



Central Mindanao University  
College of Engineering  
Civil Engineering Department  
CE-33 Numerical Solutions to CE Problems

Long Quiz No.2  
April 8, 2021

**Instructions:** Using A-4 or 8.5" x 11" size paper, solve the following neatly. Show all necessary solutions and assumptions clearly. Submit a scanned copy or a photo of your work in the Google classroom on or before the specified time.

1. Determine the approximate solution of the system of linear equations below using **Gauss- Seidel Iteration** after 8 iterations. Show all iterations/solutions. Provide a brief discussion of your solution.

$$\begin{cases} 5x_1 + x_2 + x_3 - x_4 + 2x_5 = 0.2B + 7 \\ x_1 - 6x_2 + x_3 + x_4 - 2x_5 = 0.1C - 4.5 \\ 2x_1 + x_2 - x_3 - 8x_4 + 2x_5 = 0.15D - 3.5 \\ 2x_1 + x_2 + 2x_3 - 2x_4 + 7x_5 = 0.3A + 3 \\ -x_1 + 2x_2 + 6x_3 - x_4 - x_5 = 14 - 0.1C \end{cases}$$

Assume:  $\begin{bmatrix} x_1^{(0)} \\ x_2^{(0)} \\ x_3^{(0)} \\ x_4^{(0)} \\ x_5^{(0)} \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \\ 1 \end{bmatrix}$

2. A simply supported I-beam is loaded with a distributed load, as shown. The deflection,  $y$ , of the center line of the beam as a function of the position,  $x$ , is given by the equation:

$$y = \frac{w_0 x}{360EI} (7L^3 - 10L^2x^2 + 3x^4)$$

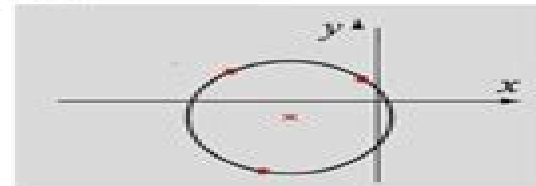


Where  $L = (4.2 + 0.3C)$  m is the length,  $E = (70 + 0.5D)$  GPa is the elastic modulus,  $I = (52.9 + A) \times 10^{-6}$  m<sup>4</sup> is the moment of inertia, and  $w_0 = (18.5 + 0.5B)$  kN/m. Find the position  $x$  where the deflection of the beam is maximum, and determine the deflection at this point.

Hint: The maximum deflection is at the point where  $dy/dx = 0$ . Use **Newton - Raphson Method** with tolerance of 0.001. Provide a brief discussion of your solution.

3. In a Cartesian coordinate system the general equation of a circle is:

$$x^2 + y^2 + Dx + Ey + F = 0$$



Given three points,  $\{(-1 + 0.1C), (3 + 0.5B)\}$ ,  $\{(-7.5 + 0.1D), (4 - 0.2B)\}$ , and  $\{(-5.5 + 0.2C), (-9.2 + 0.4A)\}$ . Determine the equation of the circle that passes through the points.

Solve the problem by deriving a system of three linear equations and solve the system using **Jacobi Iteration** up to 7 iterations and assume all initial values equal to 0.5. Provide a brief discussion of your solution.

# Numerical Solution Of Field Problems In

**Judd E. Hollander**



## **Numerical Solution Of Field Problems In:**

**Modified Strongly Implicit Procedure for the Numerical Solution of Field Problems** G. E. Schneider, *The Finite Element Method: Its Basis and Fundamentals* O. C. Zienkiewicz, R. L. Taylor, J. Z. Zhu, 2005-05-26 The Sixth Edition of this influential best selling book delivers the most up to date and comprehensive text and reference yet on the basis of the finite element method FEM for all engineers and mathematicians Since the appearance of the first edition 38 years ago The Finite Element Method provides arguably the most authoritative introductory text to the method covering the latest developments and approaches in this dynamic subject and is amply supplemented by exercises worked solutions and computer algorithms The classic FEM text written by the subject's leading authors Enhancements include more worked examples and exercises With a new chapter on automatic mesh generation and added materials on shape function development and the use of higher order elements in solving elasticity and field problems Active research has shaped The Finite Element Method into the pre eminent tool for the modelling of physical systems It maintains the comprehensive style of earlier editions while presenting the systematic development for the solution of problems modelled by linear differential equations Together with the second and third self contained volumes 0750663219 and 0750663227 The Finite Element Method Set 0750664312 provides a formidable resource covering the theory and the application of FEM including the basis of the method its application to advanced solid and structural mechanics and to computational fluid dynamics The classic introduction to the finite element method by two of the subject's leading authors Any professional or student of engineering involved in understanding the computational modelling of physical systems will inevitably use the techniques in this key text

