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[Lecture 69 - Utilisation in Different Sectors, Global Status and Future Directions](#)

Lecture 1 - Stirling's Approximation

Lecture 2 - Fourier Transforms and characteristic function

Lecture 3 - Dirac Delta function

Lecture 4 - Applications of delta function and Generating functions

Lecture 5 - Laplace Transforms and Convolution theorem

Lecture 6 - Generating function for discrete variables and Binomial distribution

Lecture 7 - Bernoulli and Poisson distributions

Lecture 8 - Waiting time distributions; Gaussian approximation to Poisson distribution

Lecture 9 - Introduction to Central Limit Theorem

Lecture 10 - Proof of Central Limit Theorem (CLT)

Lecture 11 - Universality of Normal distribution and Exceptions

Lecture 12 - Introduction to Random Walk: Extension of Central Limit Theorem

Lecture 13 - Random walk and Diffusion coefficient: Conditional and Transition

Lecture 14 - Characteristics of Stochastic Phenomena: Markov Processes

Lecture 15 - Propagating Markov processes via Transition Probability Matrix with

Lecture 16 - Chapman-Kolmogorov Equation for Multistep Transition probability and solution

Lecture 17 - Transient solutions and Continuous time Markov process

Lecture 18 - Exact solution to Symmetric (or unbiased) one-dimensional Random walk (1-D RW)

Lecture 19 - Properties of the solution for 1-D unbiased RW

Lecture 20 - 1-D unbiased RW: Asymptotic form of occupancy probability and transition

Lecture 21 - Solution to the problem of 1-D Random Walk with Bias

Lecture 22 - Generalized Random Walk with Bias and Pausing

Lecture 23 - Effect of Pausing on Mean and Variance of Random walk

Lecture 24 - Random-walk in the presence of reflecting barrier

Lecture 25 - Boundary conditions for reflected Random-Walk and formulating absorbing

Lecture 26 - The survival probability and first-passage time distribution for Random walker

Lecture 27 - Random Walk with Bias and Absorber

Lecture 28 - Drift and Survival probability for Random walk with bias and absorber

Lecture 29 - Introduction to gambler's ruin problem

Lecture 30 - Solution for ultimate winning probability in Gambler's ruin problem

Lecture 31 - Solution to gambler's ruin problem with site dependent jump probabilities

- Lecture 32 - Fourier transform method of solving lattice Random walks
- Lecture 33 - Two and higher dimensional Random walks
- Lecture 34 - Formulating the problem of Probability of Return to the origin
- Lecture 35 - Relationship between occupancy probability and first-time-return probability
- Lecture 36 - Proof of Polya's theorem on the probability of return
- Lecture 37 - Return probability estimates in various dimensions and effect of bias in 1-D
- Lecture 38 - Dependence of first time return probability (F_k) on steps
- Lecture 39 - Equilibrium solutions in lattice random walk models
- Lecture 40 - Equilibrium solution to Ehrenfest's flea model
- Lecture 41 - Differential equation formulation of stochastic phenomena
- Lecture 42 - Derivation of Fokker-Planck equation
- Lecture 43 - Generalized transition probability functions for Fokker-Planck equation
- Lecture 44 - Solution to 1-D Fokker-Planck equation for free particle: Method of Fourier
- Lecture 45 - General non-gaussian solution to translationally invariant Chapman-Kolmogorov
- Lecture 46 - Cauchy distribution, power-law and other non-gaussian solutions
- Lecture 47 - Wiener process and solution to absorbing barrier problems from Fokker-Planck
- Lecture 48 - Application of Fourier Sine transform for single absorber problem
- Lecture 49 - Setting up Langevin equation for velocity fluctuations of Brownian particles
- Lecture 50 - Understanding the origin of systematic and random parts of force from kinetic
- Lecture 51 - Kinetic derivation of a formula for delta-correlated random force
- Lecture 52 - Mean square velocity, thermal equilibrium and relationship between relaxation
- Lecture 53 - Velocity autocorrelation in Brownian motion
- Lecture 54 - Derivation of Stokes-Einstein relationship between diffusion coefficient and
- Lecture 55 - Alternative derivation of Stokes-Einstein relationship and Brownian motion with
- Lecture 56 - Numerical simulation of the Langevin equation
- Lecture 57 - Derivation of Klein-Kramers equation from Langevin equation for joint
- Lecture 58 - Illustrative solutions to the Klein-Kramers equation
- Lecture 59 - Numerical simulation: Sampling from general distributions and Central
- Lecture 60 - Numerical simulation of Random walk trajectories and method of solving Fokker

NPTEL : Heterogeneous Catalysis and Catalytic Processes (Chemical Engineering)

Co-ordinators : Dr. K.K. Pant

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NPTEL : Interfacial Engineering (Chemical Engineering)

Co-ordinators : Prof. A.N. Bhaskarwar

Lecture 1 - General Introduction Definitions

Lecture 2 - General Introduction, Definitions, Surface Tension

Lecture 3 - Surface Tension Free Energies and Adsorption

Lecture 4 - Properties over Curved Surfaces

Lecture 5 - Total Surface Energy

Lecture 6 - Interfacial Tension Entropy, Cohesion, Adhesion

Lecture 7 - Cohesion, Adhesion and Spreading

Lecture 8 - Spreading from Liquids and Solids

Lecture 9 - Spreading, Interfacial Tensions, Surface Tensions

Lecture 10 - Spreading, Contact Angles Free Energies

Lecture 11 - Spreading/Contact Angles Rough Surfaces, Free Energies

Lecture 12 - Spreading/Contact Angles Work of Adhesion, De-wetting

Lecture 13 - Work of Adhesion, Surface and Interfacial Tensions

Lecture 14 - Surface and Interfacial Tensions: Drop Weight and Wilhelmy Plate Methods

Lecture 15 - Surface and Interfacial Tensions: Wilhelmy Plate, Pendant Drop and Maximum Bubble Pressure Methods

Lecture 16 - Wetting Balance Method Spreading Coefficient Work of Adhesion Sessile Drop Method, Positive S

Lecture 17 - Indirect and Direct Methods for Positive S, Adhesion Energies Interfacial Potentials

Lecture 18 - Surface and Interfacial Potentials Distribution and Contact Potentials

Lecture 19 - Diffusion Potential Surface and Interfacial Potentials Components of Contact Potential

