

EXAMPLE:

$$\frac{d^2 y}{dx^2} + 3 \frac{d^2 y}{dx^2} - 4y = xe^x$$

$$\frac{d^2 y}{dx^2} + 3 \frac{d^2 y}{dx^2} - 4y = 0$$

$$y = u = c_1 e^x + c_2 e^{-2x} + c_3 x e^{-2x}$$

differentiate to get  $\frac{d^3 y}{dx^3} + 3 \frac{d^3 y}{dx^3} - 4 \frac{dy}{dx} = xe^x + e^x$

subtract to get  $\frac{d^3 y}{dx^3} + 2 \frac{d^2 y}{dx^2} - 3 \frac{d^2 y}{dx^2} - 4 \frac{dy}{dx} + 4y = e^x$

differentiate to get  $\frac{d^4 y}{dx^4} + 2 \frac{d^3 y}{dx^3} - 3 \frac{d^3 y}{dx^3} - 4 \frac{d^2 y}{dx^2} + 4 \frac{dy}{dx} = e^x$

subtract to get  $\frac{d^4 y}{dx^4} + \frac{d^3 y}{dx^3} - 5 \frac{d^3 y}{dx^3} - \frac{d^2 y}{dx^2} + 8 \frac{dy}{dx} - 4y = 0$

let  $y = e^{rx}$ , so  $r^4 + r^3 - 5r^3 - r^2 + 8r - 4 = 0$

$$(r-1)(r+2)(r+2)(r-1)(r-1) = 0$$

so,  $y = u + v = c_1 e^x + c_2 e^{-2x} + c_3 x e^{-2x} + c_4 x e^x + c_5 x^2 e^x$

$$y = v = e^x (c_4 x + c_5 x^2)$$

differentiate to get  $\frac{dy}{dx} = e^x (c_4 + (c_4 + 2c_5)x + c_5 x^2)$

$$\frac{d^2 y}{dx^2} = e^x (2(c_4 + c_5) + (c_4 + 4c_5)x + c_5 x^2)$$

$$\frac{d^3 y}{dx^3} = e^x (3c_4 + 6c_5 + (c_4 + 6c_5)x + c_5 x^2)$$

$$9c_4 + 12c_5 + 18c_5 x = x$$

equate coefficients of like terms to get

$$9c_4 + 12c_5 = 0 \text{ and } 18c_5 = 1$$

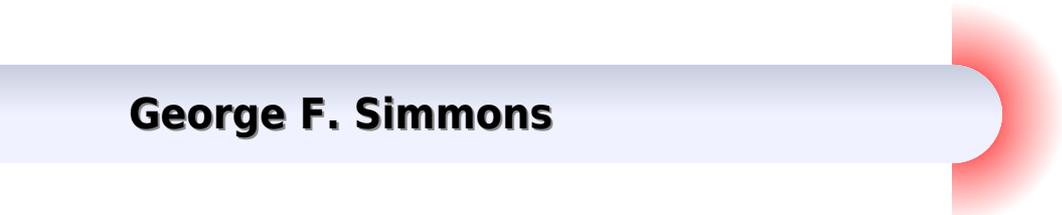
$$\text{so, } c_4 = \frac{1}{18}, c_5 = -\frac{2}{27}$$

COMPLETE SOLUTION:

$$y = u + v = c_1 e^x + c_2 e^{-2x} + c_3 x e^{-2x} - \frac{2}{27} x e^x + \frac{1}{18} x^2 e^x$$

