

# Advanced Heat and Mass Transfer - Web course

## COURSE OUTLINE

Unified point of view to energy and mass transport.

Steady and unsteady mass and heat diffusion in solids and stagnant liquids.

Laminar, forced and natural convection.

Equations of change for non-isothermal systems and multi-component systems.

Analytical and approximate solutions to equations of change with applications to problems in research and design.

Heat and Mass Transport in Turbulent Flows.

Diffusion under various driving forces and with chemical reaction.

Energy and mass transport in boundary layers with relevant analogies.

Simultaneous heat and mass transfer.

Multi-component mass transport for dilute solutions.

## COURSE DETAIL

Sl. No.	Topic	No. of lectures
1	<b>Module 1. THE EQUATION OF "CONTINUITY": 6 lectures (Lectures 1-6)</b> (i) Overall Mass Balance (ii) Momentum Balance (iii) Energy Balance (iv) Special Mass Balance (v) Equation for the fluxes	6
2	<b>Module 2. "DIFFUSIVE" HEAT AND MASS TRANSFER: 14 lectures (Lectures 7-20)</b> (i) Steady and Unsteady/One and Multiple Dimensions (ii) Mass Transfer with Chemical Reaction (iii) Perturbation Techniques (iv) Moving Boundary Problems (v) Simultaneous Heat and Mass Transfer	14
3	<b>Module 3. "CONVECTIVE" HEAT AND MASS TRANSFER: 12 lectures (Lectures 21-32)</b> (i) Flow Inside Ducts (ii) Dispersion (iii) Laminar Boundary Layers (iv) Mass Transfer with Chemical Reactions (v) Asymptotic Methods (vi) Simultaneous Momentum, Heat and Mass Transfer (vii) Natural Convection	12



# NPTEL

<http://nptel.iitm.ac.in>

## Chemical Engineering

### Pre-requisites:

1. Transport Phenomena (UG level).
2. Heat Transfer (UG level).
3. Mass Transfer (UG level).

### Additional Reading:

1. Whitaker, S., Fundamental Principles of Heat Transfer, New York, Pergamon, 1997.
2. Cussler, E. L., Diffusion, Mass Transfer in Fluid Systems, Cambridge, 1985.

### Coordinators:

**Dr. Saikat Chakraborty**  
Department of Chemical Engineering IIT Kharagpur

# Mass Transfer Nptel

**Raj K. Arya, George D. Verros, J. Paulo  
Davim**

## **Mass Transfer Nptel:**

*Simultaneous Mass Transfer and Chemical Reactions in Engineering Science* Bertram K. C. Chan, 2023-01-30

Simultaneous Mass Transfer and Chemical Reactions in Engineering Science A comprehensive look at the basic science of diffusional process and mass transfer Mass transfer as a principle is an essential part of numerous unit operations in biomolecular chemical and process engineering crystallization distillation and membrane separation processes for example use this important method Given this significance particularly in engineering design where these processes occur understanding the design and analysis of such unit operations must begin with a basic understanding of how simultaneous mass transfer and the chemical reactions that influence these occurrences It is also vital to be aware of the most up to date technologies for analyzing and predicting the phenomena Given the significance of this process *Simultaneous Mass Transfer and Chemical Reactions in Engineering Science* is an important resource as it introduces the reader to the complex subject of simultaneous mass transfer with biochemical and chemical reactions and gives them the tools to develop an applicable design Analyzing the systems of simultaneous mass transfer and reactions is at the core of this book as all known design approaches are carefully examined and compared The volume also provides the reader with a working knowledge of the latest technologies with a special focus on the open sourced computer programming language R and how these tools are an essential resource in quantitative assessment in analysis models *Simultaneous Mass Transfer and Chemical Reactions in Engineering Science* provides a working knowledge of the latest information on simultaneous mass transfer and reactions by focusing on the analysis of this process as well as discussing the existence and distinctive quality of the solutions to the *Simultaneous Mass Transfer and Chemical Reactions in Engineering Science* readers will also find A theoretical basis of each design model that is carefully stated compared and assessed Carefully developed and established Existence and Uniqueness Theorems for a general design model Comprehensive coverage of how the programming language R may be used to analyze models Numerous examples and case studies that provide a working knowledge of simultaneous mass transfer and reactions *Simultaneous Mass Transfer and Chemical Reactions in Engineering Science* is a useful reference for students in chemical engineering biotechnology or chemistry as well as professional process and chemical engineers

