

Example 1

A liquid-liquid extraction process conducted in the Electrochemical Materials Laboratory involved the extraction of nickel from the aqueous phase into an organic phase. A typical set of experimental data from the laboratory is given below.

Ni aqueous phase, a (g/l)	2	2.5	3
Ni organic phase, g (g/l)	8.57	10	12

Assuming g is the amount of Ni in the organic phase and a is the amount of Ni in the aqueous phase, the quadratic interpolant that estimates g is given by

$$g = x_1 a^2 + x_2 a + x_3, \quad 2 \leq a \leq 3$$

The solution for the unknowns x_1 , x_2 , and x_3 is given by

$$\begin{bmatrix} 4 & 2 & 1 \\ 6.25 & 2.5 & 1 \\ 9 & 3 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 8.57 \\ 10 \\ 12 \end{bmatrix}$$

Find the values of x_1 , x_2 , and x_3 using the Gauss-Seidel method. Estimate the amount of nickel in the organic phase when 2.3 g/l is in the aqueous phase using quadratic interpolation. Use

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

as the initial guess and conduct two iterations.

Solution:-

Rewriting the equations gives

$$\begin{aligned} x_1 &= \frac{8.57 - 2x_2 - x_3}{4} \\ x_2 &= \frac{10 - 6.25x_1 - x_3}{2.5} \\ x_3 &= \frac{12 - 9x_1 - 3x_2}{1} \end{aligned}$$

Iteration #1

Given the initial guess of the solution vector as

Numerical Analysis Problems And Solutions

Julia Schneider



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Numerical Methods M. K. Jain, Satteluri R. K. Iyengar, R. K. Jain, 2007 Is An Outline Series Containing Brief Text Of Numerical Solution Of Transcendental And Polynomial Equations System Of Linear Algebraic Equations And Eigenvalue Problems Interpolation And Approximation Differentiation And Integration Ordinary Differential Equations And Complete Solutions To About 300 Problems Most Of These Problems Are Given As Unsolved Problems In The Authors Earlier Book User Friendly Turbo Pascal Programs For Commonly Used Numerical Methods Are Given In The Appendix This Book Can Be Used As A Text Help Book Both By Teachers And Students Numerical Analysis Problem Solver Research and Education Association, 1983-01-01 The Problem Solvers are an exceptional series of books that are thorough unusually well organized and structured in such a way that they can be used with any text No other series of study and solution guides has come close to the Problem Solvers in usefulness quality and effectiveness Educators consider the Problem Solvers the most effective series of study aids on the market Students regard them as most helpful for their school work and studies With these books students do not merely memorize the subject matter they really get to understand it Each Problem Solver is over 1 000 pages yet each saves hours of time in studying and finding solutions to problems These solutions are worked out in step by step detail thoroughly and clearly Each book is fully indexed for locating specific problems rapidly An essential subject for students in mathematics computer science engineering and science The 19 chapters cover basic as well as advanced methods of numerical analysis A large number of related applications are included **Numerical Methods** J. Douglas Faires, Richard L. Burden, 1998 This text emphasizes the intelligent application of approximation techniques to the type of problems that commonly occur in engineering and the physical sciences The authors provide a sophisticated introduction to various appropriate approximation techniques they show students why the methods work what type of errors to expect and when an application might lead to difficulties and they provide information about the availability of high quality software for numerical approximation routines The techniques covered in this text are essentially the same as those covered in the Sixth Edition of these authors top selling Numerical Analysis text but the emphasis is much different In Numerical Methods Second Edition full mathematical justifications are provided only if they are concise and add to the understanding of the methods The emphasis is placed on describing each technique from an implementation standpoint and on convincing the student that the method is reasonable both mathematically and computationally *Numerical Analysis with Applications in Mechanics and Engineering* Petre Teodorescu, Nicolae-Doru Stanescu, Nicolae Pandrea, 2013-06-04 NUMERICAL ANALYSIS WITH APPLICATIONS IN MECHANICS AND ENGINEERING A much needed guide on how to use numerical methods to solve practical engineering problems Bridging the gap between mathematics and engineering Numerical Analysis with Applications in Mechanics and Engineering arms readers with powerful tools for solving real world problems in mechanics physics and civil and mechanical engineering Unlike most books on numerical analysis this outstanding work links theory and

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Numerical Methods for the Solution of Ill-Posed Problems A.N. Tikhonov, A. Goncharsky, V.V. Stepanov, Anatoly G. Yagola, 2013-03-09 Many problems in science technology and engineering are posed in the form of operator equations of the first kind with the operator and RHS approximately known But such problems often turn out to be ill posed having no solution or a non unique solution and or an unstable solution Non existence and non uniqueness can usually be overcome by settling for generalised solutions leading to the need to develop regularising algorithms The theory of ill posed problems has advanced greatly since A N Tikhonov laid its foundations the Russian original of this book 1990 rapidly becoming a classical monograph on the topic The present edition has been completely updated to consider linear ill posed problems with or without a priori constraints non negativity monotonicity convexity etc Besides the theoretical material the book also contains a FORTRAN program library Audience Postgraduate students of physics mathematics chemistry economics engineering Engineers and scientists interested in data processing and the theory of ill posed problems **An Introduction to Numerical Methods and Analysis, Solutions Manual** James F. Epperson, 2014-08-28 A solutions manual to accompany An Introduction to Numerical Methods and Analysis Second Edition An Introduction to Numerical Methods and Analysis Second Edition reflects the latest trends in the field includes new material and revised exercises and offers a unique emphasis on applications The author clearly explains how to both construct and evaluate approximations for accuracy and performance which are key skills in a variety of fields A wide range of higher level methods and solutions including new topics such as the roots of polynomials spectral collocation finite element ideas and Clenshaw Curtis quadrature are presented from an introductory perspective and the Second Edition also features Chapters and sections that begin with basic elementary material followed by gradual coverage of more advanced material Exercises ranging from simple hand computations to challenging derivations and minor proofs to programming exercises Widespread exposure and utilization of MATLAB An appendix that contains proofs of various theorems and other material *Numerical Methods for Ordinary Differential*

