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NPTEL : Heterogeneous Catalysis and Catalytic Processes (Chemical Engineering)

Co-ordinators : Dr. K.K. Pant

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NPTEL : Fluid Mechanics (Chemical Engineering)

Co-ordinators : Dr. V. Shankar

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NPTEL : Mass Transfer II (Chemical Engineering)

Co-ordinators : Prof. Nishith Verma

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NPTEL : Novel Separation Processes (Chemical Engineering)

Co-ordinators : Prof. S. De

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NPTEL : NOC:Metallocene and Metal-Carbene based Organometallic Compounds as Industrially Important Advanced Polyolefin Catalysts (Chemical Engineering)

Co-ordinators : Prof. Sanjib K. Patra

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[Lecture 47 - Forced Convection \(Continued...\)](#)

[Lecture 48 - Forced Convection \(Continued...\)](#)

[Lecture 49 - Forced Convection \(Continued...\)](#)

[Lecture 50 - Forced Convection \(Continued...\)](#)

[Lecture 51 - Internal Forced Convection](#)

[Lecture 52 - Internal Forced Convection \(Continued...\)](#)

[Lecture 53 - Internal Forced Convection \(Continued...\)](#)

[Lecture 54 - Internal Forced Convection \(Continued...\)](#)

[Lecture 55 - Internal Forced Convection \(Continued...\)](#)

[Lecture 56 - Natural Convection](#)

[Lecture 57 - Natural Convection \(Continued...\)](#)

[Lecture 58 - Boiling and Condensation](#)

[Lecture 59 - Radiation](#)

[Lecture 60 - Radiation \(Continued...\)](#)

Lecture 1 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 1

Lecture 2 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 1

Lecture 3 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 1

Lecture 4 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 1

Lecture 5 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 1

Lecture 6 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 2

Lecture 7 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 2

Lecture 8 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 2

Lecture 9 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 2

Lecture 10 - Introduction of Structure-Property-Process Correlation of Polymer, Elastomer and Composite - 2

Lecture 11 - Identification by Chemical Techniques, Implication of National and International Standards alongwith Practical Demonstration

Lecture 12 - Identification by Chemical Techniques, Implication of National and International Standards alongwith Practical Demonstration (Continued...)

Lecture 13 - Identification by Chemical Techniques, Implication of National and International Standards alongwith Practical Demonstration (Continued...)

Lecture 14 - Identification by Chemical Techniques, Implication of National and International Standards alongwith Practical Demonstration (Continued...)

Lecture 15 - Identification by Chemical Techniques, Implication of National and International Standards alongwith Practical Demonstration (Continued...)

Lecture 16 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites

Lecture 17 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites (Continued...)

Lecture 18 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites (Continued...)

Lecture 19 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites (Continued...)

Lecture 20 - Introduction of UV-Vis and infrared spectroscopy for polymers, elastomers and composites (Continued...)

Lecture 21 - Application of infrared spectroscopy for blends, modification of polymers, compatibilizaion, coupling etc.

Lecture 22 - Application of infrared spectroscopy for blends, modification of polymers, compatibilizaion, coupling etc.

Lecture 23 - Application of infrared spectroscopy for blends, modification of polymers, compatibilizaion, coupling etc.

Lecture 24 - Practical demonstration on UV-Visible spectroscopy

Lecture 25 - Practical demonstration on FTIR spectroscopy and Sulphur analyzer

Lecture 26 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy

Lecture 27 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy (Continued...)

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Lecture 28 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy (Continued...)

Lecture 29 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy (Continued...)

Lecture 30 - Introduction to Photoacoustic spectroscopy (PA), Raman spectroscopy, Atomic absorption spectroscopy and Electron spin response (ESR) spectroscopy (Continued...)

Lecture 31 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites

Lecture 32 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites (Continued...)

Lecture 33 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites (Continued...)

Lecture 34 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites (Continued...)

Lecture 35 - NMR Spectroscopy- principles and fundamentals. Application of NMR in polymer, elastomer and composites (Continued...)

Lecture 36 - Thermal analysis techniques and application in polymer, elastomer and composites

Lecture 37 - Thermal analysis techniques and application in polymer, elastomer and composites (Continued...)

Lecture 38 - Thermal analysis techniques and application in polymer, elastomer and composites (Continued...)

Lecture 39 - Practical demonstration on TGA, DSC and DMA

Lecture 40 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites

Lecture 41 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites (Continued...)

Lecture 42 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites (Continued...)

Lecture 43 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites (Continued...)

Lecture 44 - XRD, XPS and XRF. Principles, Fundamentals and Application in Polymer, Elastomer and Composites (Continued...)

Lecture 45 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM)

Lecture 46 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM) (Continued...)

Lecture 47 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM) (Continued...)

Lecture 48 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM) (Continued...)

Lecture 49 - Introduction to microscopy (Optical, AFM) with special reference to electron microscopy (SEM, FESEM and HRTEM) (Continued...)

Lecture 50 - Applications of microscopy in polymers, elastomers and composites

Lecture 51 - Applications of microscopy in polymers, elastomers and composites (Continued...)

Lecture 52 - Practical demonstration on optical microscopy

Lecture 53 - Practical demonstration on atomic force microscopy (AFM)

Lecture 54 - Practical demonstration on image processing using standard software (Image)

Lecture 55 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances

Lecture 56 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances (Continued...)

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[Lecture 57 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances \(Continued...\)](#)

[Lecture 58 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances \(Continued...\)](#)

[Lecture 59 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances \(Continued...\)](#)

[Lecture 60 - Chromatography, DETA, Quantification from Rate Dependent Methods, Reverse Engineering and Recent Advances \(Continued...\)](#)

Lecture 1 - Motivation for the Lab Course

Lecture 2 - Analysis of the Need of Computers in Process Industries

Lecture 3 - Analysis of the Need of Computers in Process Industries (Continued...)

Lecture 4 - Discussion on Computational Tools available to Chemical Engineers

Lecture 5 - Analysis and Comparison of different Programming Languages

Lecture 6 - MATLAB Primer - Basic Features

Lecture 7 - MATLAB Primer - Writing Codes

Lecture 8 - MATLAB Primer - Coding (Continued...)

Lecture 9 - MATLAB Primer - Coding (Continued...)

Lecture 10 - MATLAB Primer - Plotting and Presentation of Results

Lecture 11 - LAB 1 - Analysis of Frictional Losses in Pipe Flows Problem Definition and Analysis

Lecture 12 - LAB 1 - Analysis of Frictional Losses in Pipe Flows Theory and Solution Strategy

Lecture 13 - LAB 1 - Analysis of Frictional Losses in Pipe Flows Solution of the Problem under ...

Lecture 14 - LAB 1 - Analysis of Frictional Losses in Pipe Flows Solution of the Problem under ...

Lecture 15 - LAB 1 - Analysis of Frictional Losses in Pipe Flows Presentation and Interpretation ...

Lecture 16 - LAB 2 - Steady-state Operation of a Diabatic CSTR Problem Definition and Analysis

Lecture 17 - LAB 2 - Steady-state Operation of a Diabatic CSTR Theory and Solution Strategy

Lecture 18 - LAB 2 - Steady-state Operation of a Diabatic CSTR Solution of the Problem under ...

Lecture 19 - LAB 2 - Steady-state Operation of a Diabatic CSTR Solution of the Problem under ...

Lecture 20 - LAB 2 - Steady-state Operation of a Diabatic CSTR Analysis and Presentation ...

Lecture 21 - LAB 3 - Analysis of multicomponent distillation Problem definition and analysis

Lecture 22 - LAB 3 - Analysis of Multicomponent Distillation Theory and Solution Strategy

Lecture 23 - LAB 3 - Analysis of Multicomponent Distillation Solution of the Problem under Various ...

Lecture 24 - LAB 3 - Analysis of Multicomponent Distillation Solution of the Problem under Various ...

Lecture 25 - LAB 3 - Analysis of Multicomponent Distillation Presentation and Analysis of Results

Lecture 26 - LAB 4 - Analysis of Cooling of a Solid Body in a Reservoir Problem Definition ...

Lecture 27 - LAB 4 - Analysis of Cooling of a Solid Body in a Reservoir Theory and Solution ...

Lecture 28 - LAB 4 - Analysis of Cooling of a Solid Body in a Reservoir Solution of the Problem ...

Lecture 29 - LAB 4 - Analysis of Cooling of a Solid Body in a Reservoir Solution of the Problem ...

Lecture 30 - LAB 4 - Analysis of cooling of a solid body in a reservoir Presentation ...

Lecture 31 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Problem Definition ...

- Lecture 32 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Theory and Solution ...
- Lecture 33 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Solution of the Problem
- Lecture 34 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Solution of the problem
- Lecture 35 - LAB 5 - Analysis of unsteady-state operation of cascade CSTR's Presentation ...
- Lecture 36 - LAB 6 - Analysis of Steady-state Heat Conduction in a 1-D rod
- Lecture 37 - LAB 6 - Analysis of Steady-state Heat Conduction in a 1-D rod
- Lecture 38 - LAB 6 - Analysis of steady-state Heat Conduction in a 1-D rod
- Lecture 39 - LAB 6 - Analysis of steady-state Heat Conduction in a 1-D rod
- Lecture 40 - LAB 6 - Analysis of steady-state Heat Conduction in a 1-D rod
- Lecture 41 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Problem definition and ...
- Lecture 42 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Theory and solution strategy
- Lecture 43 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Solution of the problem ...
- Lecture 44 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Solution of the problem ...
- Lecture 45 - LAB 7 - Reaction-diffusion in a spherical catalyst pallet Analysis and interpretation ...
- Lecture 46 - LAB 8 - Heat conduction in higher dimensions Problem definition and analysis
- Lecture 47 - LAB 8 - Heat conduction in higher dimensions Background theory and solution strategy
- Lecture 48 - LAB 8 - Heat conduction in higher dimensions Problem solution
- Lecture 49 - LAB 8 - Heat conduction in higher dimensions Problem solution (Continued...)
- Lecture 50 - LAB 8 - Heat conduction in higher dimensions Problem solution and analysis
- Lecture 51 - LAB 9 - Process economics and optimisation Problem definition and analysis
- Lecture 52 - LAB 9 - Process economics and optimisation Theory and solution strategy
- Lecture 53 - LAB 9 - Process economics and optimisation Solution of the problem
- Lecture 54 - LAB 9 - Process economics and optimisation Solution of the problem (Continued...)
- Lecture 55 - LAB 9 - Process economics and optimisation Solution of the problem and analysis of ...
- Lecture 56 - LAB 10 - Regression and curve - fitting of data Problem definition and analysis
- Lecture 57 - LAB 10 - Regression and curve - fitting of data Background theory and solution strategy
- Lecture 58 - LAB 10 - Regression and curve - fitting of data Problem solution
- Lecture 59 - LAB 10 - Regression and curve - fitting of data Problem solution (Continued...)
- Lecture 60 - Review of the course

Lecture 1 - What is Petroleum How it is stored under the earth Exploration of petroleum underground

Lecture 2 - Concept of Seismic Reflection, Introduction to Drilling

Lecture 3 - Drilling Mud and Mechanisms of Recovery of Petroleum

Lecture 4 - Composition of Crude Petroleum and Evaluation of Oil Stocks

Lecture 5 - Evaluation of Oil Stocks: Vaporization Characteristics

Lecture 6 - Primary Processing of Crude Oil: Desalting

Lecture 7 - Primary Processing of Crude Oil: Atmospheric Distillation Unit (ADU)

Lecture 8 - Primary Processing of Crude Oil: Reflux Systems, Vacuum Distillation Unit (VDU)

Lecture 9 - Products and Process Utilities in Primary Processing, Pipe Still Heater

Lecture 10 - Refinery Units

Lecture 11 - Secondary Processing: Decomposition of Residues: Thermal Cracking

Lecture 12 - Coking, Gasification and Steam Cracking

Lecture 13 - Secondary Processing: Decomposition of Residues: Hydrocracking

Lecture 14 - Secondary Processing: Decomposition of Residues: Catalytic Cracking

Lecture 15 - Secondary Processing: Decomposition of Residues: Process description of FCC

Lecture 16 - Properties and Testing of Petroleum Products

Lecture 17 - Properties and Testing of Petroleum Products (Continued...)

Lecture 18 - Properties and Testing of Petroleum Products (Continued...)

Lecture 19 - Properties and Testing of Petroleum Products (Continued...)

Lecture 20 - Properties and Testing of Petroleum Products (Continued...)

Lecture 21 - Petroleum fractions from distillation units

Lecture 22 - Petroleum fractions from distillation units (Continued...)

Lecture 23 - Petroleum fractions from distillation units (Continued...)

Lecture 24 - Petroleum fractions from distillation units (Continued...)

Lecture 25 - Petroleum fractions from distillation units (Continued...)

Lecture 26 - Upgradation of straight run cuts from atmospheric distillation unit

Lecture 27 - Upgradation of straight run cuts from atmospheric distillation unit (Continued...)

Lecture 28 - Upgradation of straight run cuts from atmospheric distillation unit (Continued...)

Lecture 29 - Upgradation of straight run cuts from atmospheric distillation unit (Continued...)