**Essentials and Applications of Food Engineering** C. Anandharamakrishnan, S. Padma Ishwarya, 2019-03-15 *Essentials Applications of Food Engineering* provides a comprehensive understanding of food engineering operations and their practical and industrial utility It presents pertinent case studies solved numerical problems and multiple choice questions in each chapter and serves as a ready reference for classroom teaching and exam preparations The first part of this textbook contains the introductory topics on units and dimensions material balance energy balance and fluid flow The second part deals with the theory and applications of heat and mass transfer psychrometry and reaction kinetics The subsequent chapters of the book present the heat and mass transfer operations such as evaporation drying refrigeration freezing mixing and separation The final section

focuses on the thermal non thermal and nanotechnology based novel food processing techniques 3D food printing active and intelligent food packaging and fundamentals of CFD modeling Features Features 28 case studies to provide a substantial understanding of the practical and industrial applications of various food engineering operations Includes 178 solved numerical problems and 285 multiple choice questions Highlights the application of mass balance in food product traceability and the importance of viscosity measurement in a variety of food products Provides updated information on novel food processing techniques such as cold plasma 3D food printing nanospray drying electrospraying and electrospinning The textbook is designed for undergraduate and graduate students pursuing Food Technology and Food Process Engineering courses This book would also be of interest to course instructors and food industry professionals

*Chemical Engineering Essentials, Volume 1* Raj K. Arya, George D. Verros, J. Paulo Davim, 2025-04-29 In an era of rapid innovation and with a focus on sustainability Chemical Engineering Essentials provides a definitive guide to mastering the discipline Divided into two volumes this series offers a seamless blend of foundational knowledge and advanced applications to address the evolving needs of academia and industry This volume lays a strong foundation with topics such as material and energy balances thermodynamics phase equilibrium fluid mechanics transport phenomena and essential separation processes such as distillation and membrane technologies Volume 2 builds on these principles delving into reaction engineering reactor modeling with MATLAB and ASPEN PLUS material properties process intensification and nanotechnology It also addresses critical global challenges emphasizing green chemistry waste minimization resource recovery and workplace safety Together these volumes provide a holistic understanding of chemical engineering equipping readers with the tools to innovate and lead in a dynamic and sustainable future

**Structure and Properties of High-Performance Fibers** Gajanan Bhat, 2016-08-21 Structure and Properties of High Performance Fibers explores the relationship between the structure and properties of a wide range of high performance fibers Part I covers high performance inorganic fibers including glasses and ceramics plus carbon fibers of various types In Part II high performance synthetic polymer fibers are discussed while Part III reviews those natural fibers that can be used to create advanced textiles The high performance properties of these fibers are related to their chemistry and morphology as well as the ways in which they are synthesized and spun High performance fibers form the basis of textile materials with applications in protection medicine and composite reinforcement Fibers are selected for these technical applications due to their advanced physical mechanical and chemical properties Offers up to date coverage of new and advanced materials for the fiber and textile industries Reviews structure property relationships of high performance inorganic carbon synthetic polymer and natural fibers Includes contributions from an international team of authors edited by an expert in the field Reviews those natural fibers that can be used to create advanced textiles

*Mass Transfer* Thomas Kilgore Sherwood, Robert Lamar Pigford, Charles R. Wilke, 1975 Previous editions published under title Absorption and exttaction

**Mass-transfer Operations** Robert E. Treybal, 1968 **Mass Transfer** Koichi Asano, 2007-09-24 This didactic

approach to the principles and modeling of mass transfer as it is needed in modern industrial processes is unique in combining a step by step introduction to all important fundamentals with the most recent applications Based upon the renowned author s successful new modeling method as used for the O 18 process the exemplary exercises included in the text are fact proven taken directly from existing chemical plants Fascinating reading for chemists graduate students chemical and process engineers as well as thermodynamics physicists

**Mass Transfer Operations** Alapati Suryanarayana,2002 In A Simple And Systematic Manner This Book Presents An Exhaustive Account Of Various Mass Transfer Operations Involved In Chemical Engineering Emphasising The Basic Concepts And Techniques The Book Discusses In Detail Material And Energy Balances Distillation Absorption And Stripping And Extraction The Book Also Explains The Relevant Aspects Of Equipment Design Recent Developments Like Permeation Ion Exchange And Froth Flootation Have Also Been Discussed A Large Number Of Digital Computer Programs Are Included To Illustrate Computer Aided Techniques Several Solved Examples And Practice Problems Are Presented In Each Chapter To Illustrate The Theory With All These Features This Is An Ideal Text For Undergraduate Chemical Engineering Students Practising Engineers And Students Of Pharmacy And Metallurgy Would Also Find The Book A Useful Reference Source