Lecture 20 - Electrically Charged Monolayers Gouy Theory

Lecture 21 - Equations of State, Cohesion Repulsion, Limiting Area

Lecture 22 - Condensed and Liquid Expanded Monolayers Phase Transformations

Lecture 23 - Films of Polymers Molecular Weight, Surface Viscosity Drag, Canal Method

Lecture 24 - Canal Method Joly's Semi-Empirical Correction Rotational Torsional Surface Viscometer Compressional Moduli

Lecture 25 - Magnitudes of Surface Compressional Moduli Surface Waves and Ripples

Lecture 26 - Surface waves and Ripples, Velocity Effect of Surface Tension and Surface Compressional Modulus Rates of adsorption and absorption Damping

Lecture 27 - Surface waves and ripples, velocity effect of surface tension and surface compressional modulus damping for clean and contaminated, surfaces, fiber from monolayers

Lecture 28 - Shear Elastic Moduli, Yield Stress Fibres from MLs, Surface Reactions

Lecture 29 - Surface Reactions, Comparison with Bulk-Phase Reactions Steric Factors, Inhibition

Lecture 30 - Hydrolyses of Esters by Alkali Acid or Enzyme Photochemical Reactions in Monolayers Polymerization in MLs,

Lactonization

Lecture 31 - Catalytic Effects Reactions in Emulsions Complex Formation

Lecture 32 - Complex Formation Penetration into Monolayers Thermodynamics of Penetration Adsorption from Vapour Phase Mass Transfer

Lecture 33 - Introductory Concepts Resistances and their Magnitudes Evaporation and its Retardation

Lecture 34 - Evaporation and its Retardation Resistances and their Analysis Diffusional Resistance in Gas Phase

Lecture 35 - Resistances in Liquid Phase and Interface and Their Importance Some Effects and Applications, Theory

Lecture 36 - Surface Instability Theories of Mass Transfer Experiments on static and Dynamic Systems

Lecture 37 - Colloida, Aerosols, Emulsions Foams, Coagulation Smoluchowski's Theory

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Lecture 65 (31A)

Lecture 1 - Flowsheet Synthesis - I

Lecture 2 - Flowsheet Synthesis - II

Lecture 3 - Mass Balance - I

Lecture 4 - Mass Balance - II

Lecture 5 - Mass and Energy Balance of Complete Flowsheet

Lecture 6 - Equipment Sizing and Costing

Lecture 7 - Economic Evaluation

Lecture 8 - Design of Batch Plants

Lecture 9 - Simulations for Process Flowsheet

Lecture 10 - Optimization Methods used for Designing

Lecture 11 - Heat Exchanger Network Design - 1

Lecture 12 - Heat Exchanger Network Design - 2

Lecture 13 - Geometric Methods for Reactor Network Synthesis

Lecture 14 - Optimization Methods for Process Design - 1

Lecture 15 - Optimization Methods for Process Design - 2

Lecture 16 - Quantifying Sustainability for Design

Lecture 17 - Process Network Analysis and Footprint Assessment

Lecture 18 - Energy, Exergy and Emergy

Lecture 19 - Ecosystems in Sustainability Assessment

NPTEL : Heat Transfer (Chemical Engineering)

Co-ordinators : Prof. A.K. Ghoshal

Lecture 1 - Introduction to heat transfer

Lecture 2 - General heat conduction equation

Lecture 3 - One dimensional steady state conduction in rectangular coordinate

Lecture 4 - One dimensional steady state conduction in cylindrical and spherical coordinate

Lecture 5 - Critical and optimum insulation

Lecture 6 - Extended surface heat transfer - 1

Lecture 7 - Extended surface heat transfer - 2

Lecture 8 - Analysis of lumped parameter model

Lecture 9 - Transient heat flow in semi infinite solid

Lecture 10 - Infinite body subjected to sudden convective

Lecture 11 - Graphical solutions of unsteady state heat conduction problem

Lecture 12 - Dimensional analysis for forced convection

Lecture 13 - Dimensional analysis for free convection

Lecture 14 - Heat transfer co-relations for laminar and internal flows

Lecture 15 - Heat transfer co-relations for turbulent and internal flows

Lecture 16 - Co-relation for turbulent and external flows

Lecture 17 - Heat transfer co-relations for flow across tube banks

Lecture 18 - Momentum and heat transfer analogies

Lecture 19 - Boundary layer heat transfer

Lecture 20 - Boundary layer equations

Lecture 21 - Approximate analysis in boundary layer

Lecture 22 - Theoretical concepts of natural / free convection heat transfer

Lecture 23 - Empirical relations for free convection heat transfer

Lecture 24 - Condensation heat transfer over vertical plate

Lecture 25 - Condensation heat transfer for various conditions and geometries

Lecture 26 - Fundamentals of boiling heat transfer

Lecture 27 - Boiling heat transfer co-relations

Lecture 28 - Classification of heat exchangers

Lecture 29 - Various types of shell and tube heat exchangers

Lecture 30 - Various types of compact heat exchangers

Lecture 31 - Effectiveness-NTU, method of heat exchanger analysis

- [Lecture 32 - Design of double pipe heat exchanger](#)
- [Lecture 33 - Design of shell and tube heat exchanger](#)
- [Lecture 34 - Introduction to evaporation and evaporators](#)
- [Lecture 35 - Evaporation principles and evaporator performance](#)
- [Lecture 36 - Evaporator calculations](#)
- [Lecture 37 - Introduction to radiation heat transfer](#)
- [Lecture 38 - Radiation intensity and radiation view factor](#)
- [Lecture 39 - Radiation heat exchange](#)
- [Lecture 40 - Radiation shield and gas radiation](#)

NPTEL : Mass Transfer Operations I (Chemical Engineering)