Lecture 30 - Upgradation of straight run cuts from distillation unit

Lecture 31 - Purification processes

[Lecture 32 - Purification processes \(Continued...\)](#)

[Lecture 33 - Bitumen preparation processes](#)

[Lecture 34 - Grease: preparation, description and application](#)

[Lecture 35 - Emission control and effluent treatment in refinery](#)

[Lecture 36 - Fundamentals of thermochemistry: Combustion](#)

[Lecture 37 - Fundamentals of thermochemistry: Flame](#)

[Lecture 38 - Fundamentals of thermochemistry: Adiabatic flame temperature](#)

[Lecture 39 - Fundamentals of thermochemistry: Burner](#)

[Lecture 40 - Fundamentals of thermochemistry: Internal Combustion engine](#)

Lecture 1 - Basic Introduction to Polymer

Lecture 2 - Structure Process Correlation

Lecture 3 - Basic Rheology

Lecture 4 - Classification of Fluids

Lecture 5 - Flow of Liquids Through Various Channels - 1

Lecture 6 - Flow of Liquids Through Various Channels - 2

Lecture 7 - Flow of Liquids Through Various Channels - 3

Lecture 8 - Introduction to Viscometers and Rheometers

Lecture 9 - Ostwald Viscometer, Brookfield Viscometer, Falling Piston Viscometers

Lecture 10 - ODR, MDR, RPA, PPR

Lecture 11 - DMA -In-Light of rheology

Lecture 12 - Master Curve and its Implications

Lecture 13 - Capillary Rheometer

Lecture 14 - Introduction to Paints and importance of rheology in paints

Lecture 15 - Rheology of paints - 1

Lecture 16 - Rheology of paints - 2

Lecture 17 - Rheology of Adhesives and Sealants

Lecture 18 - Rheology of Fiber and Plastics

Lecture 19 - Practical demonstration on Brookfield viscometer and Oswald viscometer

Lecture 20 - Practical demonstration on Mooney viscometer, ODR and MDR

Lecture 21 - Practical demonstration on RPA

Lecture 22 - Practical demonstration on PPR and DMA

Lecture 23 - Practical demonstration on Capillary Rheometer

Lecture 24 - Numerical Problems related to basic rheology

Lecture 25 - Importance of compounding and introduction to various compounding ingredients

Lecture 26 - Properties and role of various compounding ingredients

Lecture 27 - Surface treatment of reinforcing elements

Lecture 28 - Rheology of Elastomers

Lecture 29 - Importance of die swell (correlating with normal force differences)

Lecture 30 - Melt Fracture and other extrudate instabilities

Lecture 31 - Introduction to plastic and rubber mixing and blending

Lecture 32 - Various mixing equipment and their importance

Lecture 33 - Introduction to Two-Roll Mill and Mixing on Two - Roll Mill 1

Lecture 34 - Introduction to Two-Roll Mill and Mixing on Two - Roll Mill 2

Lecture 35 - Introduction to Internal mixture Kneaders and Mixing using Internal mixture and Kneaders

Lecture 36 - Practical demonstration of Rubber mixing on a two roll and using an internal mixer

Lecture 37 - Molding Techniques

Lecture 38 - Calendering

Lecture 39 - Extrusion

Lecture 40 - Rheology of Injection moulding process

Lecture 41 - Plastic and fiber-related processing

Lecture 42 - Numerical problems related to various processing techniques

Lecture 43 - Wire coating, Garvey die, Profile Extrusion

Lecture 44 - Introduction to FEA based computationalfluid mechanics on extrusion - 1

Lecture 45 - Introduction to FEA based computationalfluid mechanics on extrusion - 2

Lecture 46 - Introduction to FEA based computationalfluid mechanics on extrusion - 3

Lecture 47 - Practical demonstartion on FEA

Lecture 48 - Concluding remarks and commentson applied rheology for advanced learners

[Lecture 1 - Petroleum Formation Evaluation](#)

[Lecture 2 - Mud Logging](#)

[Lecture 3 - Mud Logging \(Continued...\)](#)

[Lecture 4 - Coring Operations](#)

[Lecture 5 - Coring Operations \(Continued...\)](#)

[Lecture 6 - Wireline Logging](#)

[Lecture 7 - Resistivity Log](#)

[Lecture 8 - Resistivity Log \(Continued...\)](#)

[Lecture 9 - Resistivity Log \(Continued...\)](#)

[Lecture 10 - Resistivity Log \(Continued...\)](#)

[Lecture 11 - Resistivity Log \(Continued...\)](#)

[Lecture 12 - Resistivity Log \(Continued...\)](#)

[Lecture 13 - Resistivity Log \(Continued...\)](#)

[Lecture 14 - Resistivity Log \(Continued...\)](#)

[Lecture 15 - Resistivity Log \(Continued...\)](#)

[Lecture 16 - Spontaneous Potential Log](#)

[Lecture 17 - Spontaneous Potential Log \(Continued...\)](#)

[Lecture 18 - Petrophysical Model](#)

[Lecture 19 - Petrophysical Model \(Continued...\)](#)

[Lecture 20 - Gamma Ray Log](#)

[Lecture 21 - Gamma Ray Log \(Continued...\)](#)

[Lecture 22 - Gamma Ray Log \(Continued...\)](#)

[Lecture 23 - Caliper Log](#)

[Lecture 24 - Porosity Logs](#)

[Lecture 25 - Density Porosity Log](#)

[Lecture 26 - Density Porosity Log \(Continued...\)](#)

[Lecture 27 - Density Porosity Log \(Continued...\)](#)

[Lecture 28 - Density Porosity Log \(Continued...\)](#)

[Lecture 29 - Density Porosity Log \(Continued...\)](#)

[Lecture 30 - Neutron Porosity Log](#)

[Lecture 31 - Neutron Porosity Log \(Continued...\)](#)

- [Lecture 32 - Neutron Porosity Log \(Continued...\)](#)
- [Lecture 33 - Neutron Porosity Log \(Continued...\)](#)
- [Lecture 34 - Neutron Porosity Log \(Continued...\)](#)
- [Lecture 35 - Sonic \(Acoustic\) Porosity Log](#)
- [Lecture 36 - Sonic Porosity Log \(Continued...\)](#)
- [Lecture 37 - Sonic Porosity Log \(Continued...\)](#)
- [Lecture 38 - Sonic Porosity Log \(Continued...\)](#)
- [Lecture 39 - Sonic Porosity Log \(Continued...\)](#)
- [Lecture 40 - NMR Log](#)
- [Lecture 41 - NMR Log \(Continued...\)](#)
- [Lecture 42 - Well Log interpretation](#)
- [Lecture 43 - Well Log interpretation \(Continued...\)](#)
- [Lecture 44 - Well Log interpretation \(Continued...\)](#)
- [Lecture 45 - Well Log interpretation \(Continued...\)](#)
- [Lecture 46 - Well Log Interpretation \(Continued...\)](#)
- [Lecture 47 - Well Log Interpretation \(Continued...\)](#)
- [Lecture 48 - Well Log Interpretation \(Continued...\)](#)
- [Lecture 49 - Well Log Interpretation \(Continued...\)](#)
- [Lecture 50 - Well Log Interpretation \(Continued...\)](#)
- [Lecture 51 - Formation Evaluation \(well log analysis\) Practical](#)
- [Lecture 52 - Formation tops and Core Data](#)
- [Lecture 53 - Formation Temperature and Shaliness](#)
- [Lecture 54 - Formation porosity and Water Saturation](#)
- [Lecture 55 - Permeability and Effective Porosity](#)
- [Lecture 56 - Determination of Archie Equation Parameters](#)
- [Lecture 57 - Lithology Determination](#)
- [Lecture 58 - Net Pay and Well Diagram](#)
- [Lecture 59 - Rock Typing](#)
- [Lecture 60 - Miscellaneous Topics](#)

Lecture 1 - Thermodynamics and the Chemical Industry

Lecture 2 - James Prescott Joule and the first law

Lecture 3 - Sadi Carnot and the second law

Lecture 4 - Equilibrium and Extrema in work

Lecture 5 - Illustrative Calculations - I

Lecture 6 - Properties of pure substances

Lecture 7 - The p-h chart

Lecture 8 - Work calculation

Lecture 9 - Illustrative Calculations - II

Lecture 10 - Heat-Work Interconversion Devices

Lecture 11 - Refrigeration / Thermodynamics of mixtures

Lecture 12 - The Gibbs Duhem equation

Lecture 13 - Models for Excess Gibbs Free Energy

Lecture 14 - Van Laar model

Lecture 15 - Gaseous and liquid mixtures

Lecture 16 - Separation Work / Equations of state

Lecture 17 - Chemical potentials in gas and condensed phases

Lecture 18 - Vapour Liquid Equilibria - I

Lecture 19 - Vapour Liquid Equilibria - II

Lecture 20 - Solvent-Solvent mixtures

Lecture 21 - Solvent-Solute mixtures

Lecture 22 - Liquid-liquid equilibria

Lecture 23 - An industrial example

Lecture 24 - Liquid-liquid equilibria / Reaction Equilibria

Lecture 25 - Reaction Equilibria

Lecture 26 - Illustrative Examples - I

Lecture 27 - Illustrative Examples - II

Lecture 28 - Illustrative Examples - III

Lecture 29 - Simultaneous Relations

Lecture 30 - Thermodynamic Consistency / Reverse Osmosis

Lecture 31 - Miscellaneous topics in phase equilibria

[Lecture 32 - Absorption Refrigeration](#)

[Lecture 33 - Summary of Classical Thermodynamics](#)

[Lecture 34 - Molecular basis of Thermodynamics - I](#)

[Lecture 35 - Molecular basis of Thermodynamics - II](#)

Lecture 1 - Motivation for CFD and Introduction to the CFD approach

Lecture 2 - Illustration of the CFD approach through a worked out example

Lecture 3 - Eulerian approach, Conservation Equation, Derivation of Mass Conservation Equation and Statement of the momentum conservation equation

Lecture 4 - Forces acting on a control volume; Stress tensor; Derivation of the momentum conservation equation ; Closure problem; Deformation of a fluid element in fluid flow

Lecture 5 - Kinematics of deformation in fluid flow; Stress vs strain rate relation; Derivation of the Navier-Stokes equations

Lecture 6 - Equations governing flow of incompressible flow; Initial and boundary conditions; Wellposedness of a fluid flow problem

Lecture 7 - Equations for some simple cases; Generic scalar transport equation form of the governing equations; Outline of the approach to the solution of the N-S equations.

Lecture 8 - cut out the first 30s; Spatial discretization of a simple flow domain; Taylor's series expansion and the basis of finite difference approximation of a derivative; Central and one-sided difference approximations; Order of accuracy of finite difference ap

Lecture 9 - Finite difference approximation of pth order of accuracy for qth order derivative; cross -derivatives; Examples of high order accurate formulae for several derivatives

Lecture 10 - One -sided high order accurate approximations; Explicit and implicit formulations for the time derivatives

Lecture 11 - Numerical solution of the unsteady advection equation using different finite difference approximations

Lecture 12 - Need for analysis of a discretization scheme; Concepts of consistency, stability and convergence and the equivalence theorem of Lax ; Analysis for consistency

Lecture 13 - Statement of the stability problem; von Neumann stability analysis of the first order wave equation

Lecture 14 - Consistency and stability analysis of the unsteady diffusion equation; Analysis for two- and three -dimensional cases; Stability of implicit schemes

Lecture 15 - Interpretation of the stability condition; Stability analysis of the generic scalar equation and the concept of upwinding ; Diffusive and dissipative errors in numerical solution; Introduction to the concept of TVD schemes

Lecture 16 - Template for the generic scalar transport equation and its extension to the solution of Navier-Stokes equations for a compressible flow.

Lecture 17 - Illustration of application of the template using the MacCormack scheme for a three-dimensional compressible flow

Lecture 18 - Stability limits of MacCormack scheme; Limitations in extending compressible flow schemes to incompressible flows ; Difficulty of evaluation of pressure in incompressible flows and listing of various approaches

Lecture 19 - Artificial compressibility method and the streamfunction-vorticity method for the solution of NS equations and their limitations

Lecture 20 - Pressure equation method for the solution of NS equations

Lecture 21 - Pressure-correction approach to the solution of NS equations on a staggered grid; SIMPLE and its family of methods

Lecture 22 - Need for efficient solution of linear algebraic equations; Classification of approaches for the solution of linear algebraic equations.