*Mass-transfer Operations* Robert Ewald Treybal,1967

*Mass Transfer and Separation Processes* Diran Basmadjian,2007-04-25 Mass transfer along with separation processes is an area that is often quite challenging to master as most volumes currently available complicate the learning by teaching mass transfer linked with heat transfer rather than focusing on more relevant techniques With this thoroughly updated second edition *Mass Transfer and Separation Processes* Pr

*Mass Transfer Operations for the Practicing Engineer* Louis Theodore,Francesco Ricci,2011-12-06 An invaluable guide for problem solving in mass transfer operations This book takes a highly pragmatic approach to providing the principles and applications of mass transfer operations by offering a valuable easily accessible guide to solving engineering problems Both traditional and novel mass transfer processes receive treatment As with all of the books in this series emphasis is placed on an example based approach to illustrating key engineering concepts The book is divided into two major parts It starts with the principles underlying engineering problems showing readers how to apply general engineering principles to the topic of mass transfer operations It then goes on to provide step by step guidance for traditional mass transfer operations including distillation absorption and stripping and adsorption plus novel mass transfer processes Essential topics for professional engineering exams are also covered Geared towards chemical environmental civil and mechanical engineers working on real world industrial applications *Mass Transfer Operations for the Practicing Engineer* features Numerous sample problems and solutions with real world applications Clear precise explanations on how to carry out the basic calculations associated with mass transfer operations Coverage of topics from the ground up for readers without prior knowledge of the subject Overview of topics relevant to the ABET Accreditation Board for Engineering and Technology for those taking the Professional Engineering PE exams Appendix containing relevant

mass transfer operation charts and tables      *Mass-transfer Operations* Robert E. Treybal,1988      **Mass Transfer** Anthony F. Mills,2001 Mass Transfer is a derivative version of the mass transfer chapters contained in Heat and Mass Transfer 1995 New sections have been added dealing with transport in multicomponent systems and the conservation equations for multicomponent gas mixtures Elementary Mass Transfer High Mass Transfer Rate Theory Mass Exchangers Property Data Publisher      **Introduction to Computational Mass Transfer** Kuo-Tsung Yu,Xigang Yuan,2016-09-26 This book offers an easy to understand introduction to the computational mass transfer CMT method On the basis of the contents of the first edition this new edition is characterized by the following additional materials It describes the successful application of this method to the simulation of the mass transfer process in a fluidized bed as well as recent investigations and computing methods for predictions for the multi component mass transfer process It also demonstrates the general issues concerning computational methods for simulating the mass transfer of the rising bubble process This new edition has been reorganized by moving the preparatory materials for Computational Fluid Dynamics CFD and Computational Heat Transfer into appendices additions of new chapters and including three new appendices on respectively generalized representation of the two equation model for the CMT derivation of the equilibrium distribution function in the lattice Boltzmann method and derivation of the Navier Stokes equation using the lattice Boltzmann model This book is a valuable resource for researchers and graduate students in the fields of computational methodologies for the numerical simulation of fluid dynamics mass and or heat transfer involved in separation processes distillation absorption extraction adsorption etc chemical biochemical reactions and other related processes      Diffusion and Mass Transfer James S. Vrentas,Christine M. Vrentas,2016-04-19 Presenting diffusion and mass transfer from both engineering and fundamental science perspectives this book offers a comprehensive summary of the theory and applies that theory to obtain detailed solutions to a wide variety of problems It covers conservation laws and field equations boundary conditions constitutive equations parameters in constitutive equations and mathematical solution methods including Green s functions The authors pay particular attention to polymer mass transfer and they also discuss the free volume theory for prediction of self diffusion coefficients Problems analyzed include bubble dissolution impurity migration in plastic containers and drug delivery using polymers      **Principles and Applications of Mass Transfer** Jaime Benitez,2022-10-19 Principles and Applications of Mass Transfer Core textbook teaching mass transfer fundamentals and applications for the design of separation processes in chemical biochemical and environmental engineering Principles and Applications of Mass Transfer teaches the subject of mass transfer fundamentals and their applications to the design of separation processes with enough depth of coverage to guarantee that students using the book will at the end of the course be able to specify preliminary designs of the most common separation process equipment Reflecting the growth of biochemical applications in the field of chemical engineering the fourth edition expands biochemical coverage including transient diffusion environmental applications electrophoresis and bioseparations Also new