Co-ordinators : Dr. B. Mandal

Lecture 1 - Introduction to Mass Transfer

Lecture 2 - Molecular Diffusion

Lecture 3 - Fick's Law of Diffusion

Lecture 4 - Steady state molecular diffusion in fluids - Part I

Lecture 5 - Steady state molecular diffusion in fluids - Part II

Lecture 6 - Diffusion coefficient: Measurement and Prediction - Part I

Lecture 7 - Diffusion Coefficient: Measurement and Prediction - Part II

Lecture 8 - Multicomponent Diffusion and Diffusivity in Solids

Lecture 9 - Concept of Mass Transfer Coefficient

Lecture 10 - Dimensionless Groups and Co-relations for Convective

Lecture 11 - Mass Transfer coefficient in Laminar Flow Condition

Lecture 12 - Boundary Layer Theory and Film Theory in Mass Transfer

Lecture 13 - Mass Transfer Coefficients in Turbulent Flow

Lecture 14 - Interphase Mass Transfer and Mass Transfer Theories - Part I

Lecture 15 - Interphase Mass Transfer and Mass Transfer Theories - Part II

Lecture 16 - Interphase Mass Transfer and Mass Transfer Theories - Part III

Lecture 17 - Agitated and Sparged Vessels

Lecture 18 - Tray Column - Part I

Lecture 19 - Tray Column - Part II

Lecture 20 - Packed Tower

Lecture 21 - Introduction to Absorption and Solvent selection

Lecture 22 - Packed Tower Design - Part I

Lecture 23 - Packed Tower Design - Part II

Lecture 24 - Packed Tower Design - Part III

Lecture 25 - Mass Transfer Coefficients Correlation and HETP Concept

Lecture 26 - Tray Tower Design and Introduction to Multicomponent System

Lecture 27 - Introduction to Distillation and Phase diagrams

Lecture 28 - Azeotropes and Enthalpy Concentration Diagrams

Lecture 29 - Flash Distillation

Lecture 30 - Batch and Steam Distillation

Lecture 31 - Fractional Distillation

[Lecture 32 - Fractional Distillation: McCabe Thiele Method](#)

[Lecture 33 - Fractional Distillation: Minimum Reflux and Pinch Point](#)

[Lecture 34 - Fractional Distillation: Subcooled Reflux ,Tray Efficiency and Use of Open Steam](#)

[Lecture 35 - Fractional Distillation: Multiple Feeds and Side Stream](#)

[Lecture 36 - Multistage Batch Distillation with Reflux](#)

[Lecture 37 - Fractional Distillation: Ponchan and Savarit Method](#)

[Lecture 38 - Ponchan and Savarit Method and Packed Tower Distillation](#)

[Lecture 39 - Multicomponent Distillation](#)

Lecture 1 - General Introduction to the Course and Syllabus

Lecture 2 - Hierarchical Approach to Process Design - I

Lecture 3 - Hierarchical Approach to Process Design - Examples

Lecture 4 - Input Information and Design Aspects of Batch vs. Continuous Process

Lecture 5 - Input / Output Structure of Flowsheet - Part I

Lecture 6 - Input / Output Structure of Flowsheet - Part II

Lecture 7 - Input / Output Structure of Flowsheet - Part III and Recycle Structure of Flowsheet - Part I

Lecture 8 - Recycle Structure of Flowsheet - Part II

Lecture 9 - Recycle Structure of Flowsheet - Part III

Lecture 10 - Recycle Structure of Flowsheet - Part IV and Tutorial - Part I

Lecture 11 - Tutorial - Part II

Lecture 12 - Tutorial - Part III

Lecture 13 - Algorithm and Basic Principles of Reactor Design

Lecture 14 - Reactor Non-ideality, Residence Time Distribution (RTD) and Types of Chemical Reactions & Catalysts

Lecture 15 - Types of Reactors and Selection Criteria

Lecture 16 - Tutorial on Reactor Design and Cost Estimation

Lecture 17 - General Introduction (Types of Separation Processes and Criteria for Selection of the Processes)

Lecture 18 - Guidelines for Design of Separation Systems

Lecture 19 - Design of Distillation Columns - Part I (Sequencing of Columns, Energy Integration / Thermal Coupling of the Columns)

Lecture 20 - Design of Distillation Columns - Part II (Plate and Packed Towers, Number of Plates, Diameter and Height of the Column)

Lecture 21 - Tutorial - Part I (Design of Absorption Column)

Lecture 22 - Tutorial - Part II (Design of Distillation Column)

Lecture 23 - Concepts and Basic Principles of Energy (or Heat) Integration - Part 1 (Composite Curves and T_{min})

Lecture 24 - Concepts and Basic Principles of Heat Integration - Part 2 (Problem Table Algorithm and Identification of Energy Targets)

Lecture 25 - Identification of Area and Cost Targets

Lecture 26 - Pinch Technology for Heat Exchanger Network Design

Lecture 27 - Tutorial - I (Composite Curves, Problem Table Algorithm and Enthalpy Intervals)

Lecture 28 - Tutorial - II (Heat Exchanger Network Synthesis Using Pinch Technology)

Lecture 29 - Selection of Process, Design of Flowsheet and Materials Balance

Lecture 30 - Energy Balance, Process Alternatives and Design of the Absorber

Lecture 31 - Rules of Thumb & Their Limitations and Tutorial

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[Lecture 32 - General Concepts & Principles and Cost Allocation Procedure](#)

[Lecture 33 - Lumped Cost Diagram and Cost Allocation Diagram \(Case Study of Hydro-dealkylation Process\)](#)

[Lecture 34 - Assessment of Process Alternatives with Cost Allocation Diagram \(Case Study of Hydrodealkylation Process\)](#)

[Lecture 35 - Tutorial on Lumped Cost Diagram and Cost Allocation Diagram](#)

[Lecture 36 - Introduction to Chemical Projects and Their Economic Aspects](#)

[Lecture 37 - Selection of the Process and Project Site - Part I](#)

[Lecture 38 - Selection of the Process and Project Site - Part II](#)

[Lecture 39 - Project Cost Estimation - Part I](#)

[Lecture 40 - Project Cost Estimation - Part II](#)

[Lecture 41 - Simplified Cost Model and Depreciation](#)

[Lecture 42 - Time Value of Money](#)

[Lecture 43 - Measures of Profitability and Project Evaluation - Part I](#)

[Lecture 44 - Measures of Profitability and Project Evaluation - Part II](#)

[Lecture 45 - Tutorial on Project Economics - Part I](#)

[Lecture 46 - Tutorial on Project Economics - Part II](#)

Lecture 1 - Introduction

Lecture 2 - Particle properties

Lecture 3 - Particle / Powder Classifications

Lecture 4 - Minimum Fluidization Velocity: Fluid-solid System

Lecture 5 - Minimum Fluidization Velocity: Liquid-solid and gas-liquid-solid System

Lecture 6 - Flow regime and its map: Gas-solid Fluidization

Lecture 7 - Flow regime and its map: Liquid-solid and Gas-liquid-solid Fluidization

Lecture 8 - Frictional pressure drop in fluidized bed-fluid-solid system

Lecture 9 - Frictional pressure drop in fluidized Bed-Gas-liquid-solid system

Lecture 10 - Analysis of Frictional Pressure Drop in Fluidized Bed By Different Models

Lecture 11 - Gas Distribution Through Distributor

Lecture 12 - Calculation of gas pumping power consumption in fluidized bed

Lecture 13 - Bubbling Fluidization Part 1: Bubble Characteristics

Lecture 14 - Bubbling Fluidization Part 2: Bubble Characteristics (Continued...)