Lecture 23 - Direct methods for linear algebraic equations; Gaussian elimination method

Lecture 24 - Gauss-Jordan method; LU decomposition method; TDMA and Thomas algorithm

Lecture 25 - Basic iterative methods for linear algebraic equations: Description of point -Jacobi, Gauss-Seidel and SOR methods

Lecture 26 - Convergence analysis of basic iterative schemes; Diagonal dominance condition for convergence; Influence of source terms on the diagonal dominance condition; Rate of convergence

Lecture 27 - Application to the Laplace equation

Lecture 28 - Advanced iterative methods: Alternating Direction Implicit Method; Operator splitting

Lecture 29 - Advanced iterative methods; Strongly Implicit Procedure; Conjugate gradient method; Multigrid method

Lecture 30 - Illustration of the Multigrid method for the Laplace equation

Lecture 31 - Overview of the approach of numerical solution of NS equations for simple domains; Introduction to complexity arising from physics and geometry

Lecture 32 - Derivation of the energy conservation equation

Lecture 33 - Derivation of the species conservation equation; dealing with chemical reactions

Lecture 34 - Turbulence; Characteristics of turbulent flow; Dealing with fluctuations and the concept of time-averaging

Lecture 35 - Derivation of the Reynolds -averaged Navier -Stokes equations; identification of the closure problem of turbulence; Boussinesq hypothesis and eddy viscosity

Lecture 36 - Reynolds stresses in turbulent flow; Time and length scales of turbulence; Energy cascade; Mixing length model for eddy viscosity

Lecture 37 - One-equation model for turbulent flow

Lecture 38 - Two -equation model for turbulent flow; Numerical calculation of turbulent reacting flows

Lecture 39 - Calculation of near-wall region in turbulent flow; wall function approach; near-wall turbulence models

Lecture 40 - Need for special methods for dealing with irregular flow geometry; Outline of the Body-fitted grid approach ; Coordinate transformation to a general, 3-D curvilinear system

Lecture 41 - Transformation of the governing equations; Illustration for the Laplace equation; Appearance and significance of cross - derivative terms; Concepts of structured and unstructured grids.

Lecture 42 - Finite volume method for complicated flow domain; Illustration for the case of flow through a duct of triangular cross - section.

Lecture 43 - Finite volume method for the general case

Lecture 44 - Generation of a structured grid for irregular flow domain; Algebraic methods; Elliptic grid generation method

Lecture 45 - Unstructured grid generation; Domain nodalization; Advancing front method for triangulation

Lecture 46 - Delaunay triangulation method for unstructured grid generation

Lecture 47 - Co -located grid approach for irregular geometries; Pressure correction equation for a co -located structured grid; Pressure correction equation for a co-located unstructured grid.

Lecture 1 - Introduction

Lecture 2 - Computational and Error Analysis

Lecture 3 - Linear Equations - Part 1

Lecture 4 - Linear Equations - Part 2

Lecture 5 - Linear Equations - Part 3

Lecture 6 - Linear Equations - Part 4

Lecture 7 - Linear Equations - Part 5

Lecture 8 - Linear Equations - Part 6

Lecture 9 - Non Linear Algebraic Equations - Part 1

Lecture 10 - Non Linear Algebraic Equations - Part 2

Lecture 11 - Non Linear Algebraic Equations - Part 3

Lecture 12 - Non Linear Algebraic Equations - Part 4

Lecture 13 - Non Linear Algebraic Equations - Part 5

Lecture 14 - Non Linear Algebraic Equations - Part 6

Lecture 15 - Regression and Interpolation - Part 1

Lecture 16 - Regression and Interpolation - Part 2

Lecture 17 - Regression and Interpolation - Part 3

Lecture 18 - Regression and Interpolation - Part 4

Lecture 19 - Regression and Interpolation - Part 5

Lecture 20 - Differentiation and Integration - Part 1

Lecture 21 - Differentiation and Integration - Part 2

Lecture 22 - Differentiation and Integration - Part 3

Lecture 23 - Differentiation and Integration - Part 4

Lecture 24 - Differentiation and Integration - Part 5

Lecture 25 - Ordinary Differential Equations (initial value problems) - Part 1

Lecture 26 - Ordinary Differential Equations (initial value problems) - Part 2

Lecture 27 - Ordinary Differential Equations (initial value problems) - Part 3

Lecture 28 - Ordinary Differential Equations (initial value problems) - Part 4

Lecture 29 - Ordinary Differential Equations (initial value problems) - Part 5

Lecture 30 - Ordinary Differential Equations (initial value problems) - Part 6

Lecture 31 - Ordinary Differential Equations (initial value problems) - Part 7

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- Lecture 1 - Introduction: Why study particle characterization?
- Lecture 2 - Introduction: Classification of particle characteristics
- Lecture 3 - Morphological Characterization: Shape analysis methods
- Lecture 4 - Morphological Characterization: Techniques of shape assessment
- Lecture 5 - Morphological Characterization: Decision rules
- Lecture 6 - Morphological Characterization: Static vs dynamic methods of size analysis
- Lecture 7 - Morphological Characterization: Static methods of size analysis
- Lecture 8 - Morphological Characterization: Light scattering from spherical particles
- Lecture 9 - Morphological Characterization: Particle counters
- Lecture 10 - Morphological Characterization: Particle size distributions
- Lecture 11 - Morphological Characterization: Acoustic Attenuation Spectroscopy
- Lecture 12 - Morphological Characterization: Nano-particle size analysis
- Lecture 13 - Structural Characterization
- Lecture 14 - Interfacial Characterization
- Lecture 15 - Surface Adhesion: Forces
- Lecture 16 - Surface Adhesion: Electrostatic & Surface-Tension Forces
- Lecture 17 - Surface Adhesion: Adhesion Force Measurement
- Lecture 18 - Particle Removal: Methods
- Lecture 19 - Particle Removal: Wet Cleaning
- Lecture 20 - Particle Cohesion: Forces
- Lecture 21 - Particle Cohesion: Flowability Implications
- Lecture 22 - Transport Properties: Diffusion & Electrostatic Field Effects
- Lecture 23 - Transport Properties: Drag & Inertia
- Lecture 24 - Transport Properties: Deposition Fluxes & Rates
- Lecture 25 - Transport Properties: Illustrative Application
- Lecture 26 - Chemical & Compositional Characterization: Reactivity
- Lecture 27 - Chemical & Compositional Characterization: Analytical Methods
- Lecture 28 - Chemical & Compositional Characterization: XRD & AFM
- Lecture 29 - Nano-particle Characterization: Bottom-Up Synthesis Methods
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Lecture 6 - Normal probability distribution

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Lecture 8 - Exploratory Data Analysis - Part B

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Lecture 10 - Example Set - III

Lecture 11 - Random samples: Sampling distribution of the mean (Part A)

Lecture 12 - Random samples: Sampling distribution of the mean (Part B)

Lecture 13 - Point Estimation

Lecture 14 - Sampling distributions and the Central Limit Theorem

Lecture 15 - Example Set - IV Part A

Lecture 16 - Estimation of Population Parameters Using Moments

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Lecture 19 - The T-distribution

Lecture 20 - Chi-square distribution

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Lecture 26 - Analysis of Experiments involving Single Factor - Part A

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[Lecture 52 - Optimal Designs - Part A](#)

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Lecture 2 - Stratified flow in a micro channel: Velocity profiles

Lecture 3 - Stratified flow in a micro channel: Effects of physical parameters

Lecture 4 - Flow regimes in microchannels: Modeling and Experiments

Lecture 5 - Scaling Analysis: Introduction

Lecture 6 - Scaling Analysis: Worked Examples

Lecture 7 - Interfacial tension and its role in Multiphase flows

Lecture 8 - Eulerian and Lagrangian approaches

Lecture 9 - Reynolds Transport Theorem and the Equation of Continuity

Lecture 10 - Derivation of Navier-Stokes equation

Lecture 11 - Vector operations in general orthogonal coordinates: Grad., Div., Lapacian

Lecture 12 - Normal and shear stresses on arbitrary surfaces: Force balance

Lecture 13 - Normal and shear stresses on arbitrary surfaces: Stress Tensor formulation

Lecture 14 - Stresses on deforming surfaces: Introduction to Perturbation Theory

Lecture 15 - Pulsatile flow: Analytical solution

Lecture 16 - Pulsatile flow: Analytical solution and perturbation solution for $Rw \ll 1$

Lecture 17 - Pulsatile flow: Perturbation solution for $Rw \ll 1$

Lecture 18 - Viscous heating: Apparent viscosity in a viscometer

Lecture 19 - Domain perturbation methods: Flow between wavy walls

Lecture 20 - Flow between wavy walls: Velocity profile

Lecture 21 - Introduction to stability of dynamical systems: ODEs

Lecture 22 - Stability of distributed systems (PDEs): reaction diffusion example

Lecture 23 - Stability of a reaction-diffusion system (Continued...)

Lecture 24 - Rayleigh-Benard convection: Physics and governing equations

Lecture 25 - Rayleigh-Benard convection: Linear stability analysis - Part 1

Lecture 26 - Rayleigh-Benard convection: Linear stability analysis - Part 2

Lecture 27 - Rayleigh-Benard convection: Linear stability analysis - Part 3

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Lecture 31 - Capillary jet instability: Problem formulation

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[Lecture 39 - Flow in a circular curved channel: Governing equations and scaling](#)

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[Lecture 41 - Stability of flow through curved channels: Problem formulation](#)

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[Lecture 43 - Viscous Fingering: Darcy's law](#)

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[Lecture 45 - Shallow Cavity flows](#)

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Lecture 2 - Introduction - Lecture 1.1 B

Lecture 3 - Introduction - Lecture 1.2 A

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Lecture 5 - Basic Definitions and concepts - Lecture 2.1 (Basic Definitions and concepts - Part I)

Lecture 6 - Basic Definitions and concepts - Lecture 2.2 (Basic Definitions and concepts - Part II)

Lecture 7 - Basic Definitions and concepts - Lecture 2.3 (Basic Definitions and concepts - Part III)

Lecture 8 - A review of Fourier transforms - Lecture 3.1 (Continuous time Fourier series)

Lecture 9 - A review of Fourier transforms - Lecture 3.2 (Continuous time Fourier transform)

Lecture 10 - A review of Fourier transforms - Lecture 3.3 (Discrete time Fourier series)

Lecture 11 - A review of Fourier transforms - Lecture 3.4 (Discrete time Fourier transform)

Lecture 12 - A review of Fourier transforms - Lecture 3.5 (Properties of Fourier transforms)

Lecture 13 - A review of Fourier transforms - Lecture 3.6 (Discrete Fourier transform)

Lecture 14 - A review of Fourier transforms - MATLAB demo of Fourier transform and periodogram

Lecture 15 - Duration and Bandwidth - Duration and Bandwidth

Lecture 16 - Duration and Bandwidth - Bandwidth equation and Instantaneous frequency

Lecture 17 - Duration and Bandwidth - Instantaneous frequency and analytic signals

Lecture 18 - Duration and Bandwidth - Duration-Bandwidth principle

Lecture 19 - Duration and Bandwidth - Requirements of time-frequency analysis techniques

Lecture 20 - Duration and Bandwidth - Requirements of time-frequency analysis and techniques

Lecture 21 - Short-time Fourier transform - Short-time Fourier transform

Lecture 22 - Short-time Fourier transform - Auxillary (MATLAB demonstration)

Lecture 23 - Short-time Fourier transform - Properties of STFT

Lecture 24 - Practical aspects of STFT

Lecture 25 - Closing Remarks

Lecture 26 - Wigner-Ville Distributions

Lecture 27 - Properties of WVD

Lecture 28 - Properties of WVD 2

Lecture 29 - Discrete WVD

Lecture 30 - Pseudo and Smoothed WVD

Lecture 31 - Cohens class and smoothed WVD

- Lecture 32 - Cohens class and smoothed WVD
- Lecture 33 - Cohens class and Ambiguity functions
- Lecture 34 - Affine class and closing remarks
- Lecture 35 - Continuous Wavelet Transform
- Lecture 36 - Continuous Wavelet Transforms
- Lecture 37 - Scale to Frequency
- Lecture 38 - Computational aspects of CWT
- Lecture 39 - Scalogram and MATLAB demonstration
- Lecture 40 - Scalogram and MATLAB demonstration
- Lecture 41 - Scaling function
- Lecture 42 - Scaling Function
- Lecture 43 - Wavelets
- Lecture 44 - Wavelets
- Lecture 45 - Applications of CWT
- Lecture 46 - Applications of CWT
- Lecture 47 - Discrete Wavelet Transform
- Lecture 48 - Discrete Wavelet Transform.
- Lecture 49 - Orthogonal scaling function bases and MRA
- Lecture 50 - Orthogonal scaling function bases and MRA.
- Lecture 51 - Wavelet Filters and Fast DWT Algorithm
- Lecture 52 - Wavelet Filters and Fast DWT Algorithm (Continued...)
- Lecture 53 - Wavelet Filters and Fast DWT Algorithm (Continued...)
- Lecture 54 - Wavelets for DWT
- Lecture 55 - Wavelets for DWT (Continued...)
- Lecture 56 - Wavelets for DWT (Continued...)
- Lecture 57 - DWT computation
- Lecture 58 - DWT computation (Continued...)
- Lecture 59 - DWT computation (Continued...)

