Lecture 23 - Types of welding

Lecture 24 - Types of welding

Lecture 25 - Types of welding

Lecture 26 - Procedure for numerical modelling

Lecture 27 - Procedure for solving governing equations

Lecture 28 - Procedure for solving governing equations

Lecture 29 - Solvers and Boundary conditions

Lecture 30 - Transport phenomena during solidification (Continued...)

Lecture 31 - Introduction to Powder Metallurgy

Lecture 32 - Process methodology on Powder Metallurgy

Lecture 33 - Process methodology on Powder Metallurgy

Lecture 34 - Atomization and Sintering

Lecture 35 - Theory of sintering

Lecture 36 - Theory of sintering

Lecture 37 - Different processes in powder metallurgy

Lecture 38 - Design of the molding system

Lecture 39 - Ceramic Injection Molding and metal injection molding

Lecture 40 - Metal forming and process modelling

Lecture 41 - Mechanics of metal working

Lecture 42 - Mechanics of metal working

Lecture 43 - Metal working processes

Lecture 44 - Metal working processes

Lecture 45 - Metal working processes

Lecture 46 - Metal working processes

Lecture 47 - Phase field Modelling

Lecture 48 - Numerical Modelling for welding

Lecture 49 - Introduction to Additive manufacturing

Lecture 50 - Numerical Modelling of Additive manufacturing

Lecture 51 - Phase field

Lecture 52 - Transport phenomena, Process modelling of Metal forming, Machining

NPTEL : NOC:Advances in Additive Manufacturing of Materials: Current Status and Emerging Opportunities (Metallurgy and Material Science)

Co-ordinators : Prof. Bikramjit Basu

Lecture 1 - Introduction to additive manufacturing

Lecture 2 - Introduction and classification of AM processes

Lecture 3 - Advantages of AM over Conventional Manufacturing

Lecture 4 - Design aspects in 3D printing

Lecture 5 - Introduction to Engineering Materials

Lecture 6 - Properties of material classes

Lecture 7 - Introduction to material characterization

Lecture 8 - Introduction to mechanical property of materials

Lecture 9 - Overview of AM Processes and Demonstration of industry-scale L-PBF machine

Lecture 10 - Overview of AM Processes

Lecture 11 - Binderjet 3D printing: Process Science

Lecture 12 - Scientific Case study: Binderjet 3D printing of Ti6Al4V

Lecture 13 - Scientific Case study: Binderjet 3D printing of Ti-6Al-4V with in situ polymerisable ink

Lecture 14 - Scientific Case study: Binderjet 3D printing of Ti-6Al-4V with in situ polymerisable ink

Lecture 15 - Scientific Case study: Zirconia based bioceramics: binderjet printing using the novel binder

Lecture 16 - Scientific Case study: Binderjet 3D Printing of bioceramics

Lecture 17 - Inkjet Cell Printing

Lecture 18 - Process Science of Laser-based AM Process of metallic materials

Lecture 19 - Microstructure development during Laser-based AM Process

Lecture 20 - Introduction to Lattice Structures

Lecture 21 - Introduction to Cellular structure and Topology Optimisation

Lecture 22 - Scientific case study: SLM Printing of Ti6Al4V lattice structures and properties

Lecture 23 - Scientific case study: SLM Printing of SS316L lattice structures and properties

Lecture 24 - Labscale Demonstration of Directed Energy Deposition (DED)-printing of Materials

Lecture 25 - Additive Manufacturing of Materials - Applications, solutions and Future Perspective

Lecture 26 - Additive Manufacturing of Materials - Applications, solutions and Future Perspective

Lecture 27 - Introduction to biological system

Lecture 28 - Introduction to biological system

Lecture 29 - Introduction to Biological System

Lecture 30 - Introduction to biological system

Lecture 31 - Fundamentals of Rheology

Lecture 32 - Process Science: 3D extrusion (Bio)printing/4D Bioprinting

Lecture 33 - Process Science: 3D extrusion (Bio)printing/4D Bioprinting

Lecture 34 - Scientific case study: 3D extrusion printing of Alginate-Gelatin hydrogels

Lecture 35 - 3D extrusion printing of Gelatin glycidyl methacrylate/alginate/nanocellulose-based hydrogel

Lecture 36 - Scientific case study-3D extrusion bioprinting of GelMA hydrogels for hard tissue

Lecture 37 - 3D extrusion (Bio)printing of GelMA hydrogels for hard tissue

Lecture 38 - 3D (Bio)printing of GelMA hydrogels for neural tissue regeneration

Lecture 39 - 3D (Bio)printing of GelMA hydrogels for neural tissue regeneration

Lecture 40 - Labscale demonstration of 3D extrusion printing of hydrogels

Lecture 41 - 3D printing of cranium models mediated bone flaps for patient-specific Cranioplasty surgery

Lecture 42 - 3D printing of cranium models mediated bone flaps for patient-specific Cranioplasty surgery

Lecture 43 - 3D printing of Ceramic Dental implants

Lecture 44 - 3D printing of Ceramic Dental implants

Lecture 45 - Emerging topics in AM - Introduction to artificial intelligence and machine learning

Lecture 46 - Emerging topics in AM - Introduction to artificial intelligence and machine learning

Lecture 47 - Emerging topics in AM - Introduction to artificial intelligence and machine learning

Lecture 48 - Scientific case study - DED of SS316L melt pool prediction using machine learning

Lecture 49 - Scientific case study - AI/ML for regression and Classification analysis in DED 3D printing

Lecture 50 - Challenges and opportunities in Additive Manufacturing

Lecture 51 - Challenges and opportunities in Additive Manufacturing

Lecture 52 - Challenges and opportunities in Additive Manufacturing

Lecture 53 - Challenges and opportunities in Additive Manufacturing

Lecture 54 - Challenges and opportunities in Additive Manufacturing

Lecture 55 - Challenges and opportunities in Additive Manufacturing

Lecture 56 - Challenges and opportunities in Additive Manufacturing

Lecture 57 - Emerging opportunity: Bioprinting in Space

Lecture 58 - Emerging opportunity: Bioprinting in Space

Lecture 59 - Summary of key concepts in AM

Lecture 60 - Summary of Emerging topics and challenges in AM