Lecture 15 - Bubbling Fluidization Part 3: Bubble coalescence in three-phase fluidization

Lecture 16 - Bubbling Fluidization Part 4: Bubble breakup in three-phase fluidization

Lecture 17 - Bubbling Fluidization Part 5: Gas and solid movements at bubble

Lecture 18 - Bubbling Fluidization Part 6: Slugging Bed

Lecture 19 - Entrainment Characteristics (Part 1) : Entrainment Characteristics

Lecture 20 - Entrainment Characteristics (Part 2) : Fast fluidization condition

Lecture 21 - Entrainment Characteristics (Part 2) : Elutriation Characteristics

Lecture 22 - Entrainment Characteristics (Part 2) : Attrition in Fluidized Bed (Part 1)

Lecture 23 - Attrition in Fluidized Bed (Part 2)

Lecture 24 - Solid movement, mixing: Gas-fluidized Bed

Lecture 25 - Solid segregation: Gas-fluidized bed

Lecture 26 - Solid mixing and segregation: Liquid-solid fluidized bed

Lecture 27 - Gas Dispersion and Interchange

Lecture 28 - Mass transfer in fluidized Bed-Gas-solid system

Lecture 29 - Mass transfer in fluidized Bed-Gas-liquid-solid system (Continued...)

Lecture 30 - Heat transfer Characteristics

Lecture 31 - Fluidized bed reactor design and its performance

Lecture 1 - An Introduction

Lecture 2 - Fluid Mechanics: A Review

Lecture 3 - Solid Mechanics: A Review

Lecture 4 - Rheology of blood

Lecture 5 - Blood morphology

Lecture 6 - Blood flow in a channel

Lecture 7 - Viscometers and Rheometers

Lecture 8 - Viscoelasticity

Lecture 9 - Flow Bifurcation

Lecture 10 - Pulsatile Flow 1

Lecture 11 - Pulsatile Flow 2

Lecture 12 - Flow in Elastic Tubes

- Lecture 1 - An Introduction
- Lecture 2 - Interface and Surface Tension
- Lecture 3 - Flow Regimes 1
- Lecture 4 - Flow Regimes 2
- Lecture 5 - Taylor Flow 1
- Lecture 6 - Taylor Flow 2
- Lecture 7 - Computational Techniques
- Lecture 8 - Bubble and Droplet Generation
- Lecture 9 - Interface and Surface tension 2
- Lecture 10 - Void Fraction and Pressure Drop
- Lecture 11 - Liquid-Liquid Flow: Flow Regimes
- Lecture 12 - Ideal annular Flow
- Lecture 13 - Taylor Flow : Heat transfer 1
- Lecture 14 - Taylor Flow : Heat transfer 2
- Lecture 15 - Taylor Flow : Meat Transfer 1
- Lecture 16 - Taylor Flow : Meat Transfer 2
- Lecture 17 - Flow boiling in microchannels
- Lecture 18 - Flow boiling in microchannels (Continued...)
- Lecture 19 - Flow Measurement Techniques
- Lecture 20 - Particle image Velocimetry
- Lecture 21 - Inertial Microfluidics
- Lecture 22 - Microfluidic applications
- Lecture 23 - Microfluidic applications (Continued...)
- Lecture 24 - Concluding Remarks

Lecture 1 - Introduction to Multiphase flow Measurement Techniques

Lecture 2 - Invasive and Non-invasive Techniques

Lecture 3 - Hot Wire Anemometry

Lecture 4 - Optical Fiber Probe

Lecture 5 - Laser Doppler Anemometry (LDA)

Lecture 6 - LDA Post Processing and Particle Image Velocimetry (PIV)

Lecture 7 - PIV and Positron Emission Particle Tracking

Lecture 8 - Radioactive Particle Tracking - I

Lecture 9 - Radioactive Particle Tracking - II

Lecture 10 - Capacitance Probe, Optical Fiber Probe and ECT

Lecture 11 - Gamma-ray and X-ray Tomography, MRI

Lecture 12 - Summary

Lecture 1 - Multiphase flow introduction

Lecture 2 - Fundamental definitions and terminology used in Multiphase - I

Lecture 3 - Fundamental definitions and terminology used in Multiphase - II

Lecture 4 - Flow Regime Map for Gas-Liquid System

Lecture 5 - Flow Regime Map for Fluid-Solid System

Lecture 6 - Pneumatic Conveying

Lecture 7 - Momentum Equation through Reynolds Transport Theorem

Lecture 8 - Lockhart Martinelli Correlation

Lecture 9 - Pressure Drop Calculation for Homogeneous Flow

Lecture 10 - Pressure Drop Calculation for Separated and Annular Flow Regime

Lecture 11 - Lagrangian Tracking of Single Particle Under Different Forces

Lecture 12 - Multiphase Interactions: Drag Force

Lecture 13 - Multiphase Interactions: Multi-particle Drag, Virtual Mass Force, Basset Force and Lift Force