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Lecture 2 - CVD Reactor and Process Design Fundamentals

Lecture 3 - Overview of CVD Process Fundamentals

Lecture 4 - Basics of Chemical Equilibrium Calculations and Flow Dynamics

Lecture 5 - Introduction to CVD Films

Lecture 6 - Film Structure and Properties

Lecture 7 - Pressure Effects on CVD Processes

Lecture 8 - CVD of Metals

Lecture 9 - CVD of Coatings

Lecture 10 - CVD Film Property Measurements

Lecture 11 - CVD Film Property Measurements: Qualitative and Quantitative

Lecture 12 - CVD in Tungsten Filament Lamps

Lecture 13 - CVD in Tungsten Filament Lamps: Design Aspects

Lecture 14 - CVD in Hot Corrosion

Lecture 15 - CVD Transport Phenomena: Conservation Equations

Lecture 16 - CVD Transport Phenomena: Constitutive Laws

Lecture 17 - CVD Transport Phenomena: Mass Transfer Mechanisms

Lecture 18 - CVD Transport Phenomena: Mass Transfer Analogy Condition (MTAC)

Lecture 19 - CVD Transport Phenomena: Effect of Homogeneous Reactions on MTAC

Lecture 20 - CVD Applications: Hot Filament CVD (HFCVD)

Lecture 21 - CVD Applications: Aerosol CVD (ACVD)

Lecture 22 - CVD Applications: CVD of Silicon

Lecture 23 - CVD Applications: CVD in Free-Molecular Flow Regime (FMFR)

Lecture 24 - CVD Applications: CVD of nano-Structured Films

Lecture 25 - CVD Overview

Lecture 26 - Review of CVD Basics: Part-I (PDF Lecture)

Lecture 27 - Review of CVD Basics: Part-II (PDF Lecture)

Lecture 28 - CVD Question Bank (PDF Lecture)

Lecture 29 - Basics of Nano-Structured Material Synthesis: Part-I

Lecture 30 - Basics of Nano-Structured Material Synthesis: Part-II

Lecture 31 - Undesirable CVD: Bulb-Blackening (Adobe Presenter)

[Lecture 32 - Undesirable CVD: Moolten Salt Deposition in Combustion Systems \(Adobe Presenter\)](#)

[Lecture 33 - Undesirable CVD: Hot Corrosion \(Adobe Presenter\)](#)

[Lecture 34 - Multi-component Transport Fundamentals: Assumptions and Control Volumes \(Adobe Presenter\)](#)

[Lecture 35 - Multi-component Transport Fundamentals: Mass Conservation Equations \(Adobe Presenter\)](#)

[Lecture 36 - Multi-component Transport Fundamentals: Momentum and Energy Conservation \(Adobe Presenter\)](#)

[Lecture 37 - Multi-component Transport Fundamentals: Entropy conservation \(Adobe Presenter\)](#)

[Lecture 38 - Multi-component Transport Fundamentals: Constitutive Laws for Mass and Momentum \(Adobe Presenter\)](#)

[Lecture 39 - Multi-component Transport Fundamentals: Constitutive Laws for Energy and Entropy \(Adobe Presenter\)](#)

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- Lecture 2 - Motivation and Introduction - Part II
- Lecture 3 - What is Chemical Engineering - Part I
- Lecture 4 - What is Chemical Engineering - Part II
- Lecture 5 - What is Chemical Reaction Engineering - Part I
- Lecture 6 - What is Chemical Reaction Engineering - Part II
- Lecture 7 - Homogeneous and Heterogeneous Reactions - Part I
- Lecture 8 - Homogeneous and Heterogeneous Reactions - Part II
- Lecture 9 - Basics of Kinetics and Contacting
- Lecture 10 - Design of Batch reactors - Part I
- Lecture 11 - Design of Batch reactors - Part II
- Lecture 12 - Basics of Plug Flow Reactor - Part I
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- Lecture 14 - Design of Plug Flow Reactors - Part I
- Lecture 15 - Design of Plug Flow Reactors - Part II
- Lecture 16 - Basics of Mixed Flow Reactors
- Lecture 17 - Design of Mixed Flow Reactors
- Lecture 18 - Basics of Kinetics
- Lecture 19 - Kinetics of Heterogeneous reactions - Part I
- Lecture 20 - Kinetics of Heterogeneous reactions - Part II
- Lecture 21 - Kinetics of Heterogeneous reactions - Part III
- Lecture 22 - Kinetics of Homogeneous reactions
- Lecture 23 - Reaction rate for Homogeneous reactions
- Lecture 24 - Gas Phase Homogeneous reactions
- Lecture 25 - (Continued...) And later Reactor Design of PFR
- Lecture 26 - Reactor Design for MFR and Combination of reactors
- Lecture 27 - PFR and MFR in series.
- Lecture 28 - Unsteady state MFR and PFR
- Lecture 29 - Recycle Reactors
- Lecture 30 - Recycle Reactors (Autocatalytic reactions) - Part I
- Lecture 31 - Recycle Reactors (Autocatalytic reactions) - Part II

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[Lecture 52 - RTD for various reactors \(Continued...\) Part I](#)

[Lecture 53 - RTD for various reactors \(Continued...\) Part II](#)

[Lecture 54 - Diagnosing the ills of equipments and Various RTD Models](#)

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[Lecture 56 - Dispersion with reaction Model and Tanks in Series Model](#)

[Lecture 57 - Multi-parameter model \(MFR with dead space and bypass\)](#)

[Lecture 58 - Direct use of RTD to predict conversion \(Macro and Micro-fluid as well as Macro & Micro-mixing Concept\) Part I](#)

[Lecture 59 - Direct use of RTD to predict conversion \(Macro and Micro-fluid as well as Macro & Micro-mixing Concept\) Part II](#)

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- Lecture 2 - Intro to Kinetics (Continued...) for catalytic reactions in different reactors
- Lecture 3 - Heterogeneous rate of reactions and different types of kinetic models for non-catalytic reactions
- Lecture 4 - Basics of Kinetics of type A & B reactions (Shrinking core model & Porous particle homogeneous model)
- Lecture 5 - Shrinking Core Model (Continued...)
- Lecture 6 - Shrinking Core Model (Continued...)
- Lecture 7 - (Continued...) & Proof of Pseudo steady state assumption
- Lecture 8 - Shrinking core model (Continued...) for type D reactions
- Lecture 9 - Shrinking core model (Continued...) for type D reactions (Continued...)
- Lecture 10 - Reactors, Homogeneous reaction model, Design of non-catalytic gas solid reactors
- Lecture 11 - Design of non-catalytic gas solid reactors (Continued...)
- Lecture 12 - Design of non-catalytic gas solid reactors (Continued...)
- Lecture 13 - Design equation for MF of solids, uniform gas composition, const. single particle size, Shrinking core model.
- Lecture 14 - Design equation for MF of solids, mixture of particles for different sizes but unchanging size, uniform gas composition, SCM
- Lecture 15 - Design equation for MF of solids with elutriation, mixture of particles of different size, uniform gas composition, SCM
- Lecture 16 - General Performance equation for non-catalytic gas solid reactions
- Lecture 17 - Catalytic reactions (LHHW Kinetic model)
- Lecture 18 - LHHW Kinetic model (Continued...) - Part I
- Lecture 19 - LHHW Kinetic model (Continued...) - Part II
- Lecture 20 - Industrially important catalytic reaction models
- Lecture 21 - Inter and Intraphase effectiveness factor
- Lecture 22 - Interface effectiveness factor & Generalized nonisothermal effectiveness factor for external mass transfer step
- Lecture 23 - Generalized nonisothermal effectiveness factor for external mass transfer step (Continued...)
- Lecture 24 - Mass transfer correlations for various reactors
- Lecture 25 - Isothermal intraphase effectiveness factor - Part I
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- Lecture 27 - Non-isothermal intraphase effectiveness factor
- Lecture 28 - Inter and Intraphase effectiveness factor (Continued...)
- Lecture 29 - Inter and Intraphase Mass transfer
- Lecture 30 - Packed (fixed) bed catalytic reactor design

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[Lecture 41 - Continued... \(Davidson Harrison model and Kunii Levenspiel model\)](#)

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[Lecture 43 - Slurry Reactor Design](#)

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Lecture 2 - Basics of Programming using MATLAB

Lecture 3 - Array Operations in MATLAB

Lecture 4 - Loops and Execution Control

Lecture 5 - Tutorial: Using Arrays

Lecture 6 - MATLAB Files -- Scripts and Functions

Lecture 7 - Plotting and Output

Lecture 8 - How to submit MATLAB Assignment

Lecture 9 - Errors in Numerical Computation

Lecture 10 - Truncation Errors and Taylors Series

Lecture 11 - Round-Off Errors; and Iterative Methods

Lecture 12 - Step-wise Methods and Error Propagation

Lecture 13 - How to get MATLAB Online access (for all enrolled students of this course)

Lecture 14 - Differentiation in Single Variable

Lecture 15 - Higher Order Differentiation Formulae

Lecture 16 - Partial Differentials (Bonus)

Lecture 17 - Numerical Integration

Lecture 18 - Multiple Applications of Integration Formulae

Lecture 19 - In-Build MATLAB Integration Functions

Lecture 20 - Basics of Linear Algebra

Lecture 21 - Gauss Elimination and Back-Substitution

Lecture 22 - LU Decomposition and Partial Pivoting

Lecture 23 - Gauss Siedel Method

Lecture 24 - (Tutorial)

Lecture 25 - Tri-Diagonal Matrix Algorithm

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Lecture 27 - Using MATLAB command fzero

Lecture 28 - Fixed Point Iteration in Single Variable

Lecture 29 - Newton-Raphson (single variable)

Lecture 30 - Using MATLAB command fsolve (multi-variable)

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[Lecture 42 - Stiff Systems & Solution using ode15s](#)

[Lecture 43 - Method of Lines for transient PDEs](#)

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Lecture 1 - Motivation

Lecture 2 - Flow in a rectangular duct: Problem formulation

Lecture 3 - Flow in a rectangular duct: Discretization of flow domain

Lecture 4 - Tutorial 1: Converting PDE to algebraic equation using FD approximation

Lecture 5 - Tutorial 1 (Continued...) Solution for algebraic equations using Gauss-Seidel Method

Lecture 6 - Flow in a triangular duct: Problem formulation

Lecture 7 - Flow in a triangular duct: Discretization of flow domain

Lecture 8 - Tutorial 2: Converting PDE to algebraic equation using Finite Volume method

Lecture 9 - Tutorial 2 (Continued...) Description of FV method and solution using G-S Method

Lecture 10 - Effect of grid spacing & upcoming course outline

Lecture 11 - Mass conservation equations

Lecture 12 - Momentum conservation equations

Lecture 13 - Forces acting on control volume

Lecture 14 - Kinematics of deformation in fluid flow

Lecture 15 - Equations governing fluid flow in incompressible fluid

Lecture 16 - Navier-Stokes equation for simple cases of flow

Lecture 17 - Energy conservation equations

Lecture 18 - Practical cases of fluid flow with heat transfer in CFD point of view

Lecture 19 - Practical cases of fluid flow with mass transfer in CFD point of view

Lecture 20 - Equations governing fluid flow with chemical reactions

Lecture 21 - Concept of wellposedness of mathematical problems

Lecture 22 - Introduction to finite difference methods

Lecture 23 - Finite difference approximation on a uniform mesh

Lecture 24 - Higher order and mixed derivatives

Lecture 25 - Solution of Poisson equation in rectangular duct-Tutorial

Lecture 26 - Discretization of time domain

Lecture 27 - FD approx. on a non-uniform mesh and need of analysis of obtained discretization

Lecture 28 - Need for the analysis of discretized equation

Lecture 29 - Properties of Numerical Schemes: Accuracy, Conservation property, Boundedness, Consistency, Stability and Convergence

Lecture 30 - Properties of Numerical Schemes: Stability analysis

Lecture 31 - Tutorial on Stability Analysis

- Lecture 32 - Analysis of Generic 1-d scalar transport equation
- Lecture 33 - Introduction to the solution of coupled N-S equations
- Lecture 34 - N-S equation in compressible flow- Mac Cormack Scheme
- Lecture 35 - Stability limits of Mac-Cormack Scheme and the intro to Beam-Warming Scheme
- Lecture 36 - Implicit Beam-Warming Scheme
- Lecture 37 - Compressible flow to Incompressible flow
- Lecture 38 - Solution of coupled equations: Incompressible flow
- Lecture 39 - Artificial compressibility method, Stream function-vorticity method
- Lecture 40 - Pressure equation method, Staggered grid system
- Lecture 41 - Pressure Correction Method
- Lecture 42 - Tutorial on Pressure Correction Method
- Lecture 43 - Tutorial on Pressure Correction Method (Continued...)
- Lecture 44 - Introduction to the basic numerical methods
- Lecture 45 - Direct Methods: solution of the system of algebraic equations
- Lecture 46 - Tri-diagonal Matrix Algorithm: Derivation
- Lecture 47 - TDMA and other iterative methods
- Lecture 48 - Recap of basic iterative methods.
- Lecture 49 - Convergence analysis of basic iterative methods
- Lecture 50 - Successive Over Relaxation (SOR) method
- Lecture 51 - Alternating Direction Implicit (ADI) method
- Lecture 52 - Strongly Implicit Procedure (ILU) method
- Lecture 53 - Multigrid method
- Lecture 54 - Body Fitted Grid Approach
- Lecture 55 - Formulation Of Finite Volume Method
- Lecture 56 - Methods For Unstructured Grid Generation
- Lecture 57 - Triangulation: The Advancing Front Method
- Lecture 58 - The Advancing Front Method continuation
- Lecture 59 - Time and length scale of turbulence
- Lecture 60 - The turbulent closure problem
- Lecture 61 - The generic formulation for turbulence
- Lecture 62 - More generic formulation and summary