# Differential Equations With Applications

**George F. Simmons**



## **Differential Equations With Applications:**

Ordinary Differential Equations with Applications Ali Mason, 2018-10-20 Ordinary differential equations ODEs arise in many contexts of mathematics and science social as well as natural Mathematical descriptions of change use differentials and derivatives Various differentials derivatives and functions become related to each other via equations and thus a differential equation is a result that describes dynamically changing phenomena evolution and variation Often quantities are defined as the rate of change of other quantities for example derivatives of displacement with respect to time or gradients of quantities which is how they enter differential equations Ordinary differential equations are equations to be solved in which the unknown element is a function rather than a number and in which the known information relates that function to its derivatives Few such equations admit an explicit answer but there is a wealth of qualitative information describing the solutions and their dependence on the defining equation Systems of differential equations form the basis of mathematical models in a wide range of fields from engineering and physical sciences to finance and biological sciences Differential equations are relations between unknown functions and their derivatives Computing numerical solutions to differential equations is one of the most important tasks in technical computing and one of the strengths of MATLAB The book explains the origins of various types of differential equations The scope of the book is limited to linear differential equations of the first order linear differential equation of higher order partial differential equations and special methods of solution of differential equations of second order keeping in view the requirement of students

**Introduction to Partial Differential Equations with Applications** E. C. Zachmanoglou, Dale W. Thoe, 1986-01-01 This text explores the essentials of partial differential equations as applied to engineering and the physical sciences Discusses ordinary differential equations integral curves and surfaces of vector fields the Cauchy Kovalevsky theory more Problems and answers *An Introduction To Differential Equations With Applications* Harold Cohen, Daniel Gallup, 2020-07-28 This book is for students in a first course in ordinary differential equations The material is organized so that the presentations begin at a reasonably introductory level Subsequent material is developed from this beginning As such readers with little experience can start at a lower level while those with some experience can use the beginning material as a review or skip this part to proceed to the next level The book contains methods of approximation to solutions of various types of differential equations with practical applications which will serve as a guide to programming so that such differential equations can be solved numerically with the use of a computer Students who intend to pursue a major in engineering physical sciences or mathematics will find this book useful

**Ordinary Differential Equations** Charles Roberts, 2010-04-05 In the traditional curriculum students rarely study nonlinear differential equations and nonlinear systems due to the difficulty or impossibility of computing explicit solutions manually Although the theory associated with nonlinear systems is advanced generating a numerical solution with a computer and interpreting that solution are fairly elem Ordinary Differential Equations with Applications Carmen

Chicone, 1999 Through its extensive use of examples exercises and real world applications this book provides science and engineering graduate students with a thorough introduction to the theory and application of ordinary differential equations

**BOOK JACKET Differential Equations and Their Applications** M. Braun, 1985-01-30 **Ordinary Differential Equations with Applications to Mechanics** Mircea Soare, Petre P. Teodorescu, Ileana Toma, 2007-06-04 The present book has its source in the authors wish to create a bridge between mathematics and the technical disciplines that need a good knowledge of a strong mathematical tool The authors tried to reflect a common experience of the University of Bucharest Faculty of Mathematics and of the Technical University of Civil Engineering of Bucharest The necessity of such an interdisciplinary work drove the authors to publish a first book with this aim *Ecua ii diferen iale cu aplica ii n mecanica construc iilor* Ordinary differential equations with applications to the mechanics of constructions Editura Tehnic Bucharest Romania The present book is a new edition of the volume published in 1999 Unfortunately the first author M V Soare passed away shortly before the publication of the Romanian edition so that the present work is only due to the other two authors It contains many improvements concerning the theoretical mathematical information as well as new topics using enlarged and updated references We considered only ordinary differential equations and their solutions in an analytical frame leaving aside their numerical approach Compared to the Romanian edition this volume presents the applications in a new way

*DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS* ZAFAR AHSAAN, 2004-01-01 Primarily intended for the undergraduate students in Mathematics Physics and Engineering this text gives in depth coverage of differential equations and the methods of solving them The book begins with the basic definitions the physical and geometric origins of differential equations and the methods for solving first order differential equations Then it goes on to give the applications of these equations to such areas as biology medical sciences electrical engineering and economics The text also discusses systematically and logically higher order differential equations and their applications to telecom munications civil engineering cardiology and detec tion of diabetes as also the methods of solving simultaneous differential equations and their applica tions Besides the book provides a detailed discussion on Laplace transform and their applications partial differential equations and their applications to vibration of a stretched string heat flow transmission lines etc and calculus of variations and its applications This book which is a happy fusion of theory and application would also be useful to postgraduate students

