



# Introduction to Numerical Methods

## Unit

# 12

## 12.1 Numerical Solution of Non-linear Equations

### 12.1.1 Describe importance of numerical methods

Till now, all the methods we have learnt to solve the non-linear equation and finding of the derivative or integration of functions are analytical methods.

When analytic approaches are failed to find the solution of a non-linear equation or require too many tedious computations then, mathematicians used numerical methods to compute approximate solution. Therefore, numerical methods have great importance in the field of mathematics.

### 12.1.2 Explain the basic principles of solving a non-linear equation in one variable

The basic principle of solving a non-linear equation is to find the interval (values of  $a$  and  $b$ ) for a function  $f(x)$ , where  $f(a)$  and  $f(b)$  are of opposite signs such that  $f(a) \cdot f(b) < 0$ , then the root of  $f(x) = 0$  lies in the interval  $[a, b]$ .

For example,  $f(x) = x^3 - 2x - 5$ , put the values of  $x = 0, 1, 2, 3$  in  $f(x)$ , we get

$$f(0) = (0)^3 - 2(0) - 5 = -5$$

$$f(1) = (1)^3 - 2(1) - 5 = -6$$

$$f(2) = (2)^3 - 2(2) - 5 = -1$$

$$f(3) = (2)^3 - 2(3) - 5 = 16$$

Here  $f(2) = -1 < 0$  (-ve) and  $f(3) = 16 > 0$  (+ve), such that  $f(2) \cdot f(3) = (-1) \cdot (16) = -16 < 0$ .

Now, root lies in the interval  $[a, b] = [2, 3]$ .

### 12.1.3 Calculate the real roots of a non-linear equation in one variable by

- Bisection method
- regula-falsi method
- Newton-Raphson method

#### • Bisection Method

The bisection technique is a root-finding method which repeatedly bisects an interval and then selects a sub-interval in which a root must lie for further processing. It is a very easy and reliable procedure.

#### Algorithm of a Bisection method

If  $f(x)$  is a continuous function over an interval, then to find the root of  $f(x) = 0$  by bisection method, following steps are taken.

# Numerical Methods Unit Guide

**SJ Ball**



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Numerical Methods School Mathematics Project, John Higgo, 1992 The aim of 16 19 Mathematics has been to produce a course which while challenging is accessible and enjoyable to all students The course develops ability and confidence in mathematics and its applications together with an appreciation of how mathematical ideas help in the understanding of the world and society in which we live The unit guide contains an introduction to the unit stating the objectives advice on teaching and working through the unit commentaries on the discussion points and tasksheets in the student s text GATE 2020 Civil Engineering Guide with 10 Practice Sets (6 in Book + 4 Online) 7th edition Prem Mohan, 2019-05-30 GATE Civil Engineering Guide 2020 with 10 Practice Sets 6 in Book 4 Online Tests 7th edition for GATE exam contains exhaustive theory past year questions practice problems and Mock Tests Covers past 15 years questions Exhaustive EXERCISE containing 100 150 questions in each chapter In all contains around 5300 MCQs Solutions provided for each question in detail The book provides 10 Practice Sets 6 in Book 4 Online Tests designed exactly on the latest pattern of GATE exam *Handbook of Data Analysis* Melissa A Hardy, Alan Bryman, 2009-06-17 This book provides an excellent reference guide to basic theoretical arguments practical quantitative techniques and the methodologies that the majority of social science researchers are likely to require for postgraduate study and beyond Environment and Planning The book provides researchers with guidance in and examples of both quantitative and qualitative modes of analysis written by leading practitioners in the field The editors give a persuasive account of the commonalities of purpose that exist across both modes as well as demonstrating a keen awareness of the different things that each offers the practising researcher Clive Seale Brunel University With the appearance of this handbook data analysts no longer have to consult dozens of disparate publications to carry out their work The essential tools for an intelligent telling of the data story are offered here in thirty chapters written by recognized experts Michael Lewis Beck F Wendell Miller Distinguished Professor of Political Science University of Iowa This is an excellent guide to current issues in the analysis of social science data I recommend it to anyone who is looking for authoritative introductions to the state of the art Each chapter offers a comprehensive review and an extensive bibliography and will be invaluable to researchers wanting to update themselves about modern developments Professor Nigel Gilbert Pro Vice Chancellor and Professor of Sociology University of Surrey This is a book that will rapidly be recognized as the bible for social researchers It provides a first class reliable guide to the basic issues in data analysis such as the construction of variables the characterization of distributions and the notions of inference Scholars and students can turn to it for teaching and applied needs with confidence The book also seeks to enhance debate in the field by tackling more advanced topics such as models of change causality panel models and network analysis Specialists will find much food for thought in these chapters A distinctive feature of the book is the breadth of coverage No other book provides a better one stop survey of the field of data analysis In 30 specially commissioned chapters the editors aim to encourage readers to develop an appreciation of the range

of analytic options available so they can choose a research problem and then develop a suitable approach to data analysis