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Lecture 2 - Probability and statistics: Review - Part 1

Lecture 3 - Probability and Statistics: Review - Part 2

Lecture 4 - R Tutorial 1

Lecture 5 - Statistics for Hypothesis Testing - Part 1

Lecture 6 - Statistics for Hypothesis Testing - Part 2

Lecture 7 - Statistics for sample mean

Lecture 8 - Statistics for Variance and Proportion

Lecture 9 - Type I and Type II errors

Lecture 10 - p value

Lecture 11 - Hypothesis testing of means

Lecture 12 - Hypothesis testing of variance and proportions

Lecture 13 - Confidence interval construction

Lecture 14 - Hypothesis testing using confidence interval

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Lecture 16 - Statistic for linear regression

Lecture 17 - Hypothesis testing in linear regression

Lecture 18 - Power of hypothesis test

Lecture 19 - Factors affecting hypothesis test

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- Lecture 3 - Lecture 2 - Part 1 - Motivation and Overview 3
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- Lecture 5 - Lecture 3 - Part 1 - Motivation and Overview 5
- Lecture 6 - Lecture 3 - Part 2 - Motivation and Overview 6
- Lecture 7 - Lecture 4 - Part 1 - Probability and Statistics Review 1A
- Lecture 8 - Lecture 4 - Part 2 - Probability and Statistics Review 1B
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Co-ordinators : Dr. Arun K.Tangirala

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- Lecture 76 - Stress Strain Rate Relation : Introduction
- Lecture 77 - Newton's Law of Viscosity : 1D Form
- Lecture 78 - Newton's Law of Viscosity : 3D Form
- Lecture 79 - Navier Stokes Equation
- Lecture 80 - Fluid at Rest : Pressure Distribution
- Lecture 81 - Hydrostatic Pressure Distribution in Liquid
- Lecture 82 - Hydrostatic Pressure Distribution in Gas
- Lecture 83 - Fluid in Rigid Body Motion : Pressure Distribution
- Lecture 84 - Flow Regimes : Laminar and Turbulent flow
- Lecture 85 - Euler Equation
- Lecture 86 - Bernoulli Equation : Inviscid Flow
- Lecture 87 - Bernoulli Equation : Example 1
- Lecture 88 - Bernoulli Equation : Irrotational Flow
- Lecture 89 - Bernoulli Equation : Example 2
- Lecture 90 - Planar Couette Flow - Governing Equations
- Lecture 91 - Planar Couette Flow - Velocity and Pressure Distribution
- Lecture 92 - Planar Couette Flow - Shear Force
- Lecture 93 - Planar Poiseuille Flow : Governing Equations
- Lecture 94 - Planar Poiseuille Flow : Velocity and Pressure Distribution
- Lecture 95 - Planar Poiseuille Flow : Shear force
- Lecture 96 - Planar Poiseuille Flow : Shear Stress Distribution
- Lecture 97 - Viscous Stress vs. Molecular Momentum Flux - Part 1

- [Lecture 98 - Viscous Stress vs. Molecular Momentum Flux - Part 2](#)
- [Lecture 99 - Linear Momentum Balance : Fluid Mechanics vs. Momentum Transport - Part 1](#)
- [Lecture 100 - Linear Momentum Balance : Fluid Mechanics vs. Momentum Transport - Part 2](#)
- [Lecture 101 - Viscous Stress vs. Molecular Momentum Flux - Part 3](#)
- [Lecture 102 - Integral Energy Balance - Part 1](#)
- [Lecture 103 - Integral Energy Balance - Part 2](#)
- [Lecture 104 - Simplification of Integral Energy Balance](#)
- [Lecture 105 - Integral Energy Balance : Examples](#)
- [Lecture 106 - Differential Energy Balance : Introduction](#)
- [Lecture 107 - Differential Total Energy Balance - Part 1](#)
- [Lecture 108 - Differential Total Energy Balance - Part 2](#)
- [Lecture 109 - Differential Energy Balance - Part 1](#)
- [Lecture 110 - Differential Energy Balance - Part 2](#)
- [Lecture 111 - Differential Energy Balance - Part 3](#)
- [Lecture 112 - Fourier's Law of Heat Conduction](#)
- [Lecture 113 - Simplifications of Differential Energy Balance](#)
- [Lecture 114 - Heat Conduction in Slab](#)
- [Lecture 115 - Heat Conduction in Furnace Wall](#)
- [Lecture 116 - Non Isothermal Planar Couette Flow](#)

Lecture 1 - Introduction

Lecture 2 - Chemicals of Concern

Lecture 3 - Water Quality Screening Parameters

Lecture 4 - Water Quality Parameters

Lecture 5 - Air quality parameters; Sustainability

Lecture 6 - PM - Particulate Matter

Lecture 7 - Physical/Chemical properties of interest

Lecture 8 - Partition Constants

Lecture 9 - Soil-air partition constants

Lecture 10 - Application/Example of Equilibrium Partitioning

Lecture 11 - Introduction to Environmental Monitoring and Sampling

Lecture 12 - Environmental Sampling

Lecture 13 - Environmental Analysis: Quality Control - Part 1

Lecture 14 - Environmental Analysis: Quality Control - Part 2

Lecture 15 - Environmental Analysis of Organics in Water

Lecture 16 - Environmental Analysis: Quality Control - Part 3

Lecture 17 - Tutorial

Lecture 18 - Tutorial (Continued...)

Lecture 19 - Analysis Methods - Introduction and Water Quality Parameters

Lecture 20 - Analysis Methods - Water Quality Parameters

Lecture 21 - Analysis Methods - Review of Standard Methods

Lecture 22 - Analysis Methods - Organics in water

Lecture 23 - Analysis Methods - Overall Methodology for Organics

Lecture 24 - Analysis Methods - Chromatography Fundamentals

Lecture 25 - Analysis Methods - Gas Chromatography

Lecture 26 - Analysis Methods - Gas Chromatography (Mass Spectrometry)

Lecture 27 - Analysis Methods - Liquid Chromatography

Lecture 28 - Monitoring methods for Air - PM - Part 1

Lecture 29 - Monitoring methods for Air - PM - Part 2

Lecture 30 - Monitoring methods for Air - Vapor - Part 1

Lecture 31 - Monitoring methods for Air - Vapor - Part 2

- [Lecture 32 - Monitoring methods for Air - Vapor - Part 3](#)
- [Lecture 33 - Monitoring and Measurement of Microorganisms](#)
- [Lecture 34 - Transport of Pollutants - Introduction](#)
- [Lecture 35 - Transport of Pollutants - Box Models in Water](#)
- [Lecture 36 - Transport of Pollutants - Box Models in Air](#)
- [Lecture 37 - Transport of Pollutants - Dispersion](#)
- [Lecture 38 - Transport of Pollutants - Gaussian Dispersion Model](#)
- [Lecture 39 - Dispersion Model - Parameters - Part 1](#)
- [Lecture 40 - Dispersion Model - Parameters - Part 2](#)
- [Lecture 41 - Gaussian Dispersion Model](#)
- [Lecture 42 - Gaussian Dispersion Model - Example, Additional topics](#)
- [Lecture 43 - Regulatory Models](#)
- [Lecture 44 - Introduction to Interphase Mass Transfer](#)
- [Lecture 45 - Interphase mass transfer - Application to Environmental Interfaces](#)
- [Lecture 46 - Interphase mass transfer - Flux and mass transfer resistance](#)
- [Lecture 47 - Interphase mass transfer - Boundary Layer and Mass Transfer Coefficient](#)
- [Lecture 48 - Interphase mass transfer - Individual and Overall Mass Transfer Coefficients](#)
- [Lecture 49 - Overall Mass Transfer Coefficient](#)
- [Lecture 50 - Estimation of the Mass Transfer Coefficients](#)
- [Lecture 51 - Air-Water Exchange](#)
- [Lecture 52 - Evaporation from different surfaces](#)
- [Lecture 53 - Sediment-Water exchange](#)
- [Lecture 54 - Application of Interphase mass transfer](#)
- [Lecture 55 - Contamination of Sediments](#)
- [Lecture 56 - Release from Sediments](#)
- [Lecture 57 - Unsteady state release from sediments](#)
- [Lecture 58 - Other mechanisms of chemical release from sediments - Part 1](#)
- [Lecture 59 - Other mechanisms of chemical release from sediments - Part 2](#)
- [Lecture 60 - Soil - Air Transfer](#)
- [Lecture 61 - Remediation of contaminated sediments - Application of transport models](#)

NPTEL : Synthetic and Natural Supramolecular Architectures: An Approach Towards Molecular Technology (Chemical Engineering)

Co-ordinators : Prof. Chebrolu Pulla Rao

Lecture 1 - Impetus

Lecture 2 - Introduction to Supramolecular Science and Technology

Lecture 3 - Introduction to Supramolecular Science and Technology

Lecture 4 - A quickwalk - through the Supramolecular Architectures

Lecture 5 - A quickwalk - through the Supramolecular Architectures

Lecture 6 - A quickwalk - through the Supramolecular Architectures

Lecture 7 - Weak intermolecular forces : What, Where, When and How?

Lecture 8 - Weak intermolecular forces : What, Where, When and How?

Lecture 9 - Weak intermolecular forces : What, Where, When and How?

Lecture 10 - Weak intermolecular forces : What, Where, When and How?

Lecture 11 - Weak intermolecular forces : What, Where, When and How?

Lecture 12 - Weak intermolecular forces : What, Where, When and How?

Lecture 13 - Chemistry concepts of Immediate relevance - Part 1

Lecture 14 - Chemistry concepts of Immediate relevance - Part 2

Lecture 15 - Chemistry concepts of Immediate relevance - Part 3

Lecture 16 - Chemistry concepts of Immediate relevance - Part 4

Lecture 17 - Chemistry concepts of Immediate relevance - Part 5

Lecture 18 - Chemistry concepts of Immediate relevance - Part 6

Lecture 19 - Chemistry concepts of Immediate relevance - Part 7

Lecture 20 - Molecular recognition - Part 1

Lecture 21 - Molecular recognition - Part 2

Lecture 22 - Molecular recognition - Part 3

Lecture 23 - Molecular recognition - Part 4

Lecture 24 - Molecular recognition - Part 5

Lecture 25 - Molecular recognition - Part 6

Lecture 26 - Molecular recognition - Part 7

Lecture 27 - Molecular recognition - Part 8

Lecture 28 - Molecular recognition - Part 9

Lecture 29 - Molecular recognition - Part 10

Lecture 30 - Property driven functions of Supramolecular assembly

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33 - Metal coordinated architectures](#)

[Lecture 34 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 1](#)

[Lecture 35 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 2](#)

[Lecture 36 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 3](#)

[Lecture 37 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 4](#)

[Lecture 38 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 5](#)

[Lecture 39 - Engineering Supramolecular devices : Sensors,Switches,Devices and Molecules - Part 6](#)

[Lecture 40 - From molecules to machines : A glimpse at the travel](#)

- Lecture 1 - Introduction to oil and gas
- Lecture 2 - Drilling and Completion
- Lecture 3 - Well completion
- Lecture 4 - Oil and gas production systems
- Lecture 5 - Pumps, compressors and flow through pipes
- Lecture 6 - Reservoir fluid
- Lecture 7 - Fluid properties and Phase diagram - Part 1
- Lecture 8 - Fluid properties and Phase diagram - Part 2
- Lecture 9 - Nodal analysis
- Lecture 10 - Reservoir deliverability - Single phase flow
- Lecture 11 - Reservoir deliverability - Two phase flow
- Lecture 12 - Flow over a flat surface or flow through pipe - Part 1
- Lecture 13 - Flow over a flat surface or flow through pipe - Part 2
- Lecture 14 - Single-Phase, Multi-Phase-Emulsion
- Lecture 15 - Emulsification and demulsification
- Lecture 16 - Single and Multi Phase flow-flow regimes
- Lecture 17 - Multi phase flow-flow models
- Lecture 18 - Choke Performance
- Lecture 19 - Pump classifications
- Lecture 20 - Classification of artificial lifts - Part 1
- Lecture 21 - Classification of artificial lifts - Part 2
- Lecture 22 - Sucker rod pump (SRP) - Part 1
- Lecture 23 - Sucker rod pump (SRP) - Part 2
- Lecture 24 - Sucker rod pump (SRP) - Part 3
- Lecture 25 - Sucker rod pump (SRP) - Part 4
- Lecture 26 - Sucker rod pump (SRP) - Part 5
- Lecture 27 - Sucker rod pump (SRP) - Part 6
- Lecture 28 - SRP-Pump performance analysis - Part 1
- Lecture 29 - SRP-Pump performance analysis - Part 2
- Lecture 30 - SRP-Pump performance analysis - Part 3
- Lecture 31 - Introduction to progressive cavity pump