**Numerical Solution of Field Problems in Continuum Physics** Garrett Birkhoff, Richard S. Varga, 1970 [The Finite Element Method in Electromagnetics](#) Jian-Ming Jin, 2015-02-18 A new edition of the leading textbook on the finite element method incorporating major advancements and further applications in the field of electromagnetics The finite element method FEM is a powerful simulation technique used to solve boundary value problems in a variety of engineering circumstances It has been widely used for analysis of electromagnetic fields in antennas radar scattering RF and microwave engineering high speed high frequency circuits wireless communication electromagnetic compatibility photonics remote sensing biomedical engineering and space exploration The Finite Element Method in Electromagnetics Third Edition explains the method's processes and techniques in careful meticulous prose and covers not only essential finite element method theory but also its latest developments and applications giving engineers a methodical way to quickly master this very powerful numerical technique for solving practical often complicated electromagnetic problems Featuring over thirty percent new material the third edition of this essential and comprehensive text now includes A wider range of applications including antennas phased arrays electric machines high frequency circuits and crystal photonics The finite element analysis of wave propagation scattering and radiation in periodic structures The time domain finite element method for analysis of wideband

antennas and transient electromagnetic phenomena Novel domain decomposition techniques for parallel computation and efficient simulation of large scale problems such as phased array antennas and photonic crystals Along with a great many examples The Finite Element Method in Electromagnetics is an ideal book for engineering students as well as for professionals in the field

**Electromagnetics through the Finite Element Method** José Roberto Cardoso, 2016-10-03

Shelving Guide Electrical Engineering Since the 1980s more than 100 books on the finite element method have been published making this numerical method the most popular The features of the finite element method gained worldwide popularity due to its flexibility for simulating not only any kind of physical phenomenon described by a set of differential equations but also for the possibility of simulating non linearity and time dependent studies Although a number of high quality books cover all subjects in engineering problems none of them seem to make this method simpler and easier to understand This book was written with the goal of simplifying the mathematics of the finite element method for electromagnetic students and professionals relying on the finite element method for solving design problems Filling a gap in existing literature that often uses complex mathematical formulas Electromagnetics through the Finite Element Method presents a new mathematical approach based on only direct integration of Maxwell's equation This book makes an original scholarly contribution to our current understanding of this important numerical method

*Computational Electromagnetics for RF and Microwave Engineering* David B. Davidson, 2005-02-24 The numerical approximation of Maxwell's equations Computational Electromagnetics CEM has emerged as a crucial enabling technology for radio frequency microwave and wireless engineering The three most popular full wave methods the Finite Difference Time Domain Method the Method of Moments and the Finite Element Method are introduced in this book by way of one or two dimensional problems Commercial or public domain codes implementing these methods are then applied to complex real world engineering problems and a careful analysis of the reliability of the results obtained is performed along with a discussion of the many pitfalls which can result in inaccurate and misleading solutions The book will empower readers to become discerning users of CEM software with an understanding of the underlying methods and confidence in the results obtained It also introduces readers to the art of code development Aimed at senior undergraduate graduate students taking CEM courses and practising engineers in the industry

**Introduction to Engineering Electromagnetic Fields** Korada Umashankar, 1989 This is a textbook designed to provide analytical background material in the area of Engineering Electromagnetic Fields for the senior level undergraduate and preparatory level graduate electrical engineering students It is also an excellent reference book for researchers in the field of computational electromagnetic fields The textbook covers Static Electric and Magnetic Fields The basic laws governing the Electrostatics Magnetostatics with engineering examples are presented which are enough to understand the fields and the electric current and charge sources Dynamic Electromagnetic Fields The Maxwell's equations in Time Domain and solutions the Maxwell's equations in Frequency Domain and solutions Extensive approaches are

presented to solve partial differential equations satisfying electromagnetic boundary value problems Foundation to electromagnetic field radiation guided wave propagation is discussed to expose at the undergraduate level application of the Maxwell's equations to practical engineering problems      *Numerical Solution of Field Problems in Continuum Physics* ,1970