to the fourth edition is the integration of Python programs which complement the Mathcad programs of the previous edition. On the accompanying instructor's website, the online appendices contain a downloadable library of Python and Mathcad programs for the example problems in each chapter. A complete solution manual for all end-of-chapter problems, both in Mathcad and Python, is also provided. Some of the topics covered in *Principles and Applications of Mass Transfer* include: Molecular mass transfer covering concentrations, velocities, and fluxes; the Maxwell-Stefan relations and Fick's first law for binary mixtures; The diffusion coefficient covering diffusion coefficients for binary ideal gas systems, dilute liquids, and concentrated liquids; Convective mass transfer covering mass transfer coefficients, dimensional analysis, boundary layer theory, and mass and heat transfer analogies; Interphase mass transfer covering diffusion between phases, material balances, and equilibrium stage operations; Gas-dispersed gas-liquid operations covering sparged vessels, tray towers, diameter, and gas pressure drop and weeping and entrainment. *Principles and Applications of Mass Transfer* is an essential textbook for undergraduate chemical, biochemical, mechanical, and environmental engineering students taking a core course on Separation Processes or Mass Transfer Operations, along with mechanical engineers and mechanical engineering students starting to get involved in combined heat and mass transfer applications.

*Mass Transfer in Chemical Engineering Processes* Jozef Markoš, 2011-11-04. This book offers several solutions or approaches in solving mass transfer problems for different practical chemical engineering applications: measurements of the diffusion coefficients, estimation of the mass transfer coefficients, mass transfer limitation in separation processes like drying, extractions, absorption, membrane processes, mass transfer in the microbial fuel cell design, and problems of the mass transfer coupled with the heterogeneous combustion. I believe this book can provide its readers with interesting ideas and inspirations or direct solutions of their particular problems.

*Principles and Modern Applications of Mass Transfer Operations* Jaime Benitez, 2016-12-16. A staple in any chemical engineering curriculum. New edition has a stronger emphasis on membrane separations, chromatography, and other adsorptive processes: ion exchange. Discusses many developing topics in more depth in mass transfer operations, especially in the biological engineering area. Covers in more detail phase equilibrium since distillation calculations are completely dependent on this principle. Integrates computational software and problems using Mathcad. Features 25-30 problems per chapter.

*Mass Transfer and Absorbers* Tadeusz Hobler, 1962.

*Heat Transfer* S.P. Venkateshan, 2021-03-10. The book covers various topics of heat transfer. It explains and analyzes several techniques and modes of heat transfer such as conduction in stationary media, convection in moving media, and also by radiation. It is primarily a text book useful for undergraduate and postgraduate students. The book should also interest practicing engineers who wish to refresh their knowledge in the field. The book presents the various topics in a systematic way, starting from first principles. The topics are developed to a fairly advanced level, towards the end of each chapter. Several worked examples illustrate the engineering applications of the basic modeling tools developed in the text. The exercises at the end of the book are arranged chapter-wise and challenge the reader.

to tackle typical real life problems in heat transfer This book will be of potential use for students of mechanical engineering chemical engineering and metallurgy in most engineering colleges

The book delves into Mass Transfer Nptel. Mass Transfer Nptel is an essential topic that needs to be grasped by everyone, ranging from students and scholars to the general public. The book will furnish comprehensive and in-depth insights into Mass Transfer Nptel, encompassing both the fundamentals and more intricate discussions.

1. The book is structured into several chapters, namely:

- Chapter 1: Introduction to Mass Transfer Nptel
- Chapter 2: Essential Elements of Mass Transfer Nptel
- Chapter 3: Mass Transfer Nptel in Everyday Life
- Chapter 4: Mass Transfer Nptel in Specific Contexts
- Chapter 5: Conclusion

2. In chapter 1, this book will provide an overview of Mass Transfer Nptel. This chapter will explore what Mass Transfer Nptel is, why Mass Transfer Nptel is vital, and how to effectively learn about Mass Transfer Nptel.

3. In chapter 2, this book will delve into the foundational concepts of Mass Transfer Nptel. This chapter will elucidate the essential principles that need to be understood to grasp Mass Transfer Nptel in its entirety.

4. In chapter 3, the author will examine the practical applications of Mass Transfer Nptel in daily life. The third chapter will showcase real-world examples of how Mass Transfer Nptel can be effectively utilized in everyday scenarios.

5. In chapter 4, this book will scrutinize the relevance of Mass Transfer Nptel in specific contexts. This chapter will explore how Mass Transfer Nptel is applied in specialized fields, such as education, business, and technology.

6. In chapter 5, the author will draw a conclusion about Mass Transfer Nptel. The final chapter will summarize the key points that have been discussed throughout the book.

This book is crafted in an easy-to-understand language and is complemented by engaging illustrations. This book is highly recommended for anyone seeking to gain a comprehensive understanding of Mass Transfer Nptel.

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