- [Lecture 32 - Progressive cavity Pump - Part 1](#)
- [Lecture 33 - Progressive cavity Pump - Part 2](#)
- [Lecture 34 - Progressive cavity Pump - Part 3](#)
- [Lecture 35 - Progressive cavity Pump - Part 4](#)
- [Lecture 36 - Progressive cavity Pump - Part 5](#)
- [Lecture 37 - Electric submersible pump - Part 1](#)
- [Lecture 38 - Electric submersible pump - Part 2](#)
- [Lecture 39 - Electric submersible pump - Part 3](#)
- [Lecture 40 - ESP- basic electrical systems - Part 1](#)
- [Lecture 41 - ESP- basic electrical systems - Part 2](#)
- [Lecture 42 - ESP- basic electrical systems - Part 3](#)
- [Lecture 43 - ESP- numerical problems - Part 1](#)
- [Lecture 44 - ESP- numerical problems - Part 2](#)
- [Lecture 45 - ESP- numerical problems - Part 3](#)
- [Lecture 46 - ESP- numerical problems - Part 1](#)
- [Lecture 47 - ESP- numerical problems - Part 2](#)
- [Lecture 48 - Gas lift basics - Part 1](#)
- [Lecture 49 - Gas lift basics - Part 2](#)
- [Lecture 50 - Gas lift valves and installartion - Part 1](#)
- [Lecture 51 - Gas lift valves and installartion - Part 2](#)
- [Lecture 52 - Plunger lift and design](#)
- [Lecture 53 - Hydraulic jet pump fundamentals - Part 1](#)
- [Lecture 54 - Hydraulic jet pump fundamentals - Part 2](#)
- [Lecture 55 - Hydraulic engine pumps and design - Part 1](#)
- [Lecture 56 - Hydraulic engine pumps and design - Part 2](#)
- [Lecture 57 - Surface pump units for jet pump - Part 1](#)
- [Lecture 58 - Surface pump units for jet pump - Part 2](#)
- [Lecture 59 - Surface pump units for jet pump - Part 3](#)
- [Lecture 60 - Surface compressor for gas lift - Part 1](#)
- [Lecture 61 - Surface compressor for gas lift - Part 2](#)
- [Lecture 62 - Surface compressor for gas lift - Part 3](#)

Lecture 1 - Introduction to Chemical process Industries

Lecture 2 - Raw material for Organic Chemical Industries

Lecture 3 - Unit processes and unit operations in organic chemical Industries

Lecture 4 - Coal and coal as chemicals feed stock

Lecture 5 - Coal carbonization and Coke oven plant

Lecture 6 - Gasification of Coal,Petrocoke and Biomass

Lecture 7 - Introduction to Pulp and paper Industry, Raw material for paper industry and Technological development

Lecture 8 - Pulping and Bleaching

Lecture 9 - Recovery of Chemicals

Lecture 10 - Stock preparation and paper making

Lecture 11 - Introduction to Soap and detergent, Soap making and Recovery of Glycerine

Lecture 12 - Synthetic detergent and Linear alkyl benzene

Lecture 13 - Sugar and Fermentation industry

Lecture 14 - Ethanol as Biofuel and Chemical feed stock

Lecture 15 - Introduction : Status of Petroleum refinery, Crude oil and Natural gas origin, occurrence, exploration, drilling and processing, Fuel norms

Lecture 16 - Evaluation of Crude oil,Petroleum Products and Petrochemicals

Lecture 17 - Crude oil Distillation

Lecture 18 - Thermal Cracking: Visbreaking and Delayed Coking

Lecture 19 - Catalytic cracking: Fluid Catalytic cracking and Hydro cracking

Lecture 20 - Catalytic reforming

Lecture 21 - Alkylation, Isomerisation and Polymerisation

Lecture 22 - Desulphurisation Processes and Recovery of Sulphur

Lecture 23 - Profile of petrochemical Industry and its structure

Lecture 24 - Naphtha and gas cracking for production of olefins

Lecture 25 - Recovery of chemicals from FCC and steam cracking

Lecture 26 - Synthesis gas and its derivatives: Hydrogen, CO, Methanol, Formaldehyde

Lecture 27 - Ethylene derivatives: Ethylene Oxide, Ethylene glycol, Ethylene dichloride and Vinyl chloride

Lecture 28 - Propylene, Propylene oxide and Isopropanol

Lecture 29 - Aromatics Production

Lecture 30 - Aromatics product profile, Ethyl benzene & Styrene, Cumene and phenol, Bisphenol, Aniline

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Lecture 31 - Introduction to polymer, Elastomer and Synthetic Fibre, Polymerisation

Lecture 32 - Polymers: Polyolefins, Polyethylene, Polypropylene Polystyrene

Lecture 33 - Polyvinylchloride, polycarbonate, thermoset resin: phenolformaldehyde, uriaformaldehyde and melamineformaldehyde

Lecture 34 - Elastomers: Styrene butadiene Rubber(SBR), Poly butadiene, Nitrile rubber

Lecture 35 - Polymides or Nylons(PA)

Lecture 36 - DMT and Terephtalic Acid, Polyester, PET resin, PTB resin

Lecture 37 - Acrylic Fibre, Modified Acrylic Fibre, Acrylonitrile, Acrolein, Propylene Finber, Polyurethane

Lecture 38 - Viscose Rayon and Acetate rayon

Lecture 39 - Pesticide

Lecture 40 - Dye and Intermediates

Lecture 1 - Process integration, methods and area of application

Lecture 2 - Fundamental concepts related to heat integration - Part 1

Lecture 3 - Fundamental concepts related to heat integration - Part 2

Lecture 4 - Data extraction

Lecture 5 - Hot composite curves

Lecture 6 - Cold composite curves

Lecture 7 - Hot and cold composite curves and the pinch

Lecture 8 - Threshold problems

Lecture 9 - Energy targeting procedure

Lecture 10 - Problem Table Algorithm - Part 1

Lecture 11 - Grand composite curve

Lecture 12 - Problem Table Algorithm - Part 2

Lecture 13 - Number of units target

Lecture 14 - Shell targeting - Part 1

Lecture 15 - Area targeting - Part 1

Lecture 16 - Area targeting - Part 2

Lecture 17 - Coast targeting - Part 1

Lecture 18 - Coast targeting - Part 2

Lecture 19 - Supertargeting- optimization of $\hat{I}^* t \min$

Lecture 20 - Global & stream specific $\hat{I}^* t \min$ and its relevance

Lecture 21 - Topology Trap

Lecture 22 - Rules for Pinch Design Method (PDM) - Part 1

Lecture 23 - Rules for Pinch Design Method (PDM) - Part 2

Lecture 24 - Application of PDM for MER Hen Synthesis

Lecture 25 - Design for threshold problems

Lecture 26 - Design for single pinch problems

Lecture 27 - Design for multi pinch problems

Lecture 28 - HEN optimization

Lecture 29 - Remaining problem analysis

Lecture 30 - Driving Force Plot

Lecture 31 - Low Temperature process Design - Part 1

[Lecture 32 - Low Temperature process Design - Part 2](#)

[Lecture 33 - Integration of Gas turbine with process - Part 1](#)

[Lecture 34 - Integration of Gas turbine with process - Part 2](#)

[Lecture 35 - Placement and Integration of Distillation Column](#)

[Lecture 36 - Heat Integration of evaporators](#)

[Lecture 37 - Integration of heat pump](#)

[Lecture 38 - Placement of Heat Engine, Heat pump and Reactors](#)

[Lecture 39 - Integration of Furnace](#)

[Lecture 40 - Problem solving using HINT Software - Part 1](#)

[Lecture 41 - Problem solving using HINT Software - Part 2](#)

[Lecture 42 - Problem solving using HINT Software - Part 3](#)

[Lecture 43 - Problem solving using HINT Software - Part 4](#)

NPTEL : Mechanical Operations (Chemical Engineering)

Co-ordinators : Prof. Shabina Khanam

Lecture 1 - Introduction

Lecture 2 - Characterization of a single particle - 1

Lecture 3 - Characterization of a single particle - 2

Lecture 4 - Characterization of collection of particles - 1

Lecture 5 - Characterization of collection of particles - 2

Lecture 6 - Fine grain size distribution

Lecture 7 - Effectiveness of screen - 1

Lecture 8 - Effectiveness of screen - 2

Lecture 9 - Industrial screening equipment

Lecture 10 - Size reduction

Lecture 11 - Laws of comminution

Lecture 12 - Examples of Laws of comminution - 1

Lecture 13 - Examples of Laws of comminution - 2

Lecture 14 - Size reduction equipment - 1

Lecture 15 - Size reduction equipment - 2

Lecture 16 - Particle dynamics - 1

Lecture 17 - Particle dynamics - 2

Lecture 18 - Particle dynamics-Examples

Lecture 19 - Classification and Jigging - 1

Lecture 20 - Classification and Jigging - 2

Lecture 1 - Introduction - 1

Lecture 2 - Introduction - 2

Lecture 3 - Characterization of wastes - 1

Lecture 4 - Characterization of wastes - 2

Lecture 5 - Characterization of wastes - 3

Lecture 6 - Tutorial on Characterization of wastes

Lecture 7 - Energy production from wastes through incineration - 1

Lecture 8 - Energy production from wastes through incineration - 2

Lecture 9 - Tutorial on incineration

Lecture 10 - Energy production from wastes through gasification - 1

Lecture 11 - Energy production from wastes through gasification - 2

Lecture 12 - Syngas utilization - 1

Lecture 13 - Syngas utilization - 2

Lecture 14 - Energy production from wastes through pyrolysis - 1

Lecture 15 - Energy production from wastes through pyrolysis - 2

Lecture 16 - Tutorial on gasification

Lecture 17 - Tutorial on Pyrolysis

Lecture 18 - Densification of solids - 1

Lecture 19 - Densification of solids - 2

Lecture 20 - Efficiency improvement of power plant - 1

Lecture 21 - Efficiency improvement of power plant - 2

Lecture 22 - Energy production from waste plastics - 1

Lecture 23 - Energy production from waste plastics - 2

Lecture 24 - Gas clean up - 1

Lecture 25 - Gas clean up - 2

Lecture 26 - Energy production from organic wastes through anaerobic digestion - 1

Lecture 27 - Energy production from organic wastes through anaerobic digestion - 2

Lecture 28 - Design of anaerobic digester

Lecture 29 - Introduction to Microbial fuel cells

Lecture 30 - Energy production from organic wastes through fermentation - 1

Lecture 31 - Energy production from organic wastes through fermentation - 2

[Lecture 32 - Tutorial on anaerobic digestion](#)

[Lecture 33 - Tutorial on fermentation](#)

[Lecture 34 - Energy production from wastes through transesterification - 1](#)

[Lecture 35 - Energy production from wastes through transesterification - 2](#)

[Lecture 36 - Tutorial on transesterification](#)

[Lecture 37 - Cultivation of algal biomass and treatment of waste water - 1](#)

[Lecture 38 - Cultivation of algal biomass and treatment of waste water - 2](#)

[Lecture 39 - Energy production form algal biomass - 1](#)

[Lecture 40 - Energy production form algal biomass - 2](#)

Lecture 1 - Introduction

Lecture 2 - Sedimentation and Batch Sedimentation Test - 1

Lecture 3 - Sedimentation and Batch Sedimentation Test - 2

Lecture 4 - Centrifugal Sedimentation and Equipment - 1

Lecture 5 - Centrifugal Sedimentation and Equipment - 2

Lecture 6 - Filtration - 1

Lecture 7 - Filtration - 2

Lecture 8 - Filtration - 3

Lecture 9 - Continuous Filtration - 1

Lecture 10 - Continuous Filtration - 2

Lecture 11 - Fluidisation - 1

Lecture 12 - Fluidisation - 2

Lecture 13 - Liquid Fluidisation

Lecture 14 - Gas Fluidisation - 1

Lecture 15 - Gas Fluidisation - 2

Lecture 16 - Flotation - 1

Lecture 17 - Flotation - 2

Lecture 18 - Transportaion of solids - 1

Lecture 19 - Transportaion of solids - 2

Lecture 20 - Transportaion of solids - 3

- Lecture 1 - Introduction to the course, Macromolecules and Life, Molecular flexibility
- Lecture 2 - Classification of polymers, Types of polymerization, Average molecular weights and polydispersity
- Lecture 3 - Motivation to study polymer physics
- Lecture 4 - Random Walk Models of Single Chain I: end-to-end distance of a polymer chain, freely jointed chain, drunkard walk
- Lecture 5 - Random Walk Models of Single Chain II: general random walk on a lattice
- Lecture 6 - Random Walk Models of Single Chain III: Freely rotating chain, definition of persistence length
- Lecture 7 - Models of semiflexible chains (Kratky Porod Model) - Part I
- Lecture 8 - Models of semiflexible chains (Kratky Porod Model) - Part II
- Lecture 9 - Probability density of an ideal chain - Part I
- Lecture 10 - Probability density of an ideal chain - Part II
- Lecture 11 - Entropic Elasticity, Bead-Spring Model, Simulations of random walk models
- Lecture 12 - Derivation of Diffusion equation, Einstein notation
- Lecture 13 - Definition of Radius of gyration
- Lecture 14 - Radius of gyration for an ideal chain, concept of ideality
- Lecture 15 - Nonbonded interactions, hydrophobic and hydrophilic behaviour
- Lecture 16 - Definition of excluded volume; good, bad, and theta solvent
- Lecture 17 - Virial expansion, Flory theory for good solvent
- Lecture 18 - Flory theory for bad solvent, self-similarity and fractal nature of polymers
- Lecture 19 - Derivation of fractal dimension, concentration regimes and overlap concentration
- Lecture 20 - Size, shape, and structure. Gyration tensor and measures of asphericity.
- Lecture 21 - Order-disorder transition
- Lecture 22 - Scattering experiments, Pair correlation function
- Lecture 23 - Structure of polymer chain, Introduction to Monte Carlo simulations of polymer chains
- Lecture 24 - Monte Carlo algorithm: Detailed Balance, Metropolis algorithm
- Lecture 25 - Practical aspects of Monte Carlo simulation
- Lecture 26 - Molecular Dynamics Simulations, Review of Thermodynamics
- Lecture 27 - Solution Thermodynamics - I
- Lecture 28 - Solution Thermodynamics - II
- Lecture 29 - Solution Thermodynamics - III
- Lecture 30 - Solution Thermodynamics - IV
- Lecture 31 - Phase separation regime, Introduction to lattice model of solutions