Lecture 14 - Introduction to Multiphase Flow Modeling

Lecture 15 - Algebraic Slip Method and Euler-Euler Method

Lecture 16 - KTGF and Euler-Lagrangian Model

Lecture 17 - Measurement Techniques: Velocity Measurement

Lecture 18 - Measurement Techniques: Phase Fraction Measurement

Lecture 19 - Bubble Column

Lecture 20 - Packed Bed Reactor

Lecture 21 - Fluidized Bed Reactor

Lecture 22 - Summary

Lecture 1 - Introduction to Polymers

Lecture 2 - Ideal Chain Models

Lecture 3 - Ideal and Real Chains

Lecture 4 - Thermodynamics of Polymer Solutions - I

Lecture 5 - Thermodynamics of Polymer Solutions - II

Lecture 6 - Thermodynamics of Polymer Solutions - III

Lecture 7 - Phase Behaviour of Polymer Solutions and Blends

Lecture 8 - Phase Behaviour of Polymer Blends and Copolymers

Lecture 9 - Determination of Polymer Molar Mass: Osmometry

Lecture 10 - Determination of Polymer Molar Mass: Static Light Scattering - I

Lecture 11 - Determination of Polymer Molar Mass: Static Light Scattering - II

Lecture 12 - Determination of Polymer Molar Mass: Viscometry and GPC

Lecture 13 - Branching: Hyperbranched Polymers

Lecture 14 - Branching, Network Formation and Gelation

Lecture 15 - Gelation and Swelling of Network Polymers

Lecture 16 - Amorphous State of Polymers

Lecture 17 - Crystalline State of Polymers

Lecture 18 - Mechanical Properties of Polymers

Lecture 19 - Viscoelasticity: Mechanical Models

Lecture 20 - Viscoelasticity, Dynamic Mechanical Analysis and Rheology

Lecture 21 - Rubber Elasticity

Lecture 22 - Unentangled Polymer Dynamics

Lecture 23 - Entangled Polymer Dynamics

Lecture 24 - Review

Lecture 1 - Introduction to Natural Gas - I

Lecture 2 - Introduction to Natural Gas - II

Lecture 3 - Introduction to Natural Gas - III

Lecture 4 - Wellbore Performance Relationship (WPR)

Lecture 5 - Choke Performance Relationship (CPR)

Lecture 6 - Nodal Analysis

Lecture 7 - Inflow Performance Relationship (IPR) - I

Lecture 8 - Inflow Performance Relationship (IPR) - II

Lecture 9 - Gas Well Testing

Lecture 10 - Wellbore Performance Relationship (WPR)

Lecture 11 - Choke Performance Relationship (CPR)

Lecture 12 - Nodal Analysis

Lecture 13 - Natural Gas Separation - I

Lecture 14 - Natural Gas Separation - II

Lecture 15 - Dehydration of Natural Gas

Lecture 16 - Sweetening of Natural Gas

Lecture 17 - Compressor Design

Lecture 18 - Measurement of Natural Gas

Lecture 19 - Transportation of Natural Gas - I

Lecture 20 - Transportation of Natural Gas - II

Lecture 21 - Unconventional production of Natural Gas

Lecture 22 - Review: Concluding Remarks

Lecture 1 - Introduction

Lecture 2 - First law for closed systems

Lecture 3 - First law for open systems

Lecture 4 - Simple processes

Lecture 5 - Processes involving liquids and ideal gases

Lecture 6 - Temperature dependency of C_p in an ideal gas

Lecture 7 - Efficiency of Heat engines and Statement of Second Law

Lecture 8 - Entropy

Lecture 9 - Lost Work

Lecture 10 - Maxwell's Relations

Lecture 11 - Thermodynamic Diagrams

Lecture 12 - Thermodynamic Tables, Residual Properties

Lecture 13 - Virial Equation of State

Lecture 14 - Residual property relations from EoS

Lecture 15 - Cubic Equation of State

Lecture 16 - Cubic Equation of State

Lecture 17 - Thermodynamic Tables

Lecture 18 - Correlations for Liquids

Lecture 19 - Process Involving Phase Changes

Lecture 20 - Chemical potential

Lecture 21 - Partial molar properties

Lecture 22 - Examples

Lecture 23 - Ideal Solutions

Lecture 24 - Excess Properties

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Lecture 8 - Chemical Shifts

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Lecture 14 - Surface Tension and its Measurement - Part 2

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Lecture 16 - Interfacial Tension and Influence of Surface Curvature

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- Lecture 3 - Safety and Loss Prevention
- Lecture 4 - Sulfuric Acid: Reactions and Thermodynamics
- Lecture 5 - SO₂ Conversion Reactor and Sulfuric Acid Production Process
- Lecture 6 - Sulfur Production: Claus Process
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- Lecture 8 - Coal Gasification
- Lecture 9 - Coal Gasifiers
- Lecture 10 - Gasification Technology and Applications
- Lecture 11 - Thermodynamics of Ammonia Synthesis
- Lecture 12 - Integrated Ammonia Plant and Hydrogen Recovery - I
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- Lecture 14 - Urea Production
- Lecture 15 - Nitric acid: Reactions and Thermodynamics
- Lecture 16 - Production of Phosphoric Acid: Dihydrate Process
- Lecture 17 - Production of Phosphoric Acid: Hemihydrate Process
- Lecture 18 - Emission Abatement in Phosphoric Acid Plants
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- Lecture 21 - Heterogeneous Catalysis
- Lecture 22 - Catalysis with Zeolites and production of Iso-butene
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- Lecture 24 - Periodic Flow Reversal and Production of Styrene
- Lecture 25 - Selective Oxidation Processes and Ethene Production
- Lecture 26 - Monolith Reactors for Automotive Emission
- Lecture 27 - Methanol Production
- Lecture 28 - Methanol and Formaldehyde Production
- Lecture 29 - Fischer-Tropsch Synthesis
- Lecture 30 - Fischer Tropsch Process: SASOL and SDMS
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Lecture 4 - Mechanism of Size Reduction

Lecture 5 - General Machines for Size Reduction

Lecture 6 - Laws of Energy for Size Reduction

Lecture 7 - Introduction on Size Enlargement

Lecture 8 - Mechanism of Size Enlargement

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Lecture 10 - Flow Past a Cylinder and Spherical Particle

Lecture 11 - Terminal velocity of single particle

Lecture 12 - Multiple particle Interaction/Sedimentation: Hindered settling velocity

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Lecture 17 - Degree of mixing and Its Assessment

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Lecture 23 - Particulate Matter Separation by Gravity Settling Chamber

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Lecture 19 - Gasification

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Lecture 21 - Biochemical conversion processes - Anaerobic Digestion in Landfills

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Lecture 23 - Practice examples (Biogas and Bio-ethanol production)

Lecture 24 - Chemical Conversion Processes - Types of Feedstock and Pretreatment

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Lecture 26 - Green diesel synthesis from bio-based feedstocks

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- Lecture 7 - Energy Fluctuations for Monoatomic Gases
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- Lecture 10 - Partition Function for Ideal Polyatomic Gas
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- Lecture 13 - Non-reacting Ideal Gas Mixture
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- Lecture 17 - Microcanonical and Grand Canonical Ensemble
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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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- Lecture 15 - Control of Complex Column Configurations
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- Lecture 19 - Control of reactors
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- Lecture 21 - CSTR heat management
- Lecture 22 - Heat Exchangers and Miscellaneous Systems
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Lecture 16 - Maxwell Relation