*Differential Equations with Applications* Paul D. Ritger, Nicholas J. Rose, 1967 Coherent introductory text focuses on initial and boundary value problems general properties of linear equations and differences between linear and nonlinear systems Answers to most problems *Differential Equations: Theory and Applications* David Betounes, 2013-06-29 This book was written as a comprehensive introduction to the theory of ordinary differential equations with a focus on mechanics and dynamical systems as time honored and important applications of this theory His torically these were the applications that spurred the development of the mathematical theory and in hindsight they are still the best applications for illustrating the

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**Difference and Differential Equations with Applications in Queueing Theory** Aliakbar Montazer Haghighi, Dimitar P. Mishev, 2013-05-28 A Useful Guide to the Interrelated Areas of Differential Equations Difference Equations and Queueing Models Difference and Differential Equations with Applications in Queueing Theory presents the unique connections between the methods and applications of differential equations difference equations and Markovian queues Featuring a comprehensive collection of topics that are used in stochastic processes particularly in queueing theory the book thoroughly discusses the relationship to systems of linear differential difference equations The book demonstrates the applicability that queueing theory has in a variety of fields including telecommunications traffic engineering computing and the design of factories shops offices and hospitals Along with the needed prerequisite fundamentals in probability statistics and Laplace transform Difference and Differential Equations with Applications in Queueing Theory provides A discussion on splitting delayed service and delayed feedback for single server multiple server parallel and series queue models Applications in queue models whose solutions require differential difference equations and generating function methods Exercises at the end of each chapter along with select answers The book is an excellent resource for researchers and practitioners in applied mathematics operations research engineering and industrial engineering as well as a useful text for upper undergraduate and graduate level courses in applied mathematics differential and difference equations queueing theory probability and stochastic processes

**An Introduction to Delay Differential Equations with Applications to the Life Sciences** Hal Smith, 2010-09-29 This book is intended to be an introduction to Delay Differential Equations for upper level undergraduates or beginning graduate mathematics students who have a reasonable background in ordinary differential equations and who would like to get to the applications quickly The author has used preliminary notes in teaching such a course at Arizona State University over the past two years This book focuses on the key tools necessary to understand the applications literature involving delay equations and to construct and analyze mathematical models involving delay differential equations The book begins with a survey of mathematical models involving delay equations

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X Mao, 2007-12-30 This advanced undergraduate and graduate text has now been revised and updated to cover the basic principles and applications of various types of stochastic systems with much on theory and applications not previously available in book form. The text is also useful as a reference source for pure and applied mathematicians, statisticians, and probabilists, engineers in control and communications, and information scientists, physicists, and economists. Has been revised and updated to cover the basic principles and applications of various types of stochastic systems. Useful as a reference source for pure and applied mathematicians, statisticians, and probabilists, engineers in control and communications, and information scientists, physicists, and economists. *A First Course in Differential Equations with Applications*

Dennis G. Zill, 1979 An introduction to differential equations. First order differential equations. Applications of first order differential equations. Linear equations of higher order. Applications of second order differential equations. Vibrational models. Differential equations with variable coefficients. The Laplace transform. Linear systems of differential equations. Numerical methods. Partial differential equations. **An Introduction to Differential Equations and Their Applications**

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**Differential Equations with Applications and Historical Notes** George Finlay Simmons, John S. Robertson, 1991 A revision of a much admired text distinguished by the exceptional prose and historical mathematical context that have made Simmons books classics The Second Edition includes expanded coverage of Laplace transforms and partial differential equations as well as a new chapter on numerical methods

*Partial Differential Equations* Michael Shearer, Rachel Levy, 2015-03-01 An accessible yet rigorous introduction to partial differential equations This textbook provides beginning graduate students and advanced undergraduates with an accessible introduction to the rich subject of partial differential equations PDEs It presents a rigorous and clear explanation of the more elementary theoretical aspects of PDEs while also drawing connections to deeper analysis and applications The book serves as a needed bridge between basic undergraduate texts and more advanced books that require a significant background in functional analysis

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