[Lecture 32 - Lattice Model of Solutions - I](#)

[Lecture 33 - Lattice Model of Solutions - II](#)

[Lecture 34 - Phase behaviour of liquid solutions](#)

[Lecture 35 - Lattice models of polymeric systems](#)

[Lecture 36 - Brownian motion - I](#)

[Lecture 37 - Brownian motion - II](#)

[Lecture 38 - Brownian motion - III](#)

[Lecture 39 - Brownian motion - IV](#)

[Lecture 40 - Brownian motion - V](#)

[Lecture 41 - Rouse Model - I](#)

[Lecture 42 - Rouse Model - II](#)

[Lecture 43 - Rouse Model - III](#)

[Lecture 44 - Rouse Model - IV](#)

[Lecture 45 - Problems in Rouse Model, Hydrodynamic Interactions](#)

[Lecture 46 - Zimm Model - I](#)

[Lecture 47 - Zimm Model - II](#)

[Lecture 48 - Continuum Mechanics - I](#)

[Lecture 49 - Continuum Mechanics - II](#)

[Lecture 50 - Kuhn's Theory of Rubber Elasticity](#)

[Lecture 51 - Elasticity of polymer network](#)

[Lecture 52 - Microscopic definition of stress tensor - I](#)

[Lecture 53 - Microscopic definition of stress tensor - II, Dumbbell model, introduction to Rouse model](#)

[Lecture 54 - Models for entangled polymeric systems - I](#)

[Lecture 55 - Models for entangled polymeric systems - II](#)

[Lecture 56 - Rheology of complex fluids](#)

[Lecture 57 - Rheometers and rheological tests - I](#)

[Lecture 58 - Rheometers and rheological tests - II](#)

[Lecture 59 - Maxwell model - I](#)

[Lecture 60 - Maxwell model - II, Closing notes](#)

Lecture 1 - Introduction

Lecture 2 - Stress and Strain Relationship - 1

Lecture 3 - Stress and Strain Relationship - 2

Lecture 4 - Terminologies

Lecture 5 - Design of shell

Lecture 6 - Design of heads - 1

Lecture 7 - Design of heads - 2

Lecture 8 - Design of heads - 3

Lecture 9 - Compensation for Opening - 1

Lecture 10 - Compensation for Opening - 2

Lecture 11 - L D ratio

Lecture 12 - Design of Flanges - 1.1

Lecture 13 - Design of Flanges - 1.2

Lecture 14 - Design of Flanges - 2.1

Lecture 15 - Design of Flanges - 2.2

Lecture 16 - Design of support - 1

Lecture 17 - Design of support - 2

Lecture 18 - Vessel under external pressure - 1

Lecture 19 - Vessel under external pressure - 2

Lecture 20 - Vessel under very high pressure

Lecture 1 - Safety and Accident Loss Statistics

Lecture 2 - Risk Management and Hazardous Substance Rules

Lecture 3 - Nature of Accident and major disasters

Lecture 4 - Fundamental Principles: Scale up and Runaway Reactions

Lecture 5 - Problems related to Safety and Accident Loss Statistics

Lecture 6 - Toxicology: Introduction, Routes and Exposure

Lecture 7 - Toxicology: Elimination, Responses, Treatment

Lecture 8 - Dose Response Relationship

Lecture 9 - Dose Response and Threshold Dose: Predictive models and Extrapolation

Lecture 10 - Industrial Hygiene: Regulations and Identification

Lecture 11 - Material Safety Data Sheet - I

Lecture 12 - Material Safety Data Sheet - II

Lecture 13 - Industrial Hygiene: Evaluation

Lecture 14 - Noise, vibration and Radiation

Lecture 15 - Industrial Hygiene: Control

Lecture 16 - Problems related to Industrial Hygiene

Lecture 17 - Introduction to Source Models

Lecture 18 - Source Models for Gas

Lecture 19 - Source Models for Pool Boiling

Lecture 20 - Source Model Problems

Lecture 21 - Fire and Explosions: Introduction

Lecture 22 - Fire and Explosions: Flammability Characteristics

Lecture 23 - Explosion and its Classification - I

Lecture 24 - Explosion and its Classification - II

Lecture 25 - Fire Extinguishers - I

Lecture 26 - Fire Extinguishers - II

Lecture 27 - Problems related to Fire and Explosion

Lecture 28 - Designs to prevent Fire and Explosion: Inerting and Purging

Lecture 29 - Designs to prevent Fire and Explosion: Static Electricity

Lecture 30 - General Design Methods to prevent Fire

Lecture 31 - Sprinklers - I

- [Lecture 32 - Sprinklers - II](#)
- [Lecture 33 - Introduction to Reliefs](#)
- [Lecture 34 - Type of Reliefs](#)
- [Lecture 35 - Relief Scenario](#)
- [Lecture 36 - Relief Sizing](#)
- [Lecture 37 - Hazard and Hazard Identification: Introduction](#)
- [Lecture 38 - Hazard Identification Methods and HAZOP](#)
- [Lecture 39 - Safety Reviews and Risk Assessment - I](#)
- [Lecture 40 - Risk Assessment - II](#)
- [Lecture 41 - Review of Probability Theory](#)
- [Lecture 42 - Event Trees: Quantitative Risk Analysis](#)
- [Lecture 43 - Fault Trees: Quantitative Risk Analysis](#)
- [Lecture 44 - Cause Consequence Analysis and Layer of Protection Analysis](#)
- [Lecture 45 - Bow-Tie Analysis](#)
- [Lecture 46 - Accident Research: Introduction](#)
- [Lecture 47 - Accident Causation Theories](#)
- [Lecture 48 - Accident Investigation Procedure - I](#)
- [Lecture 49 - Accident Investigation Procedure - II](#)
- [Lecture 50 - Jaipur Terminal Fire, India: October 29, 2009](#)
- [Lecture 51 - The Flixborough UK, Cyclohexane Disaster: June 01, 1974](#)
- [Lecture 52 - Seveso Accident: July 10, 1976](#)
- [Lecture 53 - The Chernobyl Nuclear Disaster: April 26, 1986](#)
- [Lecture 54 - Bhopal Gas Tragedy: December 03, 1984](#)
- [Lecture 55 - Bhopal Gas Tragedy: Investigation](#)
- [Lecture 56 - Nuclear Radiation](#)
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Lecture 3 - Characterization of Coal

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- Lecture 41 - Radical Chain Polymerization Redox Initiation
- Lecture 42 - Radical Chain Polymerization Photochemical and Ionization Initiation
- Lecture 43 - Radical Chain Polymerization Other Initiation Techniques - I
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- Lecture 45 - Heterogeneous Polymerization Introduction - I
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- Lecture 47 - Population Balance Modeling Other Techniques - I
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- Lecture 49 - Emulsion Polymerization Batch Polymerization
- Lecture 50 - Emulsion Polymerization Semi-continuous polymerization
- Lecture 51 - Emulsion Polymerization Nucleation, Morphology and Reactor Types - I
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- Lecture 53 - Emulsion Polymerization PSD and Implementation of the Process - I
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Lecture 1 - Introduction to the course

Lecture 2 - Molecular basis of energy and entropy

Lecture 3 - Probability and probability distributions

Lecture 4 - Probability distributions and thermodynamic equilibrium

Lecture 5 - Energy distribution in molecular systems

Lecture 6 - First and second law of thermodynamics

Lecture 7 - Reversible and irreversible processes; third law of thermodynamics; legendre transformation; thermodynamic functions for one component system

Lecture 8 - Thermodynamic functions for multi-component systems; chemical potential; why do we minimize thermodynamic functions?

Lecture 9 - Extensive and intensive variables; gibbs duhem relation; euler theorem; maxwell relations

Lecture 10 - Discrete and continuous probabilities; stirling approximation

Lecture 11 - Binomial distribution approaches Gaussian distribution for large n; definition of drunkard walk

Lecture 12 - Solution of drunkard walk; Lagrange multipliers

Lecture 13 - Energy distribution in molecular system revisited; introduction to thermodynamic ensembles

Lecture 14 - Canonical ensemble: most probable distribution, partition function

Lecture 15 - Definition of temperature; third law of thermodynamics

Lecture 16 - Canonical ensemble: Helmholtz free energy, averages and fluctuations, specific heat, deriving ideal gas law

Lecture 17 - Partition function of a dense gas; grand canonical ensemble: partition function, most probable distribution

Lecture 18 - Computing properties in grand canonical ensemble

Lecture 19 - Isothermal isobaric ensemble

Lecture 20 - Summary of thermodynamic ensembles; partition function of an ideal gas

Lecture 21 - Mixing and phase separation, phase equilibrium of a multiphase multicomponent system, Gibbs phase rule

Lecture 22 - Pure component phase diagram; solution thermodynamics: Helmholtz free energy density

Lecture 23 - Characterizing mixing and phase separation using Helmholtz free energy density

Lecture 24 - Common tangent construction, definition of binodal, spinodal, and critical point

Lecture 25 - Osmotic pressure and chemical potential

Lecture 26 - Lattice model of liquid solutions - I

Lecture 27 - Lattice model of liquid solutions - II

Lecture 28 - Lattice model of liquid solutions - III

Lecture 29 - Critical review of Lattice model, theoretical basis of molecular dynamics simulation

Lecture 30 - Theoretical basis of molecular dynamics simulation

Lecture 31 - Interaction energy and force field

Lecture 32 - Liouville theorem; theoretical basis of Monte Carlo simulation

Lecture 33 - Introduction to Monte Carlo simulation method

Lecture 34 - Markov chain algorithm, condition for equilibrium and detailed balance

Lecture 35 - Metropolis algorithm, periodic boundary condition

Lecture 36 - Numerical implementation of Monte Carlo simulation: Python Examples - I

Lecture 37 - Numerical implementation of Monte Carlo simulation: Python Examples - II

Lecture 38 - Numerical implementation of Monte Carlo simulation: Python Examples - III

Lecture 39 - Numerical implementation of Monte Carlo simulation: Python Examples - IV

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Lecture 41 - Particle simulations: comparison with quantum chemical and continuum simulations; bridging length and time scales

Lecture 42 - Pair potentials

Lecture 43 - Saving CPU time: short range and long range interactions

Lecture 44 - Bonded and non-bonded interactions, force fields

Lecture 45 - Practical aspects of molecular simulations

Lecture 46 - Numerical implementation of MD; thermostat and barostat

Lecture 47 - MD simulations - efficiency and parallelization, sampling and averaging, analysis of simulation trajectories

Lecture 48 - MD simulations - analysis of simulation trajectories (continued), Case Studies - I

Lecture 49 - MD simulations - Case Studies - II

Lecture 50 - MD simulations - Case Studies - III

Lecture 51 - Free energies and phase behavior; extension of canonical ensemble Monte Carlo to other ensembles

Lecture 52 - Extension of canonical ensemble Monte Carlo to other ensembles (Continued...)

