



# Computational Methods for Engineers

## Lecture 2

Reuel C. Pallugna

Instructor



## Topics

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- Roots of equations
  - Open Methods
    - Fixed point iteration Method
    - Newton Raphson Method
    - Secant Method
    - Polynomials using Matlab
- Solutions to Linear Algebraic Equations
- Curve Fitting
- Numerical Differentiation and Integration
- Numerical Solutions to Ordinary Differential Equations
- Numerical Solution to Partial Differential Equations



## Fixed Point Iteration Method

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- This is called a method of successive substitution
- A function  $f(x)$  is rearranged such that the  $x$  is on the left side of the equation

Example:  
Solve for the roots of

$$f(x) = e^{-x} - x$$

Solution:

Starting with an initial guess of  $x_0 = 0$ , this iterative equation can be applied to compute:

$i$	$x_i$	$f(x_i)$	$f'(x_i)$	$f(x_i)/f'(x_i)$
0	0	1	-1	-1
1	-1	0.3679	-0.6321	-0.5831
2	-0.5831	0.5301	-0.4199	-1.2627
3	-1.2627	0.2865	-0.2865	-1.0000
4	-1.0000	0.3679	-0.6321	-0.5831
5	-0.5831	0.5301	-0.4199	-1.2627
6	-1.2627	0.2865	-0.2865	-1.0000
7	-1.0000	0.3679	-0.6321	-0.5831
8	-0.5831	0.5301	-0.4199	-1.2627
9	-1.2627	0.2865	-0.2865	-1.0000
10	-1.0000	0.3679	-0.6321	-0.5831

# Basic Computational Techniques For Engineers

**Michael E. McCormick**



## **Basic Computational Techniques For Engineers:**

Basic Computational Techniques for Engineers R. A. Adey, C. A. Brebbia, 1983      **What Every Engineer Should Know about Computational Techniques of Finite Element Analysis** Louis Komzsis, 2016-04-19 Finite element analysis FEA has become the dominant tool of analysis in many industrial fields of engineering particularly in mechanical and aerospace engineering This process requires significant computational work divided into several distinct phases What Every Engineer Should Know About Computational Techniques of Finite Element Analysis of      **Modern Computational Techniques for Engineering Applications** Krishan Arora, Vikram Kumar, Deepak Prashar, Suman Lata Tripathi, 2023-07-21 Modern Computational Techniques for Engineering Applications presents recent computational techniques used in the advancement of modern grids with the integration of non conventional energy sources like wind and solar energy It covers data analytics tools for smart cities smart towns and smart computing for sustainable development This book Discusses the importance of renewable energy source applications wind turbines and solar panels for electrical grids Presents optimization based computing techniques like fuzzy logic neural networks and genetic algorithms that enhance the computational speed Showcases cloud computing tools and methodologies such as cybersecurity testbeds and data security for better accuracy of data Covers novel concepts on artificial neural networks fuzzy systems machine learning and artificial intelligence techniques Highlights application based case studies including cloud computing optimization methods and the Industrial Internet of Things The book comprehensively introduces modern computational techniques starting from basic tools to highly advanced procedures and their applications It further highlights artificial neural networks fuzzy systems machine learning and artificial intelligence techniques and how they form the basis for algorithms It presents application based case studies on cloud computing optimization methods blockchain technology fog and edge computing and the Industrial Internet of Things It will be a valuable resource for senior undergraduates graduate students and academic researchers in diverse fields including electrical engineering electronics and communications engineering and computer engineering      **Handbook of Research on Advanced Computational Techniques for Simulation-Based Engineering** Samui, Pijush, 2015-11-30 Recent developments in information processing systems have driven the advancement of computational methods in the engineering realm New models and simulations enable better solutions for problem solving and overall process improvement The Handbook of Research on Advanced Computational Techniques for Simulation Based Engineering is an authoritative reference work representing the latest scholarly research on the application of computational models to improve the quality of engineering design Featuring extensive coverage on a range of topics from various engineering disciplines including but not limited to soft computing methods comparative studies and hybrid approaches this book is a comprehensive reference source for students professional engineers and researchers interested in the application of computational methods for engineering design      **Basics of Thermodynamics for Engineers** Cybellium Ltd, 2024-10-26 Designed for professionals

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**Computational Techniques in Environmental Engineering** Akhilesh Kumar Yadav,2025-03-31 This book provides a comprehensive and practical guide to environmental engineering covering a wide range of computational tools modeling approaches and data analysis methods It explores various computational modeling techniques including mathematical models numerical methods and computer simulations for modeling environmental systems and processes Key Features Presents case studies and examples of successful applications of computational approaches in addressing various environmental engineering challenges Focuses on the practical application of computational approaches and showcasing successful examples Aims to develop problem solving skills for environmental engineers using computational methods Discusses computational approaches for environmental impacts designs and decisions Provides real world examples of computational approaches to environmental problems This book is aimed at graduate students and researchers in environmental and civil engineering and related computational and modeling studies

**Structural Dynamic Systems Computational Techniques and Optimization** Cornelius T. Leondes,2024-12-20 Computational techniques for the analysis and design of structural dynamic systems using numerical methods have been the focus of an enormous amount of research for several decades In general the numerical methods utilized to solve these problems include two phases a spatial discretization by either the finite element method FEM or the finite difference method FDM and b solution of systems of time dependent second order ordinary differential equations In addition the significantly powerful advances in computer systems capabilities have put on the desks of structural systems designers enormous computing power either by means of increasingly effective computer workstations or else through PCs personal computers whose increasing power has succeeded in marginalizing the computational power differences between PCs and workstations in many cases This volume is a comprehensive treatment of the issues involved in computational techniques in structural dynamic systems

*Ocean Engineering Mechanics* Michael E. McCormick,2010 This book is based on the author s experiences in engineering practice and in the classroom The introductory topics in wave mechanics and the presentation of such have their foundations in the courses taught at the U S Naval Academy The advanced topics have their origins in the postgraduate courses taught at the Johns Hopkins University

**Computational Techniques for Fluid Dynamics 1** Clive Fletcher,1991-04-10 Vol 1 **Project Management for the Oil and Gas Industry** Adedeji B.

Badiru, Samuel O. Osisanya, 2013-01-23 Project management for oil and gas projects comes with a unique set of challenges that include the management of science technology and engineering aspects Underlining the specific issues involved in projects in this field Project Management for the Oil and Gas Industry A World System Approach presents step by step application of project management techniques Using the Project Management Body of Knowledge PMBOK framework from the Project Management Institute PMI as the platform the book provides an integrated approach that covers the concepts tools and techniques for managing oil and gas projects The authors discuss specialized tools such as plan do check act PDCA define measure analyze improve control DMAIC suppliers inputs process outputs customers SIPOC design evaluate justify integrate DEJI quality function deployment QFD affinity diagrams flowcharts Pareto charts and histograms They also discuss the major activities in oil and gas risk assessment such as feasibility studies design transportation utility survey works construction permanent structure works mechanical and electrical installations and maintenance Strongly advocating a world systems approach to managing oil and gas projects and programs the book covers quantitative and qualitative techniques It addresses technical and managerial aspects of projects and illustrates the concepts with case examples of applications of project management tools and techniques to real life project scenarios that can serve as lessons learned for best practices An in depth examination of project management for oil and gas projects the book is a handbook for professionals in the field a guidebook for technical consultants and a resource for students Computational Techniques for Chemical Engineers C. Storey, H. H. Rosenbrock, 2013-10-22 Computational Techniques for Chemical Engineers offers a practical guide to the chemical engineer faced with a problem of computing The computer is a servant not a master its value depends on the instructions it is given This book aims to help the chemical engineer in the right choice of these instructions The text begins by outlining the principles of operation of digital and analogue computers and then discussing the difficulties which arise in formulating a problem for solution on such a machine This is followed by separate chapters on digital computers and their programming the use of digital computers in chemical engineering design work optimization techniques and their application in the selection of optimum designs the solution of sets of non linear algebraic equations via hill climbing and determination of equilibrium compositions by minimization of Gibbs free energy Subsequent chapters discuss the solution of partial or simultaneous differential equations parameter estimation in differential equations continuous systems and analogue computers Introduction to Computational Earthquake Engineering Muneo Hori, 2011 Covers solid continuum mechanics finite element method and stochastic modeling comprehensively This book explains the numerical simulation of strong ground motion and faulting It details examples of applying computational science technology to earthquake engineering problems *Matrix, Numerical, and Optimization Methods in Science and Engineering* Kevin W. Cassel, 2021-03-04 Vector and matrix algebra Algebraic eigenproblems and their applications Differential eigenproblems and their applications Vector and matrix calculus Analysis of discrete dynamical systems Computational linear algebra Numerical

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**Thermodynamics Made Simple for Energy Engineers** S. Bobby Rauf, 2023-07-07 Every non fiction book has an objective or mission The mission of this book is to give the reader an overview of the important principles concepts and analytical techniques pertaining to thermodynamics written in a fashion that makes this abstract and complex subject relatively easy to comprehend The audience this text speaks to includes engineers professionals with science and math backgrounds energy professionals and technicians The content is presented in a way which also allows many non engineering professionals to follow the material and glean useful knowledge For energy engineers who have been away from direct engineering practice for a while this book will serve as a quick and effective refresher Thermodynamics topics such as enthalpy entropy latent heat sensible heat heat of fusion and heat of sublimation are explained and illustrated in detail Also covered are phases of substances the law of conservation of energy SFEE the first and second laws of thermodynamics ideal gas laws and pertinent formulas The author examines various thermodynamic processes as well as heat and power cycles such as Rankine and Carnot Case studies are used to illustrate various thermodynamics principles and each chapter concludes with a list of questions or problems for self assessment with answers provided at the end of the book

**Mathematical Concepts for Mechanical Engineering Design** Kaveh Hariri Asli, Hossein Sahleh, Soltan Ali Ogli Aliyev, 2016-04-19 Mathematical Concepts for Mechanical Engineering Design provides a broad understanding of the main computational techniques used for simulation of water distribution networks and water transmission systems It introduces the theoretical background to a number of techniques and general data analysis techniques The book also examines the application of techniques in an industrial setting including current practices and current research are presented It provides practical experience of commercially available systems and includes a small scale water systems related projects The authors illustrate the concepts and techniques covered in the book by using a calculation that simulates water distribution networks and water transmission systems The book also covers significant research on new methodologies and important applications in the fields of automation and control as well as includes the latest coverage of chemical databases and the development of new computational methods and efficient

algorithms for hydraulic software and mechanical engineering The book will be informative and useful to both academics and mechanical engineers in various industrial sectors including hydraulic and mechanical engineering



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