*Guide to Information Sources in Engineering* Charles Lord, 2000-08-15 The only source that focuses exclusively on engineering and technology this important guide maps the dynamic and changing field of information sources published for engineers in recent years Lord highlights basic perspectives access tools and English language resources directories encyclopedias yearbooks dictionaries databases indexes libraries buyer s guides Internet resources and more Substantial emphasis is placed on digital resources The author also discusses how engineers and scientists use information the culture and generation of scientific information different types of engineering information and the tools and resources you need to locate and access that material Other sections describe regulations standards and specifications government resources professional and trade associations and education and career resources Engineers scientists librarians and other information professionals working with engineering and technology information will welcome this research **Guidelines for Vapor**

**Cloud Explosion, Pressure Vessel Burst, BLEVE, and Flash Fire Hazards** CCPS (Center for Chemical Process Safety), 2011-12-01 This guide provides an overview of methods for estimating the characteristics of vapor cloud explosions flash fires and boiling liquid expanding vapor explosions BLEVEs for practicing engineers It has been updated to include advanced modeling technology especially with respect to vapor cloud modeling and the use of computational fluid dynamics The text also reviews past experimental and theoretical research and methods to estimate consequences Heavily illustrated with photos charts tables and diagrams this manual is an essential tool for safety insurance regulatory and engineering students and professionals Mathcad PLUS 5.0 User's Guide , 1994 *Proceedings of the 2023 9th International*

*Conference on Advances in Energy Resources and Environment Engineering (ICAEESEE 2023)* Abd El-Fatah Abomohra, Rongkui Su, Md Wasikur Rahman, Jiwei Wen, 2024-05-13 This is an open access book 2023 9th International Conference on Advances in Energy Resources and Environment Engineering ICAEESEE 2023 will be held on December 29 31 2023 in Sanya China ICAEESEE 2023 is to bring together innovative academics and industrial experts in the field of energy resources and environment engineering to a common forum The primary goal of the conference is to promote research and developmental activities in energy resources and environment engineering and another goal is to promote scientific information interchange between researchers developers engineers students and practitioners working all around the world The conference will be held every year to make it an ideal platform for people to share views and experiences in energy resources and environment engineering and related areas *Guide to Scientific Computing in C++* Joe

Pitt-Francis, Jonathan Whiteley, 2018-03-26 This simple to follow textbook reference provides an invaluable guide to object oriented C programming for scientific computing Through a series of clear and concise discussions the key features most useful to the novice programmer are explored enabling the reader to quickly master the basics and build the confidence to investigate less well used features when needed The text presents a hands on approach that emphasizes the benefits of

learning by example stressing the importance of a clear programming style to minimise the introduction of errors into the code and offering an extensive selection of practice exercises This updated and enhanced new edition includes additional material on software testing and on some new features introduced in modern C standards such as C 11 Topics and features presents a practical treatment of the C programming language for applications in scientific computing reviews the essentials of procedural programming in C covering variables flow of control input and output pointers functions and reference variables introduces the concept of classes showcasing the main features of object orientation and discusses such advanced C features as templates and exceptions examines the development of a collection of classes for linear algebra calculations and presents an introduction to parallel computing using MPI describes how to construct an object oriented library for solving second order differential equations contains appendices reviewing linear algebra and useful programming constructs together with solutions to selected exercises provides exercises and programming tips at the end of every chapter and supporting code at an associated website This accessible textbook is a must read for programmers of all levels of expertise Basic familiarity with concepts such as operations between vectors and matrices and the Newton Raphson method for finding the roots of non linear equations would be an advantage but extensive knowledge of the underlying mathematics is not assumed *Publications of the National Bureau of Standards* United States. National Bureau of Standards,1960

*Technical Bulletin* ,1973 [NIST Handbook of Mathematical Functions](#) Hardback and CD-ROM Frank W. J.

Olver,2010-05-17 The new standard reference on mathematical functions replacing the classic but outdated handbook from Abramowitz and Stegun Includes PDF version [Resources in Education](#) ,1992-04 **Handbook of Biodiversity**

**Methods** David Hill,Matthew Fasham,Graham Tucker,Michael Shewry,Philip Shaw,2005-08-11 Biodiversity is recognised to be of global importance yet species and habitats continue to be under increasing pressure from human induced influences Environmental concerns are high on the political agenda driving increased legislation to protect the natural environment The starting point for much of this legislation is the requirement for a comprehensive biodiversity audit For those needing to undertake such audits this Handbook first published in 2005 provides standard procedures which will enable practitioners to better monitor the condition of the biodiversity resource resulting in improved data upon which to base future policy decisions and actions Organised in three parts the Handbook first addresses planning covering method selection experimental design sampling strategy and data analysis and evaluation The second part describes survey evaluation and monitoring methods for a broad range of habitats Part three considers species and provides information on general methods before addressing specific methods of survey and monitoring for the major taxonomic groups **Supplementary List of**