Lecture 53 - Monte Carlo in Gibbs ensemble and semi-grand canonical ensemble, thermodynamic integration

Lecture 54 - Thermodynamic integration (continued); Widom's particle insertion; overlapping distribution method

Lecture 55 - Multiple histogram method; umbrella sampling; thermodynamic cycle; potential of mean force; pulling simulations; metadynamics; tackling time scale issues

Lecture 56 - Tackling time scale issues (continued); nonequilibrium molecular dynamics; mesoscale simulations: Langevin dynamics and Brownian dynamics, kinetic Monte Carlo simulations; dissipative particle dynamics

Lecture 57 - Multiparticle collision dynamics; lattice Boltzmann method; coarse-graining

Lecture 58 - Case studies

Lecture 59 - Simulations of chemical reactions using Kinetic Monte Carlo simulations

Lecture 60 - Reactive force fields; Ab initio molecular dynamics and other advanced methods; molecular simulations in chemical engineering; concluding remarks

Lecture 1 - Introduction to Chemical Process Utilities

Lecture 2 - Energy Perspective to the Utilities

Lecture 3 - Power Cycle

Lecture 4 - Fuel Analysis

Lecture 5 - Practice problems related to power cycle and fuel analysis

Lecture 6 - Heat Transfer Utilities - I

Lecture 7 - Heat Transfer Utilities - II

Lecture 8 - Plate and Frame Heat Exchangers Types

Lecture 9 - Solar Energy - I

Lecture 10 - Solar Energy - II

Lecture 11 - Heat Transfer Media and Solar energy

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Lecture 13 - Water Chemistry

Lecture 14 - Inhibition and Water Treatment

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Lecture 18 - Water Quality Standards - II

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Lecture 22 - Boilers

Lecture 23 - Boilers- Question Practice

Lecture 24 - Steam Generation Unit

Lecture 25 - Steam Generation Unit-Heaters

Lecture 26 - Attemperator and Steam Drum

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Lecture 28 - Economizer, Super heaters, and Safety devices

Lecture 29

Lecture 30 - Insulation of Steam Generators

Lecture 31 - Air

- Lecture 32 - Air Filtration and Pneumatic Conveying
- Lecture 33 - Introduction to Pneumatic Conveying System
- Lecture 34 - Conveying System Types
- Lecture 35 - Material Properties and Pipeline Feeding Devices
- Lecture 36 - Feeding devices
- Lecture 37 - Gas-solid flows
- Lecture 38 - Design of Pipelines Elements of Pipeline Design
- Lecture 39 - Natural Gas Transmission - I
- Lecture 40 - Natural Gas Transmission - II
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- Lecture 42 - Pipeline Mechanical design - Natural Gas Transmission - IV
- Lecture 43 - Cooling Tower; Theory and Some Basic Calculations
- Lecture 44 - Concept of Heat Transfer in Cooling Tower and its Components
- Lecture 45 - Types and Components of Cooling Tower
- Lecture 46 - Components and Materials of Construction and Applications of Cooling Tower
- Lecture 47 - Control and Maintenance in cooling towers
- Lecture 48 - Pressure Levels and Terminology - I
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- Lecture 50 - Gauges for Pressure Measurement
- Lecture 51 - Refrigerants and Refrigeration
- Lecture 52 - Introduction to Refrigeration
- Lecture 53 - Refrigeration System Components
- Lecture 54 - Refrigeration System Components and Refrigeration Cycle
- Lecture 55 - Refrigeration Systems
- Lecture 56 - Refractories
- Lecture 57 - Thermodynamic Principles and Corrosion in Refractories
- Lecture 58 - Slag Attack and Kinds of Refractories in Uses
- Lecture 59 - Brief history of Insulations and its fundamental principles
- Lecture 60 - Heat transfer in Insulations materials

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- Lecture 2 - Environmental Acts and Standards
- Lecture 3 - Water Quality Monitoring: Physical Parameters
- Lecture 4 - Water Quality Monitoring: Physical and Chemical Parameters
- Lecture 5 - Water Quality Monitoring: Chemical Parameters - I
- Lecture 6 - Water Quality Monitoring: Chemical Parameters - II
- Lecture 7 - Water Quality Monitoring: Biological/Biochemical Parameters - I
- Lecture 8 - Water Quality Monitoring: Biological/Biochemical Parameters - II
- Lecture 9 - Water Quality Monitoring: Bacteriological Parameters
- Lecture 10 - Treatment of Water and Wastewater
- Lecture 11 - Flow Equalization
- Lecture 12 - Aeration - I
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- Lecture 18 - Coagulation and Flocculation - I
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- Lecture 20 - Coagulation and Flocculation - III
- Lecture 21 - Coagulation and Flocculation - IV
- Lecture 22 - Settling and Sedimentation - I
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- Lecture 28 - Filtration - I
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- Lecture 31 - Adsorption - I

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- [Lecture 46 - Advanced Oxidation Processes \(AOP\) - Introduction](#)
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- [Lecture 49 - AOP - Electrochemical wastewater treatment - I](#)
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- [Lecture 51 - AOP - Sono-hybrid wastewater treatment](#)
- [Lecture 52 - Disinfection - I](#)
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- [Lecture 56 - Case Study - Wastewater treatment in distillery](#)
- [Lecture 57 - Case Study - Wastewater treatment in fertilizer industry](#)
- [Lecture 58 - Case Study - Wastewater treatment in petroleum refining industry](#)
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Lecture 3 - Ecosystem services and its risks - 1

Lecture 4 - Ecosystem services and its risks - 2

Lecture 5 - Tutorial-1

Lecture 6 - Pollution types and sources

Lecture 7 - Pollution: Impacts/Consequences

Lecture 8 - Transmission of pollutants in environment - 1

Lecture 9 - Transmission of pollutants in environment - 2

Lecture 10 - Tutorial-2

Lecture 11 - Environmental quality and standards - 1

Lecture 12 - Environmental quality and standards - 2

Lecture 13 - Instrumental techniques of environmental analysis - 1

Lecture 14 - Instrumental techniques of environmental analysis - 2

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Lecture 16 - Sampling and characterization - 1 (Gas, air ,emission)

Lecture 17 - Sampling and characterization - 2 (water, wastewater, effluents)

Lecture 18 - Sampling and characterization - 3 (solid waste and soil)

Lecture 19 - Environmental laws and regulatory framework

Lecture 20 - Tutorial-4

Lecture 21 - Air pollution control - 1

Lecture 22 - Air pollution control - 2

Lecture 23 - Air pollution control - 3

Lecture 24 - Air pollution control - 4

Lecture 25 - Tutorial-5

Lecture 26 - Treatment of surface and ground water for drinking water generation

Lecture 27 - Treatment of domestic and industrial wastewater: Schemes

Lecture 28 - Primary treatment equipment

Lecture 29 - Secondary treatment processes

Lecture 30 - Tutorial-6

Lecture 31 - Secondary treatment equipment - 1

- Lecture 32 - Secondary treatment equipment - 2
- Lecture 33 - Advanced secondary processes - 1
- Lecture 34 - Advanced secondary processes - 2
- Lecture 35 - Tutorial-7
- Lecture 36 - Advanced secondary processes - 3
- Lecture 37 - Tertiary treatment - 1
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- Lecture 39 - Tertiary treatment - 3
- Lecture 40 - Tutorial-8
- Lecture 41 - Sludge management - 1
- Lecture 42 - Sludge management - 2
- Lecture 43 - Sludge management - 3
- Lecture 44 - Industrial Pollution Control in GPI - 1 (General aspect and pollution control in sugar industry)
- Lecture 45 - Tutorial-9
- Lecture 46 - Industrial Pollution Control in GPI - 2 (Pollution control in Distillery)
- Lecture 47 - Industrial Pollution Control in GPI - 3 (Pollution control in Tannery)
- Lecture 48 - Pollution control in Petroleum refinery and petrochemicals industry
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- Lecture 50 - Tutorial 10
- Lecture 51 - Solid waste and hazardous waste management - 1
- Lecture 52 - Solid waste and hazardous waste management - 2
- Lecture 53 - Solid waste and hazardous waste management - 3
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- Lecture 55 - Tutorial-11
- Lecture 56 - Air Pollution Management, Air quality survey, NAAQI - 1
- Lecture 57 - Air Pollution Management, Air quality survey, NAAQI - 2
- Lecture 58 - Management of special category wastes - 1
- Lecture 59 - Management of special category wastes - 2
- Lecture 60 - Tutorial-12

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- Lecture 2 - Microorganisms in Biological Wastewater Treatment
- Lecture 3 - Fundamentals of Biochemical Operations
- Lecture 4 - Wastewater Characterization - I
- Lecture 5 - Wastewater Characterization - II
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- Lecture 9 - Stoichiometry of Microbial Growth - I
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- Lecture 15 - Reactor Hydraulics - I
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- Lecture 17 - Treatment of Water and Wastewater - I
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- Lecture 19 - Coagulation, Flocculation, and Sedimentation - I
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- Lecture 22 - Activated Sludge Process
- Lecture 23 - Sequential Batch Reactor
- Lecture 24 - Trickling Filter
- Lecture 25 - Rotating Disc Reactor
- Lecture 26 - Up-flow Anaerobic Sludge Blanket (UASB) reactor
- Lecture 27 - UASB and Biotower
- Lecture 28 - Advanced Biological Wastewater Treatment: Fluidized Bed Bioreactors
- Lecture 29 - Advanced Biological Wastewater Treatment: Membrane Bioreactors
- Lecture 30 - Advanced Biological Wastewater Treatment: Moving Bed Biofilm Reactor (MBBR)
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Lecture 2 - Introduction_Various Reactors_BR

Lecture 3 - Design Equation_Continuous reactor (CSTR_PFR_PBR)

Lecture 4 - Design Equation_Continuous reactor (CSTR_PFR_PBR)_Sizing

Lecture 5 - Reaction Rate with Conversion, Temperature, and pressure (Batch/Flow system)

Lecture 6 - Space time Space velocity and CSTRs in series/parallel

Lecture 7 - Effect of Pressure Drop on reactor design (PBR)_(X vs W) and (P vs W)

Lecture 8 - Effect of Pressure Drop on Reactor design (PBR)_(X vs W)_(P vs W)

Lecture 9 - Effect of Pressure Drop in PBR reactor_Analytical solution of Differential equation

Lecture 10 - Effect of Pressure Drop in PBR reactor_Analytical solution for Reaction With Pressure drop

Lecture 11 - Effect of Pressure Drop in PBR reactor_Example

Lecture 12 - Differential Reactor_rate of reaction_catalyst deactivation

Lecture 13 - Catalyst deactivation

Lecture 14 - Catalyst Deactivation_Temperature (T) - Time (t) trajectories

Lecture 15 - Moving Bed Reactor_Catalyst deactivation

Lecture 16 - STTR_Catalyst deactivation

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Lecture 18 - Multi phase reactors-1: Slurry reactor - 2

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Lecture 21 - Multi phase reactors-2: Trickle bed reactor - 2

Lecture 22 - Multi phase reactors-2: Trickle bed reactor - 3

Lecture 23 - Bioreactor_Cell Growth and Rate laws

Lecture 24 - Bioreactors_Stoichiometry_Yield coefficients_rate of substrate consumption

Lecture 25 - Bioreactors_Example_Yield coefficients and rate law parameters estimation

Lecture 26 - Bioreactors_Mass Balances (Cell, Substrate, Product)

Lecture 27 - Bioreactors_Chemostats

Lecture 28 - Steady State Non Isothermal reactor design_EB equation

Lecture 29 - Steady State Non Isothermal reactor design_Example

Lecture 30 - SS Non Isothermal reactor design_Reaction with Heat Exchange

Lecture 31 - SS Non Isothermal reactor design_Heat Exchange_T-profile for a few cases

- Lecture 32 - SS Non Isothermal reactor design_Equilibrium conversion
- Lecture 33 - SS Non Isothermal reactor design_Optimum feed temperature
- Lecture 34 - SS Non Isothermal reactor design_Multiple Steady States
- Lecture 35 - SS Non Isothermal reactor design_Ignition Extinction Curves
- Lecture 36 - SS Non Isothermal reactor design_Runaway reaction in a CSTR
- Lecture 37 - SS Non Isothermal reactor design_Energy Balance:Multiple rxn in a CSTR/PFR (Examples)
- Lecture 38 - Non-ideal flow - 1
- Lecture 39 - Basics of Non-ideal flow - 2
- Lecture 40 - Basics of Non-ideal flow - 3
- Lecture 41 - Non-ideal flow-Segregation model
- Lecture 42 - One parameter Model-Tank in Series model (TIS)
- Lecture 43 - Non-ideal flow-Dispersion model - Part 1
- Lecture 44 - Non-ideal flow-Dispersion model - Part 2
- Lecture 45 - Non-ideal flow-Dispersion model - Part 3
- Lecture 46 - Two parameter Models-Modeling real reactors with Combinations of Ideal Reactors
- Lecture 47 - Solid Catalyzed Reaction: Reaction and Diffusion - Part 1
- Lecture 48 - Solid Catalyzed Reaction: Reaction and Diffusion - Part 2
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- Lecture 50 - Catalysis and Catalytic Reactors - Part 1
- Lecture 51 - Catalysis and Catalytic Reactors - Part 2
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- Lecture 53 - Collection and Analysis of Rate - Part 1
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- Lecture 56 - Polymath and ODE solver
- Lecture 57 - Catalyst Synthesis - Part 1
- Lecture 58 - Catalyst Synthesis - Part 2
- Lecture 59 - Catalyst Characterization Techniques: BET, Pore size, Pore volume
- Lecture 60 - Catalyst Characterization Techniques

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Lecture 2 - Polymers and Polymerization Techniques

Lecture 3 - Characteristics of Polymers - I

Lecture 4 - Characteristics of Polymers - II

Lecture 5 - Applications of Polymers

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Lecture 7 - Thermodynamics of Polymer Systems - II

Lecture 8 - Thermodynamics of Polymer Systems - III

Lecture 9 - Thermodynamics of Polymer Systems - IV

Lecture 10 - Thermodynamics of Polymer Systems - V

Lecture 11 - Applied polymer rheology: Fluid behavior

Lecture 12 - Applied polymer rheology: Structure and properties of deforming polymer

Lecture 13 - Applied polymer rheology: Flow of polymers with supermolecular structure

Lecture 14 - Applied polymer rheology: Transport phenomena

Lecture 15 - Applied polymer rheology: Rheometry

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Lecture 17 - Heat Transfer Phenomenon in polymer systems: Thermal properties

Lecture 18 - Heat Transfer Phenomenon in polymer systems: Thermal properties and conduction

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Lecture 21 - Mass Transfer Phenomenon in Polymers: Introduction

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