Lecture 17 - Stability Criteria

Lecture 18 - Thermodynamics of phase equilibrium

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Lecture 20 - General discussion on fugacity

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Lecture 24 - Partial Molar Properties from experimental data

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Lecture 29 - Approaches to phase equilibria calculation

Lecture 30 - Traditional Approaches to phase equilibria calculations

Lecture 31 - Algorithms for vapor-liquid equilibria

- Lecture 32 - Probability and Multiplicity
- Lecture 33 - Multiplicity and maximising the multiplicity
- Lecture 34 - Introduction to statistical mechanics
- Lecture 35 - Partition function for independent particles
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- Lecture 37 - Models of Molecular Pair Potentials
- Lecture 38 - Molecular Theory of Corresponding States
- Lecture 39 - Molecular Interactions in Dense Fluid Media
- Lecture 40 - Models for Electrolyte Systems
- Lecture 41 - Membrane Osmometry
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- Lecture 44 - Models for fugacity of liquid mixtures - 1
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NPTEL : Microscale Transport Processes (Chemical Engineering)

Co-ordinators : Dr. Somnath Ganguly, Prof. S. Dasgupta

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Lecture 27 - Slip flow

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NPTEL : Multiphase Flow (Chemical Engineering)

Co-ordinators : Prof. P.K. Das, Prof. Gargi Das

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Lecture 4 - Flow Pattern Maps Fascinating Taylor Bubbles

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Lecture 9 - The Homogeneous Flow Theory (Continued...)

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Lecture 11 - Compressible Flow A Recapitulation (Continued...)

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

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

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- Lecture 56 - Flow Metering and Associated Problems
- Lecture 57 - Flow Metering and Associated Problems (Continued...)
- Lecture 58 - Flow Metering and Associated Problems (Continued...)
- Lecture 59 - Turbulence
- Lecture 60 - Flow Through Porous Media

Lecture 1 - Principles of Enhanced Oil Recovery (EOR); Difference of Tertiary recovery

Lecture 2 - Pressure maintenance and Well Patterns

Lecture 3 - Need for EOR and Screening Methods

Lecture 4 - Sweep and Displacement Efficiencies

Lecture 5 - Fundamental of immiscible fluid displacement processes

Lecture 6 - Buckley Leverette Theorem for one dimensional immiscible displacement

Lecture 7 - Welge Method for Oil Recovery Calculation

Lecture 8 - Effects of various parameters on recovery by water flood

Lecture 9 - Chemical Enhanced Oil Recovery Methods

Lecture 10 - Enhanced Oil Recovery by Polymer Flooding - I

Lecture 11 - Enhanced Oil Recovery by Polymer Flooding - II

Lecture 12 - Enhanced Oil Recovery by Polymer Flooding - III

Lecture 13 - Oil Recovery by Polymer Flooding: Lab Study and Recovery Calculations

Lecture 14 - Surfactant Flooding: Properties of Surfactants

Lecture 15 - Surfactant Flooding for Enhanced Oil recovery - I

Lecture 16 - Surfactant Flooding for Enhanced Oil recovery - II

Lecture 17 - Phase Behaviour of Surfactant Stabilized Microemulsions

Lecture 18 - Surfactant Flooding and Screening Criteria

Lecture 19 - Micellar - Polymer Flooding

Lecture 20 - Microemulsion Flooding

Lecture 21 - Nanoemulsion and Pickering Emulsion for EOR

Lecture 22 - Alkali Flooding for EOR and Monitoring of Chemical Flooding

Lecture 23 - Foam Flooding for EOR

Lecture 24 - Introduction to Miscible Flooding, Thermodynamics of miscibility

Lecture 25 - Thermodynamics of miscibility and Mechanisms of Miscible Displacement

Lecture 26 - Minimum Miscibility Pressure (MMP)

Lecture 27 - Mechanisms of Miscible flooding

Lecture 28 - Enriched Gas Injection/Condensing Gas Drive

Lecture 29 - CO₂ Sequestration, utilisation and storage

Lecture 30 - Mechanisms of CO₂ Miscible flooding

Lecture 31 - Immiscible flooding Mechanisms of CO₂

- Lecture 32 - Thermal Oil Recovery Methods
- Lecture 33 - Mechanisms of Thermal Oil Recovery
- Lecture 34 - Thermal Oil Recovery: Hot Water and Steam flooding
- Lecture 35 - Steam Flooding for EOR
- Lecture 36 - Steam Assisted Gravity Drainage and Hybrid Steam Injection
- Lecture 37 - Thermal Oil Recovery-In-Situ Combustion
- Lecture 38 - Air Requirement in In-situ Combustion
- Lecture 39 - Electromagnetic heating and Ultrasonication for Enhanced Oil Recovery
- Lecture 40 - Low salinity water flooding
- Lecture 41 - Low salinity water flooding (Continued...)
- Lecture 42 - Low salinity water flooding (Continued...)
- Lecture 43 - Low salinity water flooding (Continued...)
- Lecture 44 - Low salinity water flooding in Carbonate Reservoir - Smart Water Flooding
- Lecture 45 - Nanotechnology based EOR
- Lecture 46 - Nanotechnology based EOR (Continued...)
- Lecture 47 - Microbial Enhanced Oil Recovery
- Lecture 48 - Carbonated water injection (CWI) for EOR
- Lecture 49 - Plasma pulse technology and Exothermic Chemical Treatment (ECT) in EOR
- Lecture 50 - Enhanced Gas Recoveries
- Lecture 51 - Water Shutoff and Profile Modification
- Lecture 52 - Reservoir Simulation Studies for Enhanced Oil Recovery
- Lecture 53 - Introduction to Artificial Intelligence and Machine Learning in EOR
- Lecture 54 - Techno-economic feasibility analysis
- Lecture 55 - Review of Classes
- Lecture 56 - Review of Classes (Continued...)
- Lecture 57 - Review of Classes (Continued...)
- Lecture 58 - Case Studies of EOR Methods
- Lecture 59 - Case Studies of EOR Methods (Continued...)
- Lecture 60 - Role of Petroleum Engineering for design and operation of EOR Methods

Lecture 1 - Background of Adsorption

Lecture 2 - Adsorbents

Lecture 3 - Key Features of Adsorption, Thermodynamic Background

Lecture 4 - Adsorption Isotherm

Lecture 5 - Langmuir Isotherm

Lecture 6 - Multicomponent Langmuir and Other Isotherms

Lecture 7 - Other Important Isotherms (Continued...)