**Publications of the National Bureau of Standards** ,1960 *Scientific and Technical Aerospace Reports* ,1983

**Guidelines for Mine Waste Dump and Stockpile Design** Mark Hawley,John Cuning,2017-04-01 Guidelines for Mine Waste Dump and Stockpile Design is a comprehensive practical guide to the investigation design operation and monitoring of

mine waste dumps dragline spoils and major stockpiles associated with large open pit mines These facilities are some of the largest man made structures on Earth and while most have performed very well there are cases where instabilities have occurred with severe consequences including loss of life and extensive environmental and economic damage Developed and written by industry experts with extensive knowledge and experience this book is an initiative of the Large Open Pit LOP Project It comprises 16 chapters that follow the life cycle of a mine waste dump dragline spoil or stockpile from site selection to closure and reclamation It describes the investigation and design process introduces a comprehensive stability rating and hazard classification system provides guidance on acceptability criteria and sets out the key elements of stability and runout analysis Chapters on site and material characterisation surface water and groundwater characterisation and management risk assessment operations and monitoring management of ARD emerging technologies and closure are included A chapter is also dedicated to the analysis and design of dragline spoils Guidelines for Mine Waste Dump and Stockpile Design summarises the current state of practice and provides insight and guidance to mine operators geotechnical engineers mining engineers hydrogeologists geologists and other individuals that are responsible at the mine site level for ensuring the stability and performance of these structures Readership includes mining engineers geotechnical engineers civil engineers engineering geologists hydrogeologists environmental scientists and other professionals involved in the site selection investigation design permitting construction operation monitoring closure and reclamation of mine waste dumps and stockpiles

Bridge Engineering Handbook, Five Volume Set Wai-Fah Chen, Lian Duan, 2014-01-24 Over 140 experts 14 countries and 89 chapters are represented in the second edition of the Bridge Engineering Handbook This extensive collection provides detailed information on bridge engineering and thoroughly explains the concepts and practical applications surrounding the subject and also highlights bridges from around the world This second edition of the bestselling Bridge Engineering Handbook covers virtually all the information an engineer would need to know about any type of bridge from planning to construction to maintenance It contains more than 2 500 tables charts and illustrations in a practical ready to use format An abundance of worked out examples gives readers numerous practical step by step design procedures Special attention is given to rehabilitation retrofit and maintenance Coverage also includes seismic design and building materials Thoroughly revised and updated this second edition contains 26 new chapters

**Publications - United States.**  
**National Bureau of Standards** United States. National Bureau of Standards, 1960

**Precast Concrete Raft Units** J.W. Bull, 2012-12-06 The use of precast concrete is a well established construction technique for beams floors panels piles walls and other structural elements The advantages of precasting include excellent quality control economical large scale production improved construction productivity especially in adverse weather conditions and immediate structure availability These advantages have been recognized for precast concrete raft pavement units raft units since their introduction in the 1930s In the last ten years there has been a considerable increase in the use of raft units especially in their range of

applications their analysis and their design However the description of these developments has been published in academic journals and conference proceedings which are not readily available to practising road unit pavement design engineers Pavement design engineers are under increasing pressure to produce road unit designs that are inexpensive long lasting and able to allow reorganization to accommodate changing use and uncertainty of future loading requirements This is the first book devoted to road unit pavements and will become a standard work of reference *ODE, BVP, and 1D PDE Solvers for Scientific and Engineering Problems With MATLAB Basics* Burstein, Leonid, 2025-02-06 In the academic field engineers scientists educators and students are faced with a persistent challenge the gap between theoretical knowledge and practical implementation in solving real world engineering problems The scarcity of focused resources tailored to mastering MATLAB and its specialized solvers for Ordinary Differential Equations ODEs and One Dimensional Partial Differential Equations 1D PDEs has left many individuals struggling to bridge this educational chasm The disconnect between the theory learned in the classroom and the ability to effectively address engineering challenges in the real world has become a significant hurdle The definitive solution to the academic conundrum of this lack of a focused resource is the book *ODE BVP and 1D PDE Solvers for Scientific and Engineering Problems with MATLAB Basics* which draws on years of teaching experience This groundbreaking book provides a structured and holistic learning path designed to empower both novice learners and seasoned professionals It takes readers on a comprehensive journey commencing with the fundamentals of MATLAB software and culminating in the mastery of its application in solving ODEs and 1D PDEs for a broad range of engineering problems

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