**Boundary Elements and Other Mesh Reduction Methods** C.A. Brebbia,A.H-D Cheng,2018-02-01 Formed of presented papers this volume contains research from the 40th International Conference on Boundary Elements and other Mesh Reduction Methods recognised as THE international forum for the latest advances in these techniques and their applications in science and engineering The ongoing success of this series is a result of the strength of research being carried out all over the world and the coverage has continually evolved in line with the latest developments in the field The books originating from this conference series constitute a record of the development of BEM MRM running from the initial successful development of boundary integral techniques into the boundary element method a technique that eliminates the need for an internal mesh to the recent and most sophisticated Mesh Reduction and even Meshless Methods Since these methods are used in many engineering and scientific fields the 2017 book Boundary Elements and other Mesh Reduction Methods XXXX like the series before will be of great interest to those working within the areas of numerical analysis boundary elements and meshless methods The research papers included in this volume cover Advanced formulations Advanced meshless and mesh reduction methods Structural mechanics applications Solid mechanics Heat and mass transfer Electrical engineering and electromagnetics Computational methods Fluid flow modelling Damage mechanics and fracture Dynamics and vibrations Engineering applications Interfacing with other methods Coupling with design and manufacturing Solution of large systems of equations      **NBS Special Publication** ,1968      *Mathematical Analysis and Simulation of Field Models in Accelerator Circuits* Idoia Cortes Garcia,2021-01-04 This book deals with the analysis and development of numerical methods for the time domain analysis of multiphysical effects in superconducting circuits of particle accelerator magnets An important challenge is the simulation of quenching i.e the transition of a material from the superconducting to the normally electrically conductive state The book analyses complex mathematical structures and presents models to simulate such quenching events in the context of generalized circuit elements Furthermore it proposes efficient parallelized algorithms with guaranteed convergence properties for the simulation of multiphysical problems Spanning from theoretical concepts to applied research and featuring rigorous mathematical presentations on one side as well as simplified explanations of many complex issues on the other side this book provides graduate students and researchers with a comprehensive introduction on the state of the art and a source of inspiration for future research Moreover the proposed concepts and methods can be extended to the simulation of multiphysical phenomena in different application contexts

**Monthly Weather Review** ,1978      **Inelasticity Of Materials: An Engineering Approach And A Practical Guide** Arun R Srinivasa,Sivakumar M Srinivasa,2009-07-09 With the advent of a host of new materials ranging from shape memory

alloys to biomaterials to multiphase alloys acquiring the capacity to model inelastic behavior and to choose the right model in a commercial analysis software has become a pressing need for practicing engineers. Even with the traditional materials, there is a continued emphasis on optimizing and extending their full range of capability in the applications. This textbook builds upon the existing knowledge of elasticity and thermodynamics and allows the reader to gain confidence in extending one's skills in understanding and analyzing problems in inelasticity. By reading this textbook and working through the assigned exercises, the reader will gain a level of comfort and competence in developing and using inelasticity models. Thus, the book serves as a valuable book for practicing engineers and senior level undergraduate/graduate level students in the mechanical/civil/aeronautical/metallurgical and other disciplines. The book is written in three parts. Part I is primarily focused on lumped parameter models and simple structural elements such as trusses and beams. This is suitable for an advanced undergraduate class with just a strength of materials background. Part II is focused on small deformation multi-dimensional inelasticity and is suitable for a beginning graduate class. Sufficient material is included on how to numerically implement an inelastic model and solve either using a simple stress function type of approach or using commercial software. Case studies are included as examples. There is also an extensive discussion of thermodynamics in the context of small deformations. Part III focuses on more advanced situations such as finite deformation inelasticity, thermodynamical ideas, and crystal plasticity. More advanced case studies are included in this part. This textbook takes a new task or scenario based approach to teaching and learning inelasticity. The book is written in an active learning style that appeals to engineers and students who wish to design or analyze structures and components that are subject to inelasticity. The book incorporates thermodynamical considerations into the modeling right from an early stage. Extensive discussions are provided throughout the book on the thermodynamical underpinnings of the models. This textbook is the first to make extensive use of MATLAB to implement many inelasticity models. It includes the use of concepts such as Airy stress functions to solve plane problems for inelastic materials. The MATLAB codes are listed in the appendix for one to modify with their own models and requirements. Step by step procedures for formulations and calculations are provided for the reader to readily adapt to the inelastic problems that he or she attempts to solve. A large number of problems, exercises, and projects for one to teach or learn from are included. These can be assigned as homework, in class exercises, or projects. The book is written in a modular fashion which provides adequate flexibility for adaptation in classes that cater to different audiences such as senior level students, graduate students, research scholars, and practicing engineers.