Lecture 8 - Equilibrium Modelling - I

Lecture 9 - Equilibrium Modelling - II

Lecture 10 - Adsorption Kinetics

Lecture 11 - BET Analysis

Lecture 12 - Gas Sorption

Lecture 13 - Surface Area Calculations

Lecture 14 - Pore Size Analysis

Lecture 15 - Limitations of BET Analysis

Lecture 16 - Adsorption and Diffusion Models

Lecture 17 - Film Diffusion

Lecture 18 - Linear Driving Force Model

Lecture 19 - Intraparticle Adsorption Diffusion Model

Lecture 20 - Slurry Adsorption

Lecture 21 - Fixed Bed Adsorption

Lecture 22 - Mass Transfer Zone Modelling

Lecture 23 - Fixed Bed Design: Thomas Model

Lecture 24 - Fixed Bed Design: Adams-Bohart and Other Models

Lecture 25 - Fixed Bed Design: Constant Pattern Behaviour

Lecture 26 - Fixed Bed Design: Multi-Scale Model

Lecture 27 - Fixed Bed Adsorption: Illustrative Problems

Lecture 28 - Introduction to Pressure Swing Adsorption (PSA)

Lecture 29 - Modelling PSA Systems

Lecture 30 - Design of Medical Grade Oxygen Concentrator

Lecture 31 - Introduction to Chromatography

[Lecture 32 - Chromatography: Principles](#)

[Lecture 33 - Column Chromatography](#)

[Lecture 34 - Chromatography: Illustrative Problems 1](#)

[Lecture 35 - Chromatography: Illustrative Problems 2](#)

[Lecture 36 - Ion Exchange: Principles](#)

[Lecture 37 - Ion Exchange Adsorbents](#)

[Lecture 38 - Ion Exchange: Illustrative Problem](#)

[Lecture 39 - Ion Exchange Cycle](#)

[Lecture 40 - Ion Exchange Cycle: Illustrative Problem](#)

- 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

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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

[Lecture 32 - Ordinary Differential Equations \(initial value problems\) - Part 8](#)

[Lecture 33 - Ordinary Differential Equations \(initial value problems\) - Part 9](#)

[Lecture 34 - Ordinary Differential Equations \(boundary value problems\) - Part 1](#)

[Lecture 35 - Ordinary Differential Equations \(boundary value problems\) - Part 2](#)

[Lecture 36 - Ordinary Differential Equations \(boundary value problems\) - Part 3](#)

[Lecture 37 - Partial Differential Equations - Part 1](#)

[Lecture 38 - Partial Differential Equations - Part 2](#)

[Lecture 39 - Partial Differential Equations - Part 3](#)

[Lecture 40 - Partial Differential Equations - Part 4](#)

NPTEL : Particle Characterization (PG) (Chemical Engineering)

Co-ordinators : Dr. R. Nagarajan

- 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
- Lecture 30 - Nano-particle Characterization: Top-Down Synthesis Methods
- Lecture 31 - Nano-particle Characterization: Dispersion

[Lecture 32 - Nano-particle Characterization: Properties & Techniques](#)

[Lecture 33 - Practical Relevance of Particle Characterization: Nano-Fluids](#)

[Lecture 34 - Practical Relevance of Particle Characterization: Filtration](#)

[Lecture 35 - Practical Relevance of Particle Characterization: Cleanrooms](#)

[Lecture 36 - Practical Relevance of Particle Characterization: High-Technology Manufacturing](#)

[Lecture 37 - Practical Relevance of Particle Characterization: Explosivity](#)

[Lecture 38 - Practical Relevance of Particle Characterization: Environment & Human Health](#)

[Lecture 39 - Practical Relevance of Particle Characterization: Other Applications](#)

[Lecture 40 - Summary](#)

Lecture 1 - Introduction

Lecture 2 - Random Variables

Lecture 3 - Discrete Probability Distributions

Lecture 4 - Example Set - I

Lecture 5 - Continuous probability distributions

Lecture 6 - Normal probability distribution

Lecture 7 - Exploratory Data Analysis - Part A

Lecture 8 - Exploratory Data Analysis - Part B

Lecture 9 - Example Set - II

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

Lecture 17 - Confidence Intervals (Part A)

Lecture 18 - Confidence Intervals (Part B)

Lecture 19 - The T-distribution

Lecture 20 - Chi-square distribution

Lecture 21 - F-Distribution

Lecture 22 - Example Set - V

Lecture 23 - Hypothesis Testing - Part A

Lecture 24 - Hypothesis Testing - Part B

Lecture 25 - Hypothesis Testing - Part C

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

Lecture 27 - Analysis of Experiments involving Single Factor - Part B

Lecture 28 - Blocking and Randomization

Lecture 29 - Example Set - VI - Part A

Lecture 30 - Example Set - VI - Part B

Lecture 31 - Factorial Design of Experiments - Part A

[Lecture 32 - Factorial Design of Experiments - Part B: 22 Factorial Design](#)

[Lecture 33 - Fractional Factorial Design - Part A](#)

[Lecture 34 - Fractional Factorial Design - Part B](#)

[Lecture 35 - Factorial Design of Experiments: Example Set \(Part A\)](#)

[Lecture 36 - Factorial Design of Experiments: Example Set \(Part B\)](#)

[Lecture 37 - Factorial Design of Experiments: Example Set \(Part C\)](#)

[Lecture 38 - Regression Analysis: Part A](#)

[Lecture 39 - Regression Analysis: Part B](#)

[Lecture 40 - Hypothesis Testing in Linear Regression](#)

[Lecture 41 - Discussion on Regression Output](#)

[Lecture 42 - Regression Analysis: Example Set 8](#)

[Lecture 43 - Regression Analysis: Example Set 8 \(Continued...\)](#)

[Lecture 44 - Regression Analysis: Example Set 8 \(Continued...\)](#)

[Lecture 45 - Orthogonal Model Fitting Concepts - Part A](#)

[Lecture 46 - Orthogonal Model Fitting Concepts - Part B](#)