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Solutions Manual to accompany An Introduction to Numerical Methods and Analysis James F. Epperson, 2021-09-15 A solutions manual to accompany An Introduction to Numerical Methods and Analysis Third Edition An Introduction to Numerical Methods and Analysis helps students gain a solid understanding of a wide range of numerical approximation methods for solving problems of mathematical analysis Designed for entry level courses on the subject this popular textbook maximizes teaching flexibility by first covering basic topics before gradually moving to more advanced material in each chapter and section Throughout the text students are provided clear and accessible guidance on a wide range of numerical methods and analysis techniques including root finding numerical integration interpolation solution of systems of equations and many others This fully revised third edition contains new sections on higher order difference methods the bisection and inertia method for computing eigenvalues of a symmetric matrix a completely re written section on different methods for Poisson equations and spectral methods for higher dimensional problems New problem sets ranging in difficulty from simple computations to challenging derivations and proofs are complemented by computer programming exercises illustrative examples and sample code This acclaimed textbook Explains how to both construct and evaluate approximations for accuracy and performance Covers both elementary concepts and tools and higher level methods and solutions Features new and updated material reflecting new trends and applications in the field Contains an introduction to key concepts a calculus review an updated primer on computer arithmetic a brief history of scientific computing a survey of computer languages and software and a revised literature review Includes an appendix of proofs of selected theorems and author hosted companion website with additional exercises application models and supplemental resources

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The Numerical Analysis Problem Solver Research and Education Association,1993 [Handbook of Numerical Analysis](#)

Philippe G. Ciarlet, Jacques-Louis Lions,1990 This series of volumes covers all the major aspects of numerical analysis serving as the basic reference work on the subject Each volume concentrates on one to three particular topics Each article written by an expert is an in depth survey reflecting up to date trends in the field and is essentially self contained The handbook will cover the basic methods of numerical analysis under the following general headings solution of equations in R^n finite difference methods finite element methods techniques of scientific computing optimization theory and systems science It will also cover the numerical solution of actual problems of contemporary interest in applied mathematics under the following headings numerical methods for fluids numerical methods for solids and specific applications including meteorology seismology petroleum mechanics and celestial mechanics

[Studies in Numerical Analysis 2 Numerical Solutions of Nonlinear Problems a Collection of Papers Presented at Symposia in Numerical Analysis](#) United States,1970 **Explorations In Numerical Analysis** James V Lambers, Amber C Sumner Mooney,2018-09-17 This textbook introduces advanced undergraduate and early career graduate students to the field of numerical analysis This field pertains to the design analysis and implementation of algorithms for the approximate solution of mathematical problems that arise in applications spanning science and engineering and are not practical to solve using analytical techniques such as those taught in courses in calculus linear algebra or differential equations Topics covered include error analysis computer arithmetic solution of systems of linear equations least squares problems eigenvalue problems polynomial interpolation and approximation numerical differentiation and integration nonlinear equations optimization ordinary differential equations and partial differential equations For each problem considered the presentation includes the derivation of solution techniques analysis of their efficiency accuracy and robustness and details of their implementation illustrated through the MATLAB programming language This text is suitable for a year long sequence in numerical analysis and can also be used for a one semester course in numerical linear algebra

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Topics in Numerical Analysis G. Alefeld, Xiaojun Chen, 2001-09-11 This collection of papers on numerical analysis with special emphasis on nonlinear problems covers a broad spectrum of fields Several papers are involved in applying numerical methods for proving the existence of solutions of nonlinear problems e g of boundary problems or of obstacle problems Naturally the solution of linear and nonlinear problems by iterative methods is the subject of a couple of papers Here topics like the fast verification of solutions of monotone matrix equations the convergence of linear asynchronous iteration with spectral radius of modulus one or aggregation and disaggregation methods for p cyclic Markov chains are treated On the other hand papers involved in optimization problems can be found Nearly all fields of modern numerical analysis are touched by at least one paper **Studies in Numerical Analysis 2** James McDonough Ortega, Werner Carl Rheinboldt, 1970

Numerical Analysis of Systems of Ordinary and Stochastic Differential Equations Sergej S. Artemiev, Tatjana A. Averina, 1997 This book deals with numerical analysis of systems of both ordinary and stochastic differential equations The first chapter is devoted to numerical solution problems of the Cauchy problem for stiff ordinary differential equation ODE systems by Rosenbrock type methods RTMs Here general solutions of consistency equations are obtained which lead to the construction of RTMs from the first to the fourth order The second chapter deals with statistical simulation problems of the solution of the Cauchy problem for stochastic differential equation SDE systems The mean square convergence theorem is considered as well as Taylor expansions of numerical solutions Also included are applications of numerical methods of SDE solutions to partial differential equations and to analysis and synthesis problems of automated control of stochastic systems

An Introduction to Numerical Analysis, 2nd Ed Kendall E. Atkinson, 2008-09 Market_Desc Mathematics Students Instructors About The Book This Second Edition of a standard numerical analysis text retains organization of the original

edition but all sections have been revised some extensively and bibliographies have been updated New topics covered include optimization trigonometric interpolation and the fast Fourier transform numerical differentiation the method of lines boundary value problems the conjugate gradient method and the least squares solutions of systems of linear equations

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