*Electric Field Analysis* Sivaji Chakravorti, 2017-12-19. *Electric Field Analysis* is both a student friendly textbook and a valuable tool for engineers and physicists engaged in the design work of high voltage insulation systems. The text begins by introducing the physical and mathematical fundamentals of electric fields, presenting problems from power and dielectric engineering to show how the theories are put into practice. The book then describes various techniques for electric field analysis and their significance in the validation of numerically computed results as well.

as Discusses finite difference finite element charge simulation and surface charge simulation methods for the numerical computation of electric fields Provides case studies for electric field distribution in a cable termination around a post insulator in a condenser bushing and around a gas insulated substation GIS spacer Explores numerical field calculation for electric field optimization demonstrating contour correction and examining the application of artificial neural networks Explains how high voltage field optimization studies are carried out to meet the desired engineering needs Electric Field Analysis is accompanied by an easy to use yet comprehensive software for electric field computation The software along with a wealth of supporting content is available for download with qualifying course adoption     Analysis and Computation of Electric and Magnetic Field Problems K. J. Binns,P. J. Lawrenson,2013-10-22 Analysis and Computation of Electric and Magnetic Field Problems Second Edition is a comprehensive treatment of both analytical and numerical methods for the derivation of two dimensional static and quasi static electric and magnetic fields The essence of each method of solution is emphasized and the scopes of the different methods are described with particular regard to the influence of digital computers This book is comprised of 12 chapters and begins with an introduction to the fundamental theory of electric and magnetic fields The derivation of quantities of physical interest such as force inductance and capacitance from the field solution is explained The next section deals with the methods of images and separation of variables and presents direct solutions of Laplace s equation and of Poisson s equation The basic solutions are developed rigorously from considerations of surface charges and are expressed in complex variable form Subsequent chapters discuss transformation methods as well as line and doublet sources the transformation of regions exterior to finite boundaries and the powerful numerical methods used to enlarge the scope of conformal transformation The last section is devoted to finite difference methods and the Monte Carlo method along with all classes of boundary shape and condition This monograph is intended primarily for engineers physicists and mathematicians as well as degree students towards the end of their courses     *Scientific and Technical Aerospace Reports* ,1982     **Computer Literature Bibliography: 1964-1967** W. W. Youden,1965     **Industrial Application of Electromagnetic Computer Codes** Yves R. Crutzen,Giorgio Molinari,Guglielmo Rubinacci,2012-12-06 During the last decade a new generation of software tools has evolved in computational electromagnetics Both analytical methods and particularly numerical techniques have improved considerably leading to an extended range of capabilities and an increased applicability of both dedicated and general purpose computer codes It is the intention of this volume to review the state of the art in electromagnetic analysis and design and to describe the fundamentals and the advances in theoretical numerical approaches coupled with practical solutions for static and time dependent fields In this context the book illustrates the effectiveness of numerical techniques and associated computer codes in solving real electromagnetic field problems In addition it demonstrates the usefulness of modern codes for the analysis of many industrial practical cases In particular solutions of magnetostatic and magnetodynamic problems applied to electrical machines induction heating non destructive

testing fusion reactor technology and other industrial are presented and discussed The present volume reflects and combines the lectures which are organized in the frame of the Eurocourse programme at JRC Ispra under the sponsorship of the Institute for Systems Engineering and Informatics ISEI It is hoped that in this context the Institute and particularly the Systems Engineering Reliability SER Division can play a stimulating role in sponsoring and promoting the diffusion of knowledge in novel areas of computer and information science     Applied Mechanics Reviews ,1974     Monthly Catalog of United States Government Publications, Cumulative Index United States. Superintendent of Documents,1976



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