[Lecture 47 - Experimental Design Strategies - A](#)

[Lecture 48 - Experimental Design Strategies - B](#)

[Lecture 49 - Experimental Design Strategies - C](#)

[Lecture 50 - Response Surface Methodology - A](#)

[Lecture 51 - Response Surface Methodology - B](#)

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

[Lecture 53 - Optimal Designs - Part B](#)

[Lecture 54 - Statistics for Experimentalists - Summary Part A](#)

[Lecture 55 - Statistics for Experimentalists - Summary Part B](#)

- Lecture 1 - Introduction and overview of the course: Multiphase flows
- 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 $R_w = 1$
- Lecture 17 - Pulsatile flow: Perturbation solution for $R_w = 1$
- 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
- Lecture 28 - Rayleigh Benard convection: Discussion of results
- Lecture 29 - Rayleigh-Taylor heavy over light instability
- Lecture 30 - Rayleigh-Taylor instability (Continued...)
- Lecture 31 - Capillary jet instability: Problem formulation

[Lecture 32 - Capillary jet instability: Linear stability analysis](#)

[Lecture 33 - Capillary jet instability: Rayleigh's Work Principle](#)

[Lecture 34 - Tutorial Session: Solution of Assignment 4 on linear stability](#)

[Lecture 35 - Turing patterns: Instability in reaction-diffusion systems](#)

[Lecture 36 - Turing patterns: Results](#)

[Lecture 37 - Marangoni convection: Generalised tangential and normal stress boundary conditions](#)

[Lecture 38 - Marangoni convection: Stability analysis](#)

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

[Lecture 40 - Flow in a circular curved channel: Solution by regular perturbation](#)

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

[Lecture 42 - Stability of flow through curved channels: Numerical calculation](#)

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

[Lecture 44 - Viscous Fingering: Stability analysis](#)

[Lecture 45 - Shallow Cavity flows](#)

Lecture 1 - Introduction - Lecture 1.1 A

Lecture 2 - Introduction - Lecture 1.1 B

Lecture 3 - Introduction - Lecture 1.2 A

Lecture 4 - Introduction - Lecture 1.2 B

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...)

Lecture 1 - Introduction

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)

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[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 \(Adobe Presenter\)](#)

Lecture 1 - Motivation and Introduction - Part I

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

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Lecture 6 - Shrinking Core Model (Continued...)

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Lecture 14 - Design equation for MF of solids, mixture of particles for different sizes but unchanging size, uniform gas composition, SCM

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NPTEL : System Identification (Chemical Engineering)

Co-ordinators : Dr. Arun K.Tangirala

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Lecture 4 - Equation of Continuity Differential

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Lecture 10 - Introduction to cylindrical coordinate systems

Lecture 11 - Continuity equation in cylindrical coordinates

Lecture 12 - Solution of Navier Stokes in the Cylindrical co-ordinate system - 1

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Lecture 22 - Choice of Scaling Parameter

Lecture 23 - Non Dimensional analysis

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Lecture 25 - Non-dimensional analysis - 3 (Buckingham Pi Theorem)

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Lecture 36 - Colloidal aggregates - Introduction

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Lecture 58 - Minor Losses, Sudden Expansion and Contraction

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Lecture 61 - Momentum and Kinetic Energy Correction Factor

Lecture 62 - pressure drop in pipes which connected in series

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- Lecture 2 - Measurement and Prediction - Part 2
- Lecture 3 - Overview of Transport Phenomena
- Lecture 4 - Scope of Course
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- Lecture 6 - Lagrangian and Eulerian Descriptions - Part 1
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- Lecture 8 - Substantial Derivative - Part 1
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- Lecture 11 - Substantial Derivative Example - 2
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- Lecture 14 - Streamline, Pathline: Steady Flow Example
- Lecture 15 - Streamline, Pathline, Streakline: Unsteady Flow Example
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- Lecture 17 - Reynolds transport theorem : Introduction
- Lecture 18 - Reynolds transport theorem : Simplified form
- Lecture 19 - Reynolds transport theorem : General form - Part 1
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- Lecture 32 - Integral linear momentum balance : Examples - Part 2
- Lecture 33 - Integral linear momentum balance : Examples - Part 3
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- Lecture 41 - Components of Stress Vector : Example
- Lecture 42 - Properties of stress tensor - Part 1
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- Lecture 44 - Total stress tensor for fluids
- Lecture 45 - Comparison of solids and fluids
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- Lecture 48 - Differential linear momentum balance : All terms
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- Lecture 51 - Normal Strain and Shear Strain - Part 1
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- Lecture 53 - Displacement Field and Displacement Gradient - Part 1
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- Lecture 55 - Strain Displacement Gradient Relation : Example
- Lecture 56 - Strain Displacement Gradient Relation : Normal and shear strain
- Lecture 57 - Strain Displacement Gradient Relation : Rotation and volumetric strain
- Lecture 58 - Strain Displacement Gradient Relation : Examples
- Lecture 59 - Displacement Gradient Tensor
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- Lecture 70 - Stress Strain Relation : Introduction
- Lecture 71 - Material Properties
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- Lecture 73 - Relation Between Material Properties
- Lecture 74 - Hooke's Law - Stress-strain Relation
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- Lecture 77 - Newton's Law of Viscosity : 1D Form
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- Lecture 79 - Navier Stokes Equation
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- Lecture 81 - Hydrostatic Pressure Distribution in Liquid
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- Lecture 83 - Fluid in Rigid Body Motion : Pressure Distribution
- Lecture 84 - Flow Regimes : Laminar and Turbulent flow
- Lecture 85 - Euler Equation
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- Lecture 90 - Planar Couette Flow - Governing Equations
- Lecture 91 - Planar Couette Flow - Velocity and Pressure Distribution
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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

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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

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Lecture 24 - Analysis Methods - Chromatography Fundamentals

Lecture 25 - Analysis Methods - Gas Chromatography

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

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- 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
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- 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?

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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

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Lecture 30 - Property driven functions of Supramolecular assembly

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[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
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- 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 : Staus 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 Apetrochemicals

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

NPTEL : Process Integration (Chemical Engineering)

Co-ordinators : Dr. B. Mohanty

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

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Lecture 25 - Chemical analysis, applications

Lecture 26 - Chemiluminescence, principles

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Lecture 28 - Separations methods

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Lecture 16 - Instrumentation in AAS Radiation Sources: